THE
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ENCYCLOPEDIA AND DICTIONARY
OF
OPHTHALMOLOGY

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ASSISTED BY A LARGE STAFF OF COLLABORATORS

FULLY ILLUSTRATED

Volume II—B to Cataract, Incipient

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INTRODUCTION

In presenting the second volume of the Encyclopedia the Editor and his collaborators desire to acknowledge once more the courtesy of the publishers and writers of the monographs and text-books mentioned in the first volume, for permission to make use of such of their text and illustrations as seemed necessary to fulfill the purposes of this work. In addition to the volumes mentioned therein they are also indebted to Ophthalmic Literature, Burch's Practical Exercises in Physiological Optics, Welland-Tscherning's Physiological Optics, Parsons' Pathology of the Eye, the Brown-Salzmann Anatomy of the Eye, Beard's Semiology, Savage's Ophthalmic Myology, and to many other authorities, all of whom are quoted under their appropriate headings.

Owing to the serious and protracted illness of Dr. Thos. Hall Shastid we have been obliged to omit a number of biographies of deceased ophthalmologists, but these will appear in the Appendix.

An unfortunate error of composition is responsible for the omission from the list of contributors to Volume I of the name of Dr. Murray, the writer of the section on the Anatomy of the Eye. It should have been entered, as follows:

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The initials of collaborators are signed to topics more than a few lines in length; for unsigned rubrics the Editor is alone responsible. A few other contributors have, on invitation, written some parts and to their headings the full name has been appended.

Casey A. Wood.
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* A complete list of the contributors to this work will appear in the final volume.
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B. A. (F.) Abbreviation of balneum arenæ.

Baas, Johann Hermann. A medical historian of more than usual interest to ophthalmologists. He was born at Bechtheim, Rhenish Hesse, Germany, Oct. 24, 1838. His medical degree he received at Giessen in 1860. From that time forward until his death, which occurred in 1900, he was engaged in general practice, first in one town then in another of Rhenish Hesse: Sauerschwabenheim, Bech-

Johann Hermann Baas.

them, Hessloch, Huppenheim-on-the-Wiese, and Worms. His most important books are the following: "On Percussion, Auscultation, and Phonometry" (Stuttgart, 1877); "William Harvey" (Stuttgart, 1878); "Medical Diagnosis" (2d ed. 1883); "Practice Operations on the Cadaver" (Worms, 1887); "Sketch of the History of Medicine and the Medical Profession" (Stuttgart, 1876). The last-named book is that by which he will be forever known, for it is a work of true
Germanic scholarship—a labor of love, with the love apparent from the top to the bottom of every page. This work received an adequate translation into English by H. E. Handerson, of Cleveland, O., and, in this form, the book was published at New York City in 1910. It is now familiar to all American physicians who care for the history of their profession.

Baas wrote a few brief ophthalmologic articles, but his most important services to ophthalmology consist in the numerous passages relating to the history of that subject, which lie distributed throughout the masterpiece above referred to.—(T. H. S.)

**Babibeurre.** (F.) Butter-milk.

**Babinski sign,** or extensor plantar reflex, is the involuntary, deliberate (occasionally sharp) extension or hyper-extension of the great toe, frequently associated with a fan-like spreading of all the toes in response to a tickling or stroking form of stimulation applied to the sole of the foot. The normal response to plantar stimulation is flexion of all the toes. The extensor plantar reflex (Babinski phenomenon) is, therefore, practically always an evidence of organic disease of the central nervous system involving the pyramidal tracts somewhere throughout their extent in the brain or spinal cord. It is not present in uncomplicated hysteria. It is a sign of great importance in distinguishing organic from functional disease of the nervous system. A positive Babinski is observed in epilepsy immediately following the convulsive seizure and it has been recorded as present after the administration of hyoscine (scopolamine) in medicinal doses.—(D. H.)

**Babyloniens, Ophthalmology of the ancient.** See Ardi-Nana and History of ophthalmology.

**Bach’s pupil-reflex tests.** Although the pupillary reactions or pupil-reflexes sometimes attributed to Bach are not all original with him, yet he must be credited with a most exact description and elaboration of them. According to de Schweinitz the *direct light reflex of the pupil*, by the Bach method, is as follows: The patient is seated as before described, and *both* eyes, which gaze steadily in the direction of the light, are covered with the examiner’s hand or a card, and after a few seconds the cover is removed from one eye and the initial width and the rapidity and completeness of the contraction of the exposed pupil is observed. The same procedure is repeated with the other eye. Again, inasmuch as a properly-lighted window is not always available, the test should be made with artificial illumination. The patient is seated in a dark room in front of the source of illumination (Argand burner, Welsbach light, lamp, or electric light), and looks over the observer’s head into distance. Convergence and accom-
modation are relaxed, and the diameter of the pupil is measured with a pupillometer. Next, light is reflected into the eye with the ophthalmoscope mirror and the pupil reaction noted. Finally, the patient is required to face the light and the pupil area is subjected to oblique illumination and the effects observed.

The indirect or consensual light-reflex, the contraction of the pupil of one eye while the other is being illuminated, may be determined as follows: One eye is completely excluded from the source of illumination, and the other shaded in such a manner that the pupil can be observed beneath the cover. The completely excluded eye is now uncovered and the light directed into its pupil, the reaction which occurs in the shaded pupil being at the same time observed. Although the pupil of one eye acts under normal conditions in unison with its fellow, the direct and indirect reactions are not equal in intensity. According to Bach, the direct reaction to light is greater than the consensual. The statement, often made, that in normal eyes the pupils should be equal, not only with both eyes open but with one eye shaded, is not strictly correct, and usually the difference in width may be demonstrated by allowing for some seconds the stronger illumination to fall on one pupil.

The associated pupil reflex or, as it is also called, the accommodation-convergence reaction refers to the contraction of the pupil when the visual axes converge to a near point. de Schweinitz advises that the test be made as follows: The patient is required to look into distance and then quickly direct his eyes at a near object—for example, the point of a pencil held at a distance of about 10 cm. Under normal conditions a contraction of the pupils will occur, that is, the sphincter of the iris contracts in association with the ciliary muscle and the internal recti. Bach’s procedure is the following: The patient, seated facing a wall between two windows, is required to observe for twenty seconds a small white button placed 50 cm. from his eyes. The button is then gradually approached. No change in the pupil is observed until the object reaches a distance of 40 cm. from the eye, as it is usually gradual at first. When a distance of 20 to 15 cm. is reached the contraction is stronger and may occur suddenly, associated with a strong convergence impulse. The amplitude of contraction, which is less marked than that which follows the action of light, varies between $\frac{1}{4}$ and $\frac{3}{4}$ mm.; exceptionally it is greater. Generally it is less marked in old than in young persons. Refraction anomalies, according to Bach, produce no marked difference in the degree of contraction during convergence, except that in high myopia the reaction is sometimes delayed and less in amplitude. The asse-
ciated movement of the pupil is much more closely connected with convergence than with accommodation; indeed, it is chiefly due to the impulse of convergence.

**Bacillaire.** (F.) Bacillary, bacillar.

**Bacille de Ducrey.** (F.) A small bacillus discovered by Ducrey, of Naples, in 1889. It is found in the lesions of chaneroid and is diagnostic of it. It stains best with carbol-fuchsin, and shows polar staining. —(S. H. M.)

**Bacille de la morve.** (F.) Bacillus of glands.

**Bacillen bei atypischen ulcer serpens.** (G.) Bacilli in atypical cases of serpentine ulcer of the cornea.

**Bacillus.** (L.) Cohn’s name for a genus of **schizomyces** belonging to the order **bacteriaceae** or **endosporeae** which are distinguished by their occurrence in some period of their existence under the form of rod-shaped cells the length of which is several times as great as the diameter. Some species are known only under this form, others occur also as micrococci or as elongated, straight or spiral filaments, but in every case develop from a rod-shaped organism and tend to revert to the latter form. The bacilli increase by transverse division and [some] are reproduced by spores formed in their interior. Formerly the term was restricted to individuals the length of which considerably exceeded their breadth, while the term **bacterium** was applied to the organisms whose length was only two or three times as great as their diameter. (Foster). The name **bacterium**, however, is now practically discarded by bacteriologists.

In the following list of bacilli a brief account of each is given for the convenience of the reader who desires to find a definition but does not wish to read the more complete account of their relations, which will be found under the major heading, **Bacteriology of the eye**.

The following microorganisms, although mentioned, and to some extent described, are occasionally referred to in ophthalmic literature but their identification is, generally speaking, not satisfactory.

**Bacillus agilis;** Bacillus albicans; Bacillus aurantiacus; Bacillus aureus; Bacillus butyricus; Bacillus cuticularis; Bacillus cyanogenus; Bacillus diffusus; Bacillus fluorescens; Bacillus fragilis; Bacillus inflatus; Bacillus latericus; Bacillus liodermos; Bacillus luteus; Bacillus mycoides; Bacillus nodosus parvus; Bacillus ochraceus; Bacillus paleriformis; Bacillus radiciformis; Bacillus violaceus.—(S. H. M.)

**Bacillus acidi lactici.** Bacillus of lactic acid; one of the spore-free bacteria.

**Bacillus, Angina.** See Bacillus funduliformis.

**Bacillus anthracis.** This bacillus is found in the blood of animals
Bacillus candidans. This is one of the organisms found in soil. It is aërobic, non-liquefactive, non-motile and non-pathogenic. See Bacteriology of the eye.

Bacillus capsulatus chinensis. A name given to an encapsulated micro-organism discovered by Hamilton. It is a very narrow bacillus, eight to ten times as long as broad.

Bacillus, Capsule, of Loeb. This micro-organism, pathogenic for mice and guinea-pigs but not for pigeons and rabbits, resembles the Bacillus capsulatus of Pfeiffer. It has few relations to ophthalmology. See Bacteriology of the eye.

Bacillus choleræ. By the term cholera is usually meant Asiatic cholera, a highly malignant, acute, specific and contagious disease, endemic and frequently epidemic in India and tropical Asia. The specific cause of the disease is generally believed to be the comma bacillus (q. v.) of Koch. The pathogenic germs generally find their way into the system by drinking water and food. The eye symptoms are conjunctival congestion, followed by dryness of the surface, opacities of the cornea; blue deposits in the sclera; hemorrhage into the vitreous and cloudiness of the lens and vitreous body. Of course visual disturbances, corresponding in intensity with the extent of the ocular infections, are almost always present. In cases where the patient survives, secondary changes, such as retinal hemorrhages and optic atrophy have been observed.

Bacillus choleræ gallinarum. The bacillus of chicken cholera. See Bacillus septicemæ hemorrhagice, (Sternberg); also, Bacteriology of the eye.

Bacillus circumscriptus. This is a delicate, oval, short bacillus (from one to one and a half microns in length and from a half to three-fourths in breadth) presenting rounded ends. It resembles the Bacillus fulvus, but differs from it in growth both in gelatin and on agar. See Bacteriology of the eye.

Bacillus coerulefaciens. A full description of this bacillus, which has been found in the conjunctival secretion of granular conjunctivitis, is given by the discoverer, J. McFarland, in A System of Diseases of the Eye, Vol. 2, p. 492-494. "It is a minute bacillus, measuring from about 1.50 to 1.75 microns in length, and, being very slender, often curved, so that there is some resemblance between it and the tuberele bacillus. It was never observed to form filaments or chains, the
individuals being constantly isolated and having rounded ends. When examined in the hanging drop, the individuals are found to be actively motile. No spores can be detected. The bacillus colors quite well with the ordinary dyes, and stains well by Gram's method. When cultivated upon gelatin plates the colonies appear in from 24 to 48 hours as small, circumscribed, round, slightly granular points, which increase but little in size in the next 24 hours, which have a yellowish color, and which gradually sink below the surface, possibly because of the evaporation of the slowly liquefied gelatin.

**Bacillus coli communis.** This important organism, discovered by Escherich, is found in the air, in putrefying infusions and constantly in the alvine discharges of healthy and unhealthy human beings. Randolph first showed that this bacillus, so far from being a mere saprophyte, is seen in many inflammatory lesions, sometimes alone and sometimes accompanied by other organisms. It is aérobie (facultative anaërobe) non-liquefactive, grows readily on ordinary media, stains well with ordinary aniline dyes and is negative to Gram's stain. It is pathogenic and has been found in the pus in cases of ophthalmia neonatorum, daeryocystitis, panophthalmitis and hypopion keratitis. See *Bacteriology of the eye.*

**Bacillus conjunctivitidis subtiliformis.** (L.) This microörganism has been found in many cases of acute conjunctivitis. It closely resembles the bacillus subtilis and in some respects the bacillus megariterium (bacillus mycoides). It is Gram negative and liquefies blood serum. See *Bacteriology of the eye.*

**Bacillus crassus.** (L.) This microörganism is one of the broadest known, being four microns wide. It is motile and non-pathogenic. See *Bacteriology of the eye.*

**Bacillus cuticularis.** (L.) This is a bacterium whose habitat is mainly water. It is aérobie, liquefactive, motile, chromogenie (yellow) and probably non-pathogenic. See *Bacteriology of the eye.*

**Bacillus cyanogenes.** This is a spore-free bacterium which has but little to do with ocular lesions.

**Bacillus dendriticus.** Lewin and Guillery assert that after injection of this organism into the anterior ocular chamber of a guinea-pig iritis with closed pupil resulted. Infection of the vitreous brought about a plastic iritis with opacities in the posterior chamber and detachment of the retina. There does not seem to be any reported cases in which the bacillus has produced human eye lesions. See *Bacteriology of the eye.*—(S. H. M.)

**Bacillus der Meerschweinchensepticämie.** Bacillus of guinea-pig septicæmia. Phisalix has reported an experiment on dogs into
Bacillus der Vogeltuberkulose. (G.) Bacillus of avian tuberculosis (q. v.)

Bacillus diphtheriae. (L.) This pathogenic bacillus, formerly considered to be so important from the ocular standpoint, was discovered by Klebs and Loeffler in 1883. It is found in diphtheritic false membranes and is aerobic, non-liquefactive and non-motile. The bacilli occur singly or in pairs. They possess no spores but usually have in them highly refractive bodies. The Klebs-Loeffler bacillus stains well with the ordinary aniline dyes, and is positive to Gram’s stain. See Bacteriology of the eye.—(S. H. M.)

Bacillus diphtheriae cuniculi. This organism was isolated by Ribbert in 1889, who discovered it in the diphtheritic membrane of a rabbit. It has little or no connection with human eye diseases.

Bacillus dysenteriae. (L.) A morbid microorganism only indirectly related to ocular pathology. It was isolated by Chantemesse and Widal. They found it in the intestinal contents and viseera. It is aerobic and non-liquefactive, stains readily with the aniline dyes and is decolourized by Gram’s stain. See Bacteriology of the eye.—(S. H. M.)

Bacillus erysipelas malignum. See Bacillus murisepticus.

Bacillus erysipelatos suis. See Bacillus murisepticus.

Bacillus fluorescens. One of a large group of saprophytes, which when allowed entrance to the globe, may produce a vigorous reaction.

Bacillus fluorescens liquefaciens. (L.) A well known, benign bacterium discovered by Flügge. It is found in water, putrefactive solutions and infusions. It is liquefactive, aerobic, motile and chromogenic (greenish yellow). See Bacteriology of the eye.

Bacillus fluorescens putridus. (L.) A non-pathogenic organism found in water. It is aerobic, motile and chromogenic (greenish).

Bacillus funduliformis. This organism has been found in the purulent excretion of a dacryocystitic fistula. Morax, who reported the case, attributed the virulence of the attack to the presence of the organism. It is one of the putrefactive organisms and is related to the angina bacillus of Vincent. See Bacteriology of the eye.—(S. H. M.)

Bacillus Gromakowski. (L.) In 18 cases of epidemic conjunctival catarrh Gromakowski in 1897 found a bacillus with rounded edges, whose length was three times its breadth. There was an absence of spore formation. Personal experiment resulted in an acute attack of conjunctivitis.—(S. H. M.)
Bacillus hæmofiló. See Bacillus influenzæ.

**Bacillus, Herbert's.** This bacillus, which was first described by Herbert, is called the intraepithelial capsulated bacillus. It is not unlike bacillus mucosus capsulatus in appearance but differs in being difficult to stain.—(S. H. M.)

**Bacillus hirsutus.** This innocent microorganism was discovered and described by McFarland (System of Diseases of the Eye, Vol. 2, p. 501-504) as follows: It is a large bacillus, 1.75 microns by 3.5 microns, with ends which are rounded when free, but squared when filaments are formed and the individuals are joined together. Long threads of twenty or even more individuals are very common. The first impression obtained when these organisms are observed is that they are without locomotive power; but if a single individual be observed for a short time it may be seen to start off abruptly and swim quietly but swiftly away. Chains of two and three—even four—likewise possess this motility. Fresh cultures in gelatin and agar-agar are generally composed of long threads, and are very constantly without spores. Old cultures, however, particularly agar-agar cultures, present large numbers of large oval spores situated in the centre of the bacillus, but not disturbing its contour, and often lying free. When cultivated, the bacillus grows well, is a fine organism for experimentation because of its many pronounced characteristics, and bears a distinct resemblance to anthrax. See Bacteriology of the eye.

**Bacillus indicus ruber.** (L.) This organism was found by Koch to be pathogenic in rabbits. It is of slight importance in ophthalmology, is aerobic (facultative anaerobic), liquefactive, motile and chromogenic (brick-red). See Bacteriology of the eye.

**Bacillus inflatus.** (L.) This innocent organism was isolated by A. Koch from the air. It is motile and liquefactive. See Bacteriology of the eye.

**Bacillus influenzae.** (L.) A highly morbid and ophthalmologically important microorganism credited to Pfeiffer, Kitasato, and Canon. It is found in purulent bronchial secretions and in the blood of persons suffering from epidemic influenza. It is an aerobic, non-motile and very small bacillus, very like a coccus in appearance, and when found, is present in very large numbers. It does not stain easily with the ordinary aniline dyes, but does stain well with Loefler's methylene blue and heat. It is negative to Gram's stain. It is cultivated best in hemoglobin agar. The bacillus influenzae is very pathogenic on the human conjunctiva, being a common cause of conjunctivitis. See Bacteriology of the eye.—(S. H. M.)
Bacillus, Klebs-Loeffler. The organism characteristic of diphtheria. See Bacillus diphtheriae; Bacteriology of the eye.

Bacillus, Koch-Weeks. This is the well-known microorganism characteristic of "pink-eye" or acute epidemic conjunctivitis (q. v.). Koch, studying acute contagious conjunctivitis in Egypt during 1883, found in the secretions of the disease a bacillus resembling that of mouse septicæmia; Weeks in 1886 was able to make pure cultures of this bacillus and to produce the disease in healthy conjunctivæ, while Morax, Hansell, and others confirmed these observations. Great stress was laid upon the Koch-Weeks bacillus as the cause. This bacillus stains readily with aniline dyes and often is associated with the xerosis bacillus. In the last few years, however, it has been shown that the pneumococcus is more often the cause of acute catarrhal conjunctivitis than is the bacillus just described. Gasparini in 1893 was the first investigator to note that the muco-purulent type of conjunctivitis could be caused by pneumococcus. The investigations of Gifford, who found the pneumococcus in 36 of 40 cases, and of Junius, who met with it in 49 of 60 cases of acute catarrhal conjunctivitis, have gone far toward the settlement of the etiology of this disease. Gifford carried the disease to healthy eyes by means of the discharge, and always found the pneumococcus in the discharge from the inoculated eye. In 31 of the 60 examinations made by Junius the pneumococcus was found in a pure state; in 18 it was associated with the staphylococcus or with the xerosis bacillus. Recent investigations by Veasey show that for Philadelphia and vicinity the most frequent cause of acute catarrhal conjunctivitis is the pneumococcus of Fraenkel. Of 64 cases examined by this observer, the pneumococcus was present in 52. In 10 of these the pneumococcus was mixed with other bacteria. Those cases in which the pneumococcus pyogenes albus or aureus was present were mild in character. In only three of Veasey's cases was the Koch-Weeks bacillus present. Occasionally the disease is produced by the Koch-Weeks bacillus. The clinical signs of both infections are so similar that in severe cases only a bacteriologic examination can distinguish between them.—(J. M. B.)

Koch-Weeks bacilli from the conjunctival secretion are small, very slender, and vary in length. The ends are rounded. The bacillus stains best with dilute Loeffler's methylene blue or carbol fuchsin. Sometimes slight polar staining is seen. It is negative to Gram's stain. See Bacteriology of the eye.—(S. H. M.)

Bacillus latericeus. (L.) Eisenberg found this aerobic, benign, and
chromogenic (brick-red) organism in water. It is non-liquefactive and non-motile. See Bacteriology of the eye.

**Bacillus lepræ.** (L.) This important microorganism was discovered by Armauer and Hansen. It was first isolated from leprous tubercles, and is not capable of cultivation in ordinary media. The bacillus is a small, slender rod, not unlike the tubercle bacillus in appearance; is however shorter and not so apt to be curved. It stains readily with the aniline dyes and is positive to Gram's stain. The bacillus of leprosy has recently been cultivated by Duval, of New Orleans, and others. Leprosy of the lids is not infrequent in districts where this disease exists. The conjunctival form is that of diffuse catarrh with numerous papillae. See Bacteriology of the eye.—(S. H. M.)

**Bacillus luteus.** (L.) Flügge is the discoverer of this non-pathogenic, aerobic and non-motile bacterium. It is non-liquefactive but chromogenic (yellow). See Bacteriology of the eye.

**Bacillus mallei.** (L.) A pathogenic bacillus isolated by Löffler. It was found in the nasal discharges and nodules of animals afflicted with glanders. It is aerobic and non-motile. This bacillus is small, with rounded ends, usually single, sometimes in pairs or growing out to long filaments, especially on potato. It stains with difficulty with the aniline dyes, and is positive to Gram's stain. In rare cases glanders infection has occurred through the conjunctiva.—See Bacteriology of the eye.—(S. H. M.)

**Bacillus megatherium.** Credited to De Bary. Found on the leaves of boiled cabbage. It is an aerobic, liquefactive, motile, and non-pathogenic organism.

**Bacillus mesentericus fuscus vel ruber.** (L.) This is the so called potato bacillus discovered by Globig and Flügge. It is found on potatoes, in the air, hay-dust, water, etc. It is a harmless and common organism, aerobic, liquefactive and motile. See Bacteriology of the eye.

**Bacillus mesentericus vulgatus.** (L.) This microorganism is probably identical with *Bacillus mesentericus fuscus vel ruber*. It is closely related to the subtilis group from which it is difficult to differentiate it. It was discovered by Flügge, and is found on potatoes as well as in water, milk, the intestinal contents of man, etc. See Bacteriology of the eye.—(S. H. M.)

**Bacillus minimus.** See Bacillus murisepticus.

**Bacillus mucosus capsulatus.** See Friedländer's bacillus; Bacillus pneumoniae Friedländeri.

**Bacillus mycoides.** (L.) This is another of the discoveries of Flügge. It has been found in at least one case of lachrymal obstruction; and
produces a vigorous reaction in the anterior chamber. It is recoverable from both soil and water, is aerobic, non-liquefactive, motile, and, generally speaking, non-pathogenic. The bacillus is .8 microns wide and 1.75 to 2.75 microns long. It stains readily with aniline dyes and is positive to Gram’s stain. Often large numbers of oval spores are seen. See Bacteriology of the eye.—(S. H. M.)

Bacillus nodosus parvus. (L.) A benign organism isolated by Lustgarten. It is facultative anaerobic, non-liquefactive and non-motile. See Bacteriology of the eye.

Bacillus of anthrax. See Bacillus anthracis.

Bacillus of avian tuberculosis. The bacilli grow more readily on artificial media than the human form. They are not believed to be a factor in the production of human tuberculosis.

Bacillus of Colomiatti. (L.) This innocent organism has been obtained from cases of conjunctivitis and xerotic masses in the eye. It is non-motile and aerobic. See Bacteriology of the eye.

Bacillus of diphtheria. See Bacteriology of the eye.

Bacillus of Fick. This is another name for the proteus vulgaris of Hauser. Although frequently found on diseased conjunctivae it is probably only an accidental occurrence on those organs. It has also been found in dacryocystitic gangrene of the lids, and ulcer serpens. The bacillus varies greatly in size, does not form spores, and stains readily. Nevertheless, Fick found that when introduced into the eye it produces an acute conjunctivitis and is capable of causing a serious keratitis. See Bacteriology of the eye.—(S. H. M.)

Bacillus of Friedländer. The bacillus pneumoniac Friedländeri (q. v.).

Bacillus of glanders. See Bacillus mallei; also the Bacteriology of the eye.

Bacillus of Hoffman. The pseudo-diphtheria bacillus. See Bacteriology of the eye.

Bacillus of hog erysipelas. See Bacillus murisepticus.

Bacillus of Koch. Bacillus tuberculosis. See Bacteriology of the eye.

Bacillus of McKee. This is an organism of the influenza group, which was described as a cause of infantile conjunctivitis with definite clinical characteristics. It is a Gram-negative, tiny bacillus, very like a coccus in appearance. See Bacteriology of the eye.—(S. H. M.)

Bacillus of measles. An organism isolated by Canon and Pielicke in the blood, secretions of the nose and conjunctiva of persons affected by measles. See Bacteriology of the eye.

Bacillus of Morax-Axenfeld. This very common cause of conjunctivitis is a large Gram-negative bacillus, which generally occurs in pairs.
It stains easily with the aniline dyes and is easily cultivated in alkaline or neutral blood serum. See Bacteriology of the eye.—(S. H. M.) Bacillus of mouse septicemia. See Bacillus murisepticus.

Bacillus murisepticus. This highly pathogenic organism is also known as Bacillus erysipelatos suis, (Koch, Löffler, Schütz and Pasteur); also Bacillus erysipelats malignum, Bacillus minimus, Bacillus septicus, (Koch). Bacillus of mouse septicemia. Bacillus of hog erysipelas. It was first obtained by Koch by injecting putrid flesh beneath the skin of mice; afterward by Löffler and Schütz from the carcasses of dead swine. It is aerobic, and non-liquefacitive.

Bacillus of Petit. This is a Gram-negative bacillus, which generally occurs in pairs, described first by Petit as a cause of superficial ulceration of the cornea. In morphology and staining reactions it is identical with the bacillus of Morax and Axenfeld but is easily differentiated by its cultivation on agar-agar. See Bacteriology of the eye.—(S. H. M.)

Bacillus of pink-eye. The Koch-Weeks' bacillus. See Bacillus, Koch-Weeks and Bacteriology of the eye.

Bacillus of Scholtz. This organism was found in Parinaud's conjunctivitis, is a Gram-negative bacillus, with polar staining; non-motile, and can be grown in all ordinary media. See Bacteriology of the eye.

Bacillus of Shiga-Kruse. Another name for the bacillus of dysentery (q. v.)

Bacillus of syphilis. This organism, isolated by Lustgarten, was at the time supposed to be pathogenic of lues. It was found in syphilitic new growths and secretions and does not develop in ordinary culture media. It is like the bacillus of tuberculosis in shape and size but not in its staining qualities. This bacillus closely resembles the smegma bacillus and, if not identical with it, probably belongs to the same group of acid-fast, non-parasitic bacilli. The method by which Lustgarten succeeded in coloring his bacilli in tissue is as follows: Sections were placed for 24 hours, at a temperature of 40° C., in Ehrlich's gentian-violet stain (aniline water, one hundred parts; saturated alcoholic solution of gentian-violet, eleven parts.) They were then washed in alcohol, and decolorized by immersion in a 1.5 per-cent. solution of permanganate of potassium and a weak watery solution of sulphuric acid. After being thoroughly washed in water they were dehydrated and mounted in the usual way. On examination Lustgarten found his bacillus not free in the tissues, but contained within the cell in numbers from two to five.—(S. H. M.)
BACILLUS OF TETANUS

Bacillus of tetanus. This highly pathogenic bacterium has been found in garden earth as well as in the wounds of persons dead of tetanus. It is anaerobic, liquefactive and motile.

The bacilli form round spores, thicker than the cell, occupying one of the extremities. It stains with aniline dyes and is positive to Gram's stain. In rare cases tetanus infection has followed a wound of the eye or its appendages.—See Bacteriology of the eye.—(S. H. M.)

Bacillus of Weeks. See Koch-Weeks' bacillus and Bacteriology of the eye.

Bacillus of zur Nedden. This is a straight or slightly curved rod 0.7 micron long by 0.6 micron broad. The ends are rounded. In many features it resembles bacillus xerosis. It is, however, Gram-negative and differs culturally as well. The colonies on agar tend to run together and form a thick mucous slime. See Bacteriology of the eye.—(S. H. M.)

Bacillus ozaena. This organism is either very similar to or identical with the pneumo-bacillus (q.v.) whose pathogenic properties and morphologic characters it closely imitates. It is found in the nose and on the conjunctive of patients suffering from ozena. There is very little difference, if any, in morphology, staining reactions, or biology between this bacillus and the pneumobacillus. Friedländer's pneumobacillus, better known as the bacillus mucosus capsulatus, embraces a group of allied organisms whose cultural characteristics show marked variations. All, however, are Gram-negative bacilli whose growth on solid media is characteristically slimy and mucoid. See Bacteriology of the eye.—(S. H. M.)

Bacillus perfringens. This is an anaerobic microorganism, said to be identical with the microbe discovered by Fraenkel in connection with gas-producing subcutaneous phlegmon. In several cases, it has been present in, and was probably the cause of, violent inflammation (panophthalmitis, orbital abscess) after penetrating wounds of the eye. B. perfringens is probably identical with the bacillus arogenes capsulatus or gas bacillus—the so-called bacillus Welchii.

Bacillus pestis. This bacillus of the bubonic plague is a not uncommon cause of eye diseases, as well as of other organic lesions. Of 601 cases during an epidemic, 4.3 per cent. exhibited ocular changes ranging from keratitis to retinal hemorrhages. The bacilli from infected tissues, are short, thick rods with rounded ends. They appear mostly single or in pairs, and are characterized by exceptional variations. This bacillus stains well with the aniline dyes.
and is negative to Gram's stain. See Bacteriology of the eye.—(S. H. M.)

**Bacillus, Pneumo.** See Bacteriology of the eye; and *Bacillus pneumoniae* Friedländeri.

**Bacillus pneumoniae.** (L.) Flügge. See, also, *Bacillus pneumoniae* Friedländeri; and Bacteriology of the eye.

**Bacillus pneumoniae Friedländeri.** This organism was first obtained from the exudates in the pulmonary alveoli in cases of croupous pneumonia. It is aerobie, as well as facultative anaerobic. It is a large, non-liquefactive, non-motile, Gram-negative, capsulated bacillus, which grows very profusely on ordinary media and furnishes a typical "nail culture" in gelatine. Pure infections of the conjunctiva with Friedländer's bacillus have been frequently noted. The organism is probably identical with *bacillus mucosus* capsulatus. See Bacteriology of the eye.—(S. H. M.)

**Bacillus prodigiosus.** This is a perfectly innocent organism discovered by Ehrenberg. It is frequently found upon food-stuffs, boiled potatoes, hard-boiled eggs, moist bread, etc. It is aerobic, motile, liquefactive, and chromogenic (red). It acts as a protective to rabbits against anthrax. See Bacteriology of the eye.—(S. H. M.)

**Bacillus proteus mirabilis.** Probably identical with *Bacillus proteus vulgaris.*

**Bacillus proteus vulgaris.** This term includes a group of bacilli which are very common and the most widely distributed of the putrefactive bacteria. It varies greatly in size, does not form spores, stains readily and grows rapidly on ordinary media at room temperature. Cultures are frequently contaminated by this widespread organism. It is probable that this bacillus is not pathogenic so far as the eye is concerned. Lobanow claims that after an injection of a pure culture into the anterior chamber of animals an iritis sometimes results, which may go on to panophthalmitis. See Bacteriology of the eye.—(S. H. M.)

**Bacillus pseudoconjunctivitis.** This organism was cultivated by Krause. It is very like the Koch-Weeks bacillus, but has a more profuse and yellow growth.—(S. H. M.)

**Bacillus pseudodiphtheriae.** (L.) See Bacteriology of the eye.

**Bacillus pseudo-influenzae.** (L.) This organism is known to be responsible for an acute conjunctivitis—in some cases a blennorrhcea neonatorum. It has also been responsible for various forms of conjunctival catarrh, marginal keratitis, and follicular edema—as well as for direct infections of the cornea. Pseudo-influenza bacillus is identical with the bacillus influenzae in morphology and staining.
BACILLUS PSEUDOTUBERCULOSIS

reactions. It is also similar in culture media, but may be distinguished by its larger size and a tendency to grow into long threads. See Bacteriology of the eye.—(S. H. M.)

Bacillus pseudotuberculosis. (L.) This morbid bacillus was first isolated by Pfeiffer from the visera of a horse killed on suspicion of having glands. It is non-liquefactive, aërobic, and non-motile. See Bacteriology of the eye.

Bacillus putrificus coli. (L.) A benign organism isolated by Bienstock and found in human faeces. It is aërobic, liquefactive and motile. See Bacteriology of the eye.

Bacillus pyocyaneus. A chromogenic (greenish-yellow) aërobic and pathogenic organism discovered by Gessard. It is a widely distributed form, found in purulent and serous wounds, in perspiration, and in the visera of human cadavers. It is liquefactive and facultative anaërobic. The blue and green coloration in purulent discharges from open wounds is usually due to this bacillus. The bacillus appears as a medium-sized rod, is actively motile, does not form spores, stains with ordinary aniline dyes and is negative to Gram’s stain. When an agar culture is agitated with chloroform a blue coloration demonstrates the presence of this bacillus. It has been isolated from cases of hypopion keratitis, dacryocystitis and ophthalmia neonatorum.—(S. H. M.) See Bacteriology of the eye.

Two cases of infection of the conjunctival sac with the bacillus pyocyaneus are also reported by Brown Pusey. In the first case the conjunctiva of the lids was swollen and red and numerous follicles were present in the transitional folds. The bulbar conjunctiva was also inflamed, although there was no discharge from the eyes. Cultures showed large colonies of the bacillus pyocyaneus and small colonies of the staphylococcus albus. Bouillon culture injected intraperitoneally in a guinea-pig caused death in 24 hours, while the same culture in the conjunctival sac of a rabbit caused no reaction.

In the second case the patient complained of some itching and burning of the lids, but there were no objective signs of conjunctivitis. Culture from the conjunctival sac showed the bacillus pyocyaneus in pure culture.

Zinc sulphate was used and at the end of two or three weeks the organisms had disappeared.

Another example of the morbid action of this bacillus is reported by Bietti: A patient, 44 years old, was struck in the left eye by a piece of wood. Three days later there was a corneal ulcer with infiltrated margins and a yellow base. The loss of substance was great, measuring 5/6 mm. The ulcer did not occupy precisely the center
Bacillus pyogenes. (L.) Poels has demonstrated this organism in infectious keratitis of cattle, but there is no evidence of its having affected the human eye. See Bacteriology of the eye.

Bacillus pyogenes fœtidus. (L.) Fasset isolated this pathogenic organism from an ischio-rectal abscess. It is ærobic, non-liquefactive and motile. See Bacteriology of the eye.

Bacillus rhinoscleromatis. (L.) A pathogenic organism found in the newly-formed tubercles of rhinoscleroma. It is ærobic, facultative anaerobic, non-liquefactive and usually non-motile. Its etiologic relations are not well established, and it is considered by many as identical with bacillus pneumoniae Friedländeri. It is, however, less virulent than the pneumobacillus, gelatin cultures are more transparent and the capsules are more persistent. The bacillus rhinoscleromatis, the ozena bacillus and pneumo-bacillus of Friedländer are very closely related, and the first two are noticed here only as very rare causes of catarrh.—(S. H. M.) See Bacteriology of the eye.

Bacillus ruber. (L.) This is the so-called (benign and ærobic) red bacillus found in water and on boiled rice. It is liquefactive, motile and chromogenic (magenta red). See Bacteriology of the eye.

Bacillus salivarius septicus. (L.) A pathogenic bacillus discovered by Biondi. It is found both in healthy and in pneumatic sputum, in the fibrinous exudates of croupous pneumonia, and in the pus of meningitis. It is ærobic, non-motile and non-liquefactive. By some authorities it is believed to be the cause of croupous pneumonia in man, and by others to be identical with bacillus lyssæ, Pasteur.

Ewetzky in 1895 found in the exudate of an eye lost after cataract extraction from panophthalmitis, bacilli, arranged in pairs, each surrounded by a broad capsule. The same organism was demonstrated in the secretion from the lachrymal sac and in the sputum. They closely resembled the bacillus salivarius septicus of Biondi.
Infection of the anterior chamber of animals with a pure culture of these microbes induced a fibrinous iridocyclitis, edema with vascularization of the cornea and, finally, phthisis bulbi. See **Bacteriology of the eye.**—(S. H. M.)

**Bacillus septatus.** (L.) This is a short organism, colored by the Gram method and said to be responsible for some forms of acute epidemic conjunctivitis. It belongs to the group of ocular pseudodiphtheria bacilli—like xerosis bacillus. See **Bacteriology of the eye.**

**Bacillus septicus.** See **Bacillus murisepticus.**

**Bacillus septicus keratomalacia.** This organism was isolated by Babes in the corneal tissues and viscera of a child dead of septicemia following keratomalacia. It is aërobic, non-liquefactive and pathogenic for rabbits and mice, slightly for birds, but not for guinea-pigs.

**Bacillus sporiferus.** (L.) This bacillus is classed with a group of organisms the identification of which is not very satisfactory. It was first described by Lachowiej.

**Bacillus subtilis.** (L.) This is a non-pathogenic and abundant bacillary form, obtained from the air, water, soil and plants. It is aërobic, liquefactive and oscillating. Although an innocent microbe it was at one time supposed to produce the conjunctival hyperemia of jequirity. The subtilis bacilli are large motile rods with flagella. They are Gram-positive and, in old cultures, spores are seen. In bouillon a scum forms, which is wrinkled, and easily sinks to the bottom. It has been found in conjunctivitis and ulcer serpens cases. See **Bacteriology of the eye.**—(S. H. M.)

**Bacillus sucinacius.** This organism as described by McFarland is small, measuring from 1 micron to 1.75 microns in length, and 0.3 to 0.5 micron in breadth. The discoverer found it but once in the secretions of a case of granular conjunctivitis. He describes (Norris and Oliver, Vol. 2, p. 521) the organisms as having rounded ends, occurring isolated or joined in twos, and being peculiar in presenting many club-form and falciform individuals in comparatively fresh cultures, so that involution forms are very common. The organism seems to be non-motile, and no spores were observed in it. It takes the aniline dyes rather badly, perhaps because of the rapid degeneration which it shows, and is not colored at all by Gram's method. Upon gelatin plates the colonies are slow in developing, not appearing until from 24 to 48 hours. They are small, sharply circumscribed, spherical or round, yellow, translucent, and slightly granular, the granular condition being observed particularly in the center, where they present a partial resemblance to powdered glass. The growth in bouillon seems to be scant. Litmus milk becomes

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Bacillus, Tubercle. See Bacillus tuberculosis and Bacteriology of the eye.

Bacillus tuberculosis. This is the well-known pathogenic, parasitic bacterium so important to ophthalmologists. It was discovered by Koch in tuberculous sputum and in the tuberculous organs of persons and animals affected with tuberculosis. It is aerobic, and non-motile. The tubercle bacilli are slender rods 0.3 micron by 1.5 to 4 microns in length which occur singly or in pairs, and are usually slightly curved. Its staining peculiarities are important for its differentiation and recognition.—(S. H. M.) See Bacteriology of the eye.

Bacillus typhi murium. (L.) Löffler. Obtained from mice affected with an epidemic disease. It is aerobic, facultative anaerobic, non-liquefactive, and motile. See Bacteriology of the eye.

Bacillus varicosus conjunctivae. (L.) This pathogenic bacillus was found by Gombert in the healthy conjunctival sac of man. It is motile, aerobic and non-liquefactive. See Bacteriology of the eye.

Bacillus violaceus. (L.) An organism isolated by Becker in river water. It is aerobic, liquefactive, motile, and chromogenic (dark violet). See Bacteriology of the eye.

Bacillus violaceus flavus. (L.) This is a spore-free, short, oval bacillus with rounded ends. It forms chains of from two to eight bacilli all of which are actively motile. It takes the ordinary stains readily and shows in the hanging drop; but is Gram-negative. McFarland, to whom we are indebted for a description of this microbe, cultivated it from the conjunctiva in a case of granular conjunctivitis. The violet color associated with the name of the organism is very intense on agar. The growth on the potato is of a dull salmon color, and the same coloration is seen in bouillon, although the liquid at first assumes a violet hue. See Bacteriology of the eye.—(S. H. M.)

Bacillus Welchii. Bacillus perfringens. This is an anaerobic microorganism, said to be identical with the microbe discovered by Fraenkel in connection with gas-producing subcutaneous phlegmon. In several cases, it has been present in and was probably the cause of violent inflammation (panophthalmitis, orbital abscess) after pene-
BACILLUS XEROSIS

trating wounds of the eye. B. Welchii is probably identical with the *Bacillus aerogenes capsulatus* or *gas bacillus*—the so-called *bacillus perfringens*.—(S. H. M.)

**Bacillus xerosis.** This organism was discovered by Fränkel in the white, fatty scales of the conjunctivae in cases of xerophthalmia. It is non-motile and does not grow on a gelatin or potato. Its pathogenesis is not fully determined, and though generally considered innocent yet in combination with other bacteria and toxins may be productive of serious lesions. It is, moreover, a constant inhabitant of the normal conjunctiva. See **Bacteriology of the eye**.—(S. H. M.)

**Back focal length.** In the work of the mechanical optician, the distance between the back focus of a lens and the last lens surface.

**Back focus.** See **Focus.**

**Background.** The part of a picture or eye farthest from the eye of the spectator.

**Backstaff.** An old-fashioned appliance for the determination of the sun's altitude.

**Back-water theory of papillitis.** This is a phrase intended to explain von Graefe's theory of "choked disk." He attributed the papillitis which accompanies meningitis to a "descending neuritis." The swelling of the nerve-head, which is found in intracranial diseases, he attributed to obstruction of the return of blood from the eye, by compression of the cavernous sinus. This, known as the *back-water theory*, held sway until 1869, when Sesemann showed that the communication between the orbital and facial veins is so free that pressure on the cavernous sinus can produce only transient engorgement of the retinal veins.—(J. M. B.)

**Bacon, Roger.** This distinguished natural historian, chemist, mechanician, mathematician, and philosopher (worthily, if unofficially, entitled "Doctor Mirabilis") was born in 1214, near Ilchester, Somersetshire, England. His family was noble and wealthy, and his earliest education was received from private tutors in his father's house. Next, he entered Oxford University, then the University at Paris, where he mastered numerous languages—among them, Arabic, Hebrew, Greek, and Latin—as well as physics and mathematics. He left this institution with the degree of Doctor of Theology, as well as with the complimentary title of "Doctor Mirabilis." Returning to London about 1250, he joined the Franciscan monks. Shortly afterward, he was suspected of magic and the black arts, and, in 1257, was actually sent to the prison of the Franciscan order in Paris. Here, for ten years, he suffered greatly, not merely from physical restraint and other bodily discomforts, but also, and perhaps far more, from
the interdiction of his studies and publications. In 1265, however, a friend of Bacon's, Guy de Foulkes, became Pope Clement IV, and this worthy father, himself a man of liberal culture, commanded Bacon to compose and to send to him certain treatises on science. Bacon, who hitherto had written nothing but brief affairs of very fugitive character, now, in eighteen months, planned, composed, and completed three immense treatises, namely, the *Opus Majus*, the *Opus Minus*, and the *Opus Tertium*—works on which the writer's fame is founded as on eternal rock. Such is the effect on the creative powers—when these really exist—of adequate appreciation!

It is safe to say that these works of Roger Bacon produced a complete right-about-face in the world of physical science, and that much, very much, of the progress of the present day, is, directly or indirectly, due to them. Only to Bacon's still greater namesake, Francis, who appeared three centuries later, is it due in greater measure.
Shortly after these works were sent to the Pope, Bacon was released from prison (1268). When, however, Jerome de Ascoli succeeded to the papal chair, Bacon was once more thrown into prison. In 1292, he seems to have been at liberty again. He died about 1294.

The general accomplishments of Bacon we leave to other pens; here we have liberty to speak merely of his services to ophthalmology—which were chiefly in the field of optics. Famous indeed is the passage from the *Opus Majus* (p. 352 of the London edition of 1733) on magnifying-glasses. The passage runs as follows: "If indeed a man observes letters and other minute objects through the medium of a crystal, either of glass or of other transparent material, set down upon the letters, and if it be the lesser portion of a sphere, whose convexity is towards the eye, and the eye be in the air, far better he sees the letters, and they appear to him larger. For, according to the truth of the fifth law of a spherical medium, whatever is below it and this side its center, and whose convexity is toward the eye, all things co-operate for size, because the angle is larger under which it is seen, and the image is larger, and the place of the image is nearer, because the object is between the eye and the center, and, therefore, this instrument is useful to the aged and to those having weak eyes. For they can see any letter, howsoever small, of a sufficient magnitude. If indeed it be the major portion of a sphere, or the half, then, according to the sixth law, there arrives the enlargement of the angle and an enlargement of the image, but the propinquity is wanting, because the place of the image is beyond the object to the degree that the center of the sphere is between the eye and the thing seen, and therefore this instrument has no value, except as it may be a minor portion of a sphere, and instruments of plane crystalline bodies according to the first law of plane surfaces and instruments and instruments of concave spheres according to the first and second law of spheres can do likewise. But, among all, the minor portion of a sphere whose convexity is toward the eye, exhibits the size more plainly, because of three reasons, at the same time conjoined, as I have already indicated."

Aside from the fact, in this passage, the great philosopher has committed a number of errors, each and all of which could easily be pointed out today by Macaulay's schoolboy (if he be in existence still), there remains the further and unforgettable fact that, in this self-same bit of exposition, there was pointed out, for the very first time in history, that those who are old, or weak-of-sight from other causes, can be given material assistance by means of the convex lens.

We may add, for the sake of completeness, the following interesting facts:
1. Lenses of any sort or kind, as aids to vision, were wholly unknown to antiquity. The often cited passage from Suetonius about Nero and his emerald, is irrelevant absolutely, referring as it does, not to a lens of any sort, but to a concave mirror.

2. Lenses were certainly not introduced (the contrary has carelessly been alleged) into Europe from China. The earliest citations in this regard, to writings or affairs Chinese, date back to a time much later than the passage above translated from Bacon.

3. The very first mention in history of the employment of lenses as a means of assisting the sight is that of Bacon, as rendered above.

4. The first inventor of spectacles is not known.

5. The re-inventor of spectacles was Alexander de Spina, who died in 1313. See Alexander de Spina.

6. Salvino Armati had nothing to do with the matter, though often asserted (on insufficient grounds) to have been the first inventor of spectacles. See Armati, Salvino.

7. By the middle of the 14th century, convex lenses and spectacle frames were in general use.

8. Concave lenses began to be employed about the beginning of the 16th century. Pope Leo X, for example, is known to have worn a pair in 1517.

9. Bi-focal spectacles were invented by Benjamin Franklin.

10. Cylindrical lenses began to be employed about the beginning of the 19th century.

11. Near the middle of the 19th century, owing chiefly to the efforts of Arlt, the fitting of glasses was taken up by ophthalmologists. See History of ophthalmology.—(T. H. S.)

Bacon, Samuel. This well-known, blind, American educator and founder of schools for the blind in Illinois, Iowa and Nebraska, was born in Cortland, Trumbull County, Ohio, May 10, 1823. The Editor is indebted for the following abstracted account of his life and works to a paper in the Outlook for the Blind. The subject of the sketch was a boy in the full sense of the word—active, daring, wide-awake boy, keenly interested in nature and fond of outdoor sports.

For four years he attended school, where he learned to read, write and spell. Regarding his introduction into the intricacies of mathematics, Bacon said, in after years, "I have no remembrance of a time when I could not compute anything I desired." Eager as he was to acquire knowledge, to a lad of such buoyant spirit the schoolroom offered less attraction than the great forest teeming with life. The birds, squirrels and even the trees themselves were well-known friends of this ardent lover of nature. Fond of pictures, his eye never failed
to see, and his artist soul never failed to appreciate the beauty in the ever-changing scenes on the great canvas which Nature had spread wide before him. A landscape once seen was indelibly stamped upon his memory. This power of being able to recall clearly what he had looked upon must have been a source of infinite satisfaction, for all too soon the time came when the pictures which hung in memory's gallery were the only ones which could afford pleasure. At the age of eleven years, the boy had an attack of scarlet fever, the most disastrous effect of which was the loss of sight. Life must henceforth be faced under new conditions. However, his misfortune did not baffle this lad of dauntless courage. He continued to participate in all games the same as before. His loss of sight, instead of intimidating seemed rather to stimulate and develop his naturally daring spirit. He readily learned to skate, ride and swim. First with, and later without the aid of a long pole, he learned to walk on the edge of the top board of a fence, a perilous performance, yet one which served him well, for in the same way he could cross a stream on a log or pole, and in the same way, too, he could, in later years, walk a joist in a building.

To the habits formed in youth can be traced the success of later years. When Bacon, as a boy, resolutely faced and conquered the obstacles which lay in his path, then and there he laid the foundation without which such a career as his proved to be would have been impossible. Instead of allowing his affliction to fetter him, instead of shrinking into himself and isolating himself from his companions, Bacon heroically faced life, determined to conquer in spite of odds. It was because he continued to mingle with his playfellows and because he learned to do all the things they did, that they in turn continued to look upon him as one of them, and expected him to do whatever they themselves could do. A further knowledge of his character reveals undaunted courage, a strong will and untiring industry. In his every act we read the determined declaration, "I will find a way or make one."

Eager to acquire knowledge, Bacon was, while yet a boy, very fond of books, but it was not altogether easy to obtain a reader. Fortunately, there was a near neighbor who was also fond of books. The difficulty lay in the fact that this friend was too poor to furnish light by which to read. He, therefore, proposed to the boy that he gather wood with which to make a blaze in the fireplace, thus providing the necessary light. To this the lad readily agreed, for he could take his ax, go into the timber, cut down and put up as much cord wood as any boy of his age. Thus, by the light of the wood fire, all of the books in the neighborhood were read. His retentive mind made it
unnecessary for the young student to hear a book the second time. For nearly four years he and his book-loving friend continued their reading. Then it was decided that the boy should be placed in school. Accordingly, at the age of fifteen, he entered the School for the Blind at Columbus, Ohio. Though small for his age, he was strong and active, free from all awkward, cautious habits.

William Chapin was then superintendent of the Columbus institution. He and his two assistants, W. H. Churchman and A. W. Penniman, men well known as educators of the blind, came in due time, to be deeply interested in the bright, energetic lad, who had been placed under their instruction. Thus availing himself of the service of his friend, the eager, zealous lad achieved much. In a short time he completed "Davies' Descriptive Geometry," and in fourteen days he mastered "Davies' Analytical Geometry," omitting the seventh book. So thoroughly did he master the geometry that, in later years, he taught the subject a number of times without reference to any text book. Regarding his work along this line, Bacon is quoted as saying: "In all my mathematical pursuits I have never used any tangible apparatus, have never failed to teach the blind in the same manner, and in teaching the seeing, with their figures before them, have always been able to follow quickly, being less liable to get my lines mixed. I never experienced any difficulty in comprehending or retaining in mind the most complex mathematical figures."

Kenyon College was among the number which had offered a scholarship. Thither the boy resolved to go, knowing that there was there an excellent professor of mathematics. Thus it was that in September, 1844, Samuel Bacon entered college. He was kindly received by teachers and students. It was not long until he found that his self-conducted course of study had carried him far beyond the college course in everything except the languages. In these he was very deficient. He had studied French a little, hoping thereby to be able to read French mathematics, but he had barely looked inside a Latin grammar. He was, therefore, assigned two classics, Latin and Greek. He feared his progress would be slow, for in early youth he had become strongly prejudiced against memorizing, a prejudice which he deeply regretted all his life. The necessity of depending entirely on his memory was due to the fact that he had no means of taking notes. It was not until some years later that New York Point and Braille were introduced into the schools for the blind in this country. Thus, with no method of writing, the student of languages found himself handicapped, it being especially hard to handle sentences; for if any part slipped from memory, it was then necessary to have
it reread. Yet all these difficulties did not baffle the resolute, energetic pupil from Columbus. He soon became familiar with both Latin and Greek, especially Greek, which he greatly preferred to Latin. In time he could memorize a sentence in either of these languages as quickly, if not more quickly, than a sentence in English, the reason for this being that the idea in the English sentence always absorbed his attention. He kept up with his seeing classmates, and at the close of the year passed as good an examination as any of them.

During this first year in college, in addition to the two classics, he reviewed logic and rhetoric and took a course in chemistry.

"The most he gleans who works and never swerves." During his first vacation after entering Kenyon College, Bacon did not leave, finding it cheaper to remain there and study than to go elsewhere. Then, too, another student, who decided to stay in order to review the year's course in classics, offered to read the same aloud.

When the second year of his college career began, no studies other than the classics were assigned Mr. Bacon, as he had already mastered the other subjects taught there. Thus he had ample time for miscellaneous reading, his fellow students willingly doing such reading without charging for their services. Nevertheless, his dependent position made him restless and discontented; so when the Christmas vacation had come, he decided to return to Columbus. Though he had practiced the most rigid economy, yet, after all bills had been settled, he did not have left enough money to pay fare in the stage which ran between Gambier and Columbus, there being no railroad at that time. Whatever he willed to do that he did; so, having made up his mind to return to Columbus, nothing could hinder. With the few pennies which he had in his possession he bought same cakes, and, with these in his pocket, he resolutely set forth at nine o'clock at night, a fifty-mile walk before him.

In the same year in which he severed his connection with the Ohio Institution, he became greatly interested in the blind of Illinois. He felt the need of a school in that state, and exerted all his powers, both mental and physical, in his efforts to secure the same. In due time his hopes were realized, for in 1849 a school was opened.

It was about this time that Bacon married Miss Sarah Graves, a lady who heartily sympathized and co-operated with him in his efforts to better the condition of the blind. Throughout her life Mrs. Bacon made it a rule to read to her husband four hours each day, thus rendering most valuable service.

In 1852 Mr. and Mrs. Bacon visited friends in Iowa. They found that no school for the blind had as yet been established, and straight-
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way gave their attention to the matter. As a result of their united efforts, an institution was opened at Iowa City, but was later removed to Vinton, its present location.

In 1874 the Bacons went to Nebraska, and located at Nebraska City. There, as had previously been the case in Illinois and Iowa, it was found that the state had made no provision for the education of the blind, and Bacon was a third time instrumental in establishing an institution. On March 1, 1875, he was appointed superintendent. He rented a small building, and on March 19 of the same year, formally opened school. An appropriation for the erection of a suitable school building was obtained; a desirable site was selected, and on January 13, 1876, the new building was ready for occupation. During the erection of this building, Bacon gave his personal attention to every detail. He attended to it that the best material was used. He was often to be seen climbing about on the roof, critically examining the work. His perilous position was a source of anxiety to the workmen, but, now that he was a man grown, Mr. Bacon found it no more difficult to walk a joist than, in early youth, it had been to walk the edge of the top board of a fence.

For two years and eight months Bacon served as superintendent of the Nebraska School for the Blind. Upon retiring from this position, he took up his residence at Woodland Home, his farm near Nebraska City. Here he made as thorough and as comprehensive a study of agriculture as he had previously made of education.

Throughout the remainder of his life, Bacon was a warm friend of the Nebraska School for the Blind, and took a deep, personal interest in the pupils, ever ready to use his influence in their behalf and to render such service as he could.

Bacteræmia. (L.) f. n. The systemic condition in which bacteria (schizomycetes) are present in the blood.

Bacteria in iritis. The theory that iritic and other uveal inflammatory processes are frequently of bacterial origin is by no means new. As Brailey and Stephenson long ago pointed out (Norris and Oliver, System of Diseases of the Eye, Vol. 3, p. 301), most forms of irido-cyclitis result from the action of microorganisms. It is possible that the immediate cause of these inflammations is to be sought in the vicarious glandular excretion of microbes (or their products) circulating in the blood or other nutrient fluids of the body.

More than thirty years have elapsed since Memorsky proved that chemicals circulating in the blood might find their way into the aqueous humor. He injected a solution of potassium ferrocyanide into the veins, and twenty minutes later was able to demonstrate its
existence in the aqueous humor by the perchloride of iron reaction. More recently, Ehrlich noted coloration of that fluid after fluoresceine had been introduced beneath the skin. These observations prove, therefore, that soluble salts, when thrown into the circulation, may be excreted by the iris and ciliary body. Evidence will be next adduced to show that micro-organisms may be thus got rid of. The following, reported by Gillet de Grandmont, in a case in point. That surgeon was consulted by a young man convalescent from typhoid fever. The patient was thin and weak, had albumen in the urine, and a jaundiced hue of the skin. His left eye was affected with iritis; it showed numerous posterior synechiae and hypopyon, and its vision was so impaired that fingers could be counted with difficulty at the distance of one metre only. Grandmont opened the anterior chamber of the inflamed eye and inoculated a tube of agar-agar with some of the pus. Two days later he obtained a pure culture, which when examined with the microscope was found to be made up of the bacilli described by Eberth as present in the spleen, glands, and Peyer's patches of those with typhoid fever. A small quantity of this culture was next injected into the vitreous humor of a rabbit, which when killed three weeks afterward was found to have numerous typhoid bacilli in the liver and intestines.

The same author has found streptococci in a culture obtained by inoculating gelatin with the aqueous humor from a case of hyaloiditis (or, rather, cyclitis) following erysipelas.

Other instances may be quoted in which micro-organisms have been demonstrated in the anterior chamber. Herman Snellen, for example, has lately reported the following cases: "(1) A lady, aged twenty-eight years, had marked descemetitis of the left eye, the lower third of the cornea being speckled over with punctate opacities. Increased tension coming on, sclerotomy was performed. One of the punctate dots escaped with the aqueous humor, and was found to be made up of very short bacilli, capable of cultivation on agar-agar. This patient later developed descemetitis of the other eye, in one of the dots from which identical microbes were discovered. (2) A young man had a similar affection of his right eye. The anterior chamber was tapped, a dot examined with the microscope, and found to consist of cells and short bacilli. Snellen concludes from these facts that descemetitis is a disease sui generis, and that 'it is due to microbes growing in the anterior chamber, which by their producing toxines cause an irritation of the uveal tract.' The pathogenesis of his cases would perhaps be better explained by assuming that both were due to some constitutional condition of microbic nature, and that the organisms found
in the anterior chamber represented an excretion of the virus by the ciliary body.'"

**Bacterial reactions.** See Seropathy.

**Bacterial therapy in eye diseases.** Although this subject will be more fully and more thoroughly considered under Seropathy in eye diseases, yet it may be said here that early in the eighteenth century, following the observation that one attack of smallpox protected the individual against subsequent attacks, the inoculation of healthy persons with the virus from a mild case of smallpox was extensively practised, and after the discovery by Jenner of the protective power of successful inoculation with virus from cowpox, vaccination against smallpox became world-wide. Soon after the discovery of the bacterial etiology of anthrax, Pasteur, having observed that one attack of anthrax protected sheep or cattle against subsequent infection, devised the method of protective immunization of healthy animals by the injection of attenuated cultures of anthrax bacilli. A few years later he proposed the treatment of rabies by the injection of attenuated virus contained in the dried spinal cords of infected rabbits.

Thus gradually the idea of the prophylactic production of active immunity to disease gained ground, and it was only a step further, to the application of the method to cases in which infection was already present. We have seen that the injection of bacteria into the animal body gives rise to the production in the serum of certain substances, that have a definite destructive or inhibiting effect on the bacteria, and that these substances are within certain limits specific for each bacterium. Metchnikoff held that the essential factor in immunity was the phagocytic cell. Later Denys showed that if leucocytes are washed free from serum, they are no longer able to ingest bacteria. If, however, the bacteria are treated with serum, and then mixed with the washed leucocytes, they are at once taken up. This sensitizing substance, which prepares the bacteria for phagocytosis is called opsonin.

Opsonins are present in normal serum, and following the injection of bacteria are increased as are the other known immune substances such as the agglutinins and bacteriolysins, though the increase of the several immune bodies is not necessarily in equal proportion in any given case. Thus Hektoen showed that an immune serum may have marked opsonic and little or no bacteriolytic properties, and vice versa. In their structure opsonins are thought to resemble agglutinins and are, in the terms of Ehrlich's side chain theory, receptors of the second order.

From a study of opsonins in their relation to infectious processes,
Wright developed the idea that they play an important part in the production of immunity in infections. He showed that in cases of infection by the tubercle bacillus for example, the injection of small quantities of tuberculin, containing the bacilli and their products, was followed by certain characteristic fluctuations in the amount of opsonin, and proposed therefore to use the opsonic power of the blood as a guide to the therapeutic injection of the bacterial products.

The opsonic index is determined by comparing the amount of phagocytosis occurring in suspensions of leucocytes, bacteria, and normal serum with that taking place in a similarly prepared suspension to which has been added in place of the normal serum, the immune serum to be tested. The leucocytic suspension is prepared by allowing about 20 drops of blood from a puncture of the finger or ear to flow into a tube of .85 per cent. sodium chloride solution to which 1 per cent. sodium citrate has been added. Upon centrifugation, the red corpuscles collect in the bottom of the tube, and the leucocytes in a lighter colored layer just above, the so-called leucocytic cream. After a second washing with sodium chloride solution, the supernatant clear fluid is pipetted off, and the leucocytic layer, together with a certain unavoidable number of red cells, is removed for use in the opsonic determination. The bacterial suspension is obtained by washing off with salt solution the bacterial growth from a young (preferably an 18 to 24 hour growth) culture on agar or other solid medium, of the organism in question. The suspension is centrifugalized to remove clumps of the bacteria and the density of the resulting opalescent fluid adjusted so that it contains a suitable number of organisms. This is important, for if too many or too few bacteria are present in the mixture of leucocytes and serum, errors in the estimation of phagocytosis will result. For tuberculopsonic determinations the residue of bacilli after the preparation of old tuberculin is frequently used. The organisms are washed free from glycerine, etc., are ground up in a mortar, suspended in 1.5 per cent. salt solution, and the resulting suspension centrifugalized to remove the clumps. Difficulty may be met with in obtaining homogeneous suspension of certain organisms such as the gonococcus and meningococcus, but this can be avoided to a large degree by the use of young cultures (12 to 18 hours old). The serum for the test is collected from a needle puncture in the finger or ear of the patient, two or three drops of blood in a capillary U-tube being sufficient. After the blood has been allowed to clot, the serum is collected by centrifugalization. The normal control serum is obtained in the same way by mixing the sera from two or three normal persons. Equal volumes of the serum, leucocytic suspension, and bacterial emul-
sion are mixed and incubated at 37° C. for 10 to 20 minutes. A convenient pipette for mixing is obtained by drawing out a glass tube into a fine capillary several inches in length, and then bending it at right angles. A mark is placed at a distance of an inch or so from the end, and the serum, leucocytes and bacterial emulsions are drawn up successively to the mark, allowing a small air bubble to intervene between each volume. The contents of the tube are expelled upon a glass slide and mixed by drawing gently back and forth into the pipette. The mixture is returned to the pipette, which is sealed in the flame. A similar procedure is carried out with the mixture or pool of normal sera, and the two pipettes incubated at 37° C. for 10 to 20 minutes. Smears are made from each pipette, fixed and stained. Fixation may be accomplished by heat, or by the application of ethyl or methyl alcohol, or saturated aqueous solution of corrosive sublimate. A number of staining solutions are in use. Carbolthionin, J. H. Wright's stain, or methylene blue give good results. For tests with the tubercle bacillus the ordinary carbol-fuchsin or anilin-fuchsin is used followed by methylene blue after decolorization.

The degree of phagocytosis is determined by counting the number of organisms taken up by a consecutive series of 50 to 100 leucocytes, and calculating the average number per leucocyte. The opsonic index is found by dividing the average number of organisms taken up per leucocyte in the mixture of serum to be tested, by the average number per leucocyte in the normal control serum mixture. Thus, if the average in the test serum mixture is 3 organisms per leucocyte, and the average in the control is 5, the opsonic index is 0.6.

In any given series of leucocytes there will be, providing the bacterial emulsion is of proper density and the incubation time not too long, a certain proportion of leucocytes which have not taken up organisms. Simon has suggested that the relation of the per cents of phagocytizing cells in the immune and control serum mixtures be determined just as in Wright's method, and that this quotient be called the phagocytic index. As a rule curves obtained by plotting the opsonic and phagocytic indices show corresponding oscillations.

Wright has demonstrated that in any one of a series of normal individuals, the opsonic index for any given bacterium lies within certain limits, usually .8 and 1.2. In other words, the amount of opsonin present in normal serum is a fairly constant quantity. In the course of an infection the index curve shows marked oscillations, which may be correlated with the variations in clinical symptoms. Thus in the stage of invasion or in the case of laboratory animals following an injection of bacterial suspension, the opsonic index falls, sometimes as
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low as .1 or .2. This fall is denominated the "negative phase." Later during the stage of improvement, or reaction the index rises above the normal, reaching 2.0 or 3.0 or higher.

Wright has proposed the opsonic curve as a means of diagnosis, and as a guide in the therapeutic administration of vaccines. In a case of suspected tuberculosis, for instance, if the tuberculo-opsonic curve is persistently low, or fluctuates beyond the normal limits, either while the patient is at rest, or after exercise or massage of affected parts, this is taken as evidence in favor of tuberculous infection. It is assumed that an opsonic index above normal indicates a reaction on the part of the body against the infecting organism, and the therapeutic immunizing injections are so spaced that this reaction may be maintained, as evidenced by the continuation of the index slightly above normal. The giving of a second injection before the reaction from the negative phase of the previous injection has occurred, may result in a prolonged depression of the opsonic curve, and a corresponding exacerbation of symptoms. Persistent low indices are regarded as undesirable.

Opsonic estimations also serve to indicate the amount of immunizing material to be injected. If after the first injection the low index is further depressed, the dose has been too large. Or if the dose is too small to produce a reaction, no rise in the index results. Numerous cases have been reported by Wright and others, both in this country and abroad in which the opsonic determinations have apparently been of value as a guide to the size and interval of therapeutic bacterial injections.

It is held by many that the importance and reliability of the opsonic index have been much overrated. In addition to the difficulty of technique and certain unavoidable errors in the preparation of the serum mixtures and the making of smears, there is a considerable variation in the counts in two or more consecutive series of 50 leucocytes, and to obtain approximately constant results it is frequently necessary to count 100 or more leucocytes. Even then the results obtained by different workers on the same set of slides show marked differences. In the second place, it is urged that the course of the opsonic curve does not always correspond to the clinical findings. Patients with persistently low indices sometimes improve and in patients in whom the disease is advancing, high indices may be found. Opsonins are only of the several substances found in serum which vary with the progress of infections, and are not necessarily more important as a measure of immunity than are agglutinins or bacteriolysins, which
at the time of their discovery were thought to offer methods for the gauging of the progress of immunity.

While a conservative position in regard to opsonins is advisable, there seems to be no question that the opsonic curve displays definite and characteristic fluctuations which for the most part can be correlated with the clinical changes. Indeed it frequently happens that the opsonic index shows characteristic fluctuations a number of hours before the oncoming pathological changes become manifest by clinical symptoms. There are those who hold that vaccine therapy should not be attempted unless controlled by opsonic determinations, while others maintain that clinical findings furnish sufficient evidence for guidance in therapy. Although we may reasonably doubt the value of some of the slighter fluctuations in the opsonic curve, we must admit that the more marked variations are beyond the ordinary limits of error, and indicate to some degree the changes that are taking place in the body fluids. To this extent at least, the opsonic index is a valuable guide along the path of vaccine therapy, the clinical landmarks of which are none too plain. Experience alone can tell us how much we may rely on this form of laboratory guide.

We have already seen that high degrees of bacterial immunity may be produced in otherwise susceptible animals by repeated injections of dead or attenuated bacteria. In man, this observation has been put to practical use in the prophylactic injections of vaccine prepared from the organisms of cholera, bubonic plague, and typhoid fever. In regions where these diseases are endemic, the incidence of the diseases in those who receive the injections is much less than in other untreated individuals under like conditions of hygiene and exposure.

Bacterial therapy as developed up to the present time in the cure of diseases is of value chiefly in chronic localized infections such as staphylococcus infections of the skin, tuberculosis and other infections of bones and joints, sinuses, etc. In these there is but little absorption of bacterial products, and consequently there is relatively slight reaction to the infection on the part of the body. The injection of killed cultures of bacteria appears to be a rational means of increasing this reaction and augmenting active immunity with a resulting acceleration in healing of the lesion.—(E. E. I.)

Bacterial vaccines. This subject will be more thoroughly treated under Seropathy in eye diseases. It will be sufficient to say here that the value and importance of the serum treatment of ocular lesions is now as well established as any other.

Bactériodie. (F.) Bacteridium; bacterium (specially that of anthrax).
Bacterienembolien in Netz hautgefässen. (G.) Bacterial embolism of the retinal vessels.

Bacteriengifte. (G.) Bacterial poisons or toxins.

Bacterien, Saprophytische als Krankheitserreger. (G.) Saprophytic bacteria as causes of diseases.

Bacterins. These are therapeutic agents, preparations of sterile, dead bacteria incapable of producing disease, which when injected into the body stimulate the formation of antagonistic material (antibodies) specific for the corresponding microorganism. See Bacterin, Strepto-

Bacterin, Strepto-. This is really a trade name although the term bacterin (q. v.) is a well-known term in bacteriology. Mulford's Digest, July 10, 1913, gives the following account of strepto-bacterin which is said to be a standardized suspension of killed streptococci in physiological salt solution. The sterile bacteria are incapable of causing disease, but when injected into the organism, they stimulate the production of antagonistic substances (antibodies) specific for the streptococcus:

Owing to the diversity of strains of the streptococcus, most authorities recommend the use of autogenous bacterins. For the same reason, when using the stock bacterin, care should be exercised to secure a polyvalent bacterin prepared by those who are competent to isolate the various strains or types and properly combine them. For immunization against scarlet fever the organisms should be secured from cases of this disease.

Strepto-bacterin should be injected subcutaneously, usually at the site of the insertion of the deltoid. The procedure is that of the ordinary hypodermic injection. Strict asepsis must, of course, be observed. The uninfected body may be said to give the immunizing reaction without exception, and prophylactic injections (such as those given for the prevention of scarlet fever) are productive of uniform results. Success in treatment, however, is dependent upon (1) the extent of which the partially disabled organism will react to the stimulation of the bacterin by the formation of antibodies, and (2) the free passage to the infected area of the body fluids containing these antibodies. The condition of the patient may be such that bacterin treatment will be ineffectual and must be replaced by the administration of a serum containing the necessary antibodies; in other cases the bacterin and serum may be used conjointly, the procedure of choice depending upon the distribution of the infection and the patient's condition.

For prophylactic immunization three or four gradually increased doses are administered at intervals of two to four days. In treatment,
after having injected the first dose, if no improvement is noted, the size of the dose may be increased or the intervals shortened, or both. If a clinical reaction occurs, characterized by rise in temperature and aggravation of local symptoms, general malaise, etc., the next dose should be decreased. As a general statement the intervals between doses are usually from two to four days in acute cases and from two to seven days in chronic cases. Later in the course of treatment the intervals may be lengthened or shortened, according to indications.

**Bacteriology of conjunctivitis in general.** See **Bacteriology of the eye.**

**Bacteriology of the normal conjunctiva.** See **Bacteriology of the eye.**

**Bacteriolysins.** In 1896 Pfeiffer noticed that certain bacteria are broken up or destroyed within the organism by other bacteria and their excretions (bacteriolysins). Finally, they were entirely absorbed so that the whole number of organisms rapidly decreased. Ehrlich believed this result to be due to antitoxins alone. Referring to this experiment of Pfeiffer's, Parsons (*Pathology of the Eye*, p. 1087) says: 'It will be remembered that it is a matter here of organisms, such as typhoid, cholera, plague, pneumonia, etc., which exert their main influence, not by virtue of excreted toxins as do the tetanus and diphtheria bacilli, but by noxious properties contained in themselves. The subject is of enormous importance in the whole range of medicine, but chiefly from the prophylactic and therapeutic points of view.

It seems certain that the injection of dead cultures of the type of organism under consideration produces a definite reaction whereby the leucocytes are stimulated to increased bacteriolytic activity. The chemical stimuli which produce this result have been called *opsonins* by Wright.

It may be mentioned in passing that Römer has instituted a campaign in this field also. It has already been pointed out that the majority of cases of ulcer serpens are due to pneumococcus. Statistical researches show that more than half the accidental wounds of the eye eventuate in ulcer serpens (Römer). Römer has shown that the eye can be protected against pneumococci by immunization. As a prophylactic method the results are perfect in rabbits; as a curative method they are successful if the remedy is applied early. The immune serum is best obtained from rabbits, even when used for man. Römer maintains that early immunization by anti-pneumococcic serum in man protects against the development of ulcer serpens, and that even progressive hypopyon ulcers can be brought under control.'

**Bacterioscopy.** The microscopic examination of bacteria.
Bacteriology of the eye. This section will be considered under the following sub-headings: (1) Technique, smears, stains and culture media; (2) Bacteriology of the normal conjunctiva; (3) Bacteriology of conjunctivitis in general, with statistics; (4) Bacteriology of Morax-Axenfeld conjunctivitis; (5) Bacteriology of Koch-Weeks conjunctivitis; (6) Bacteriology of pneumococcus conjunctivitis; (7) Bacteriology of gonococcus (ophthalmia neonatorum, adult ophthalmia) conjunctivitis; (8) Bacteriology of influenza and allied forms of conjunctivitis; (9) Bacteriology of streptococcus and staphylococcus conjunctivitis; (10) Bacteriology of conjunctivitis from rare microorganisms, such as bacillus diphtheriae, bacillus coli communis, bacillus subtilis, bacillus pyocyaneus, bacillus mucosus capsulatus, micrococcus catarrhalis and the meningococcus; (11) Bacteriology of Parinaud’s conjunctivitis; (12) Bacteriology of spring catarrh; (13) Bacteriology of phlyctenular conjunctivitis; (14) Bacteriology of trachoma; (15) Bacteriology of follicular conjunctivitis; (16) Bacteriology of metastatic conjunctivitis; (17) Bacteriology of dacryocystitis; (18) Bacteriology of wound infections; (19) Bacteriology of panophthalmitis; (20) Bacteriology of corneal ulceration; (21) Immunity.

Technique. To carry out thoroughly the work in ophthalmic bacteriology some preliminary knowledge of the general subject is, of course, necessary and one should have the appliances to hand which are found in a well-equipped laboratory. Nevertheless, it will surprise the clinician, especially he who has avoided this work as outside of his sphere, what an amount of assistance he can obtain from careful routine examination of the properly-prepared film.

A simple apparatus for the consulting-room consists of a small stand upon which are bottles containing, gentian violet, Gram’s iodine, absolute alcohol, and safranin. At one end there is a glass beaker; in this is placed a funnel over which one does the staining. Another beaker contains distilled water. Two other bottles contain Loeffler’s blue and Giemsa’s stain. Filter paper, a platinum wire and a spirit lamp make the set complete. With such a stand all the ordinary film-staining of prepared slides, such as Gram’s, Loeffler’s blue for gonococci and the bacillus of diphtheria, Giemsa’s stain for trachoma bodies, and spirochaeta pallida and gonococci, may be done without any inconvenience in the consulting-room.

The film. With a platinum loop a little discharge is taken from the conjunctival sac and smeared well over a clean glass slide. The material should be taken from the conjunctival sac proper and should be well-teased out, by spreading it over as much of the slide as possi-
ble. It is important that the film be thin and even, else fallacy in the staining is apt to occur. Often in a diplobacillary infection the only secretion available is the small particle at the inner or outer canthus. This will always show diplobacilli but will rarely give a pure culture. The slide is allowed to dry in the air and is "fixed" by passing three times through the flame. When cool it is ready for staining. Other methods of fixation are, to immerse the slide in 80 per cent., or absolute, alcohol for fifteen minutes to half an hour, or in saturated sublimation solution for ten to twenty minutes. Another method for fixation highly recommended is Schaudin's; the solution consists of:

Saturated solution of corrosive sublimate 2 parts
Absolute alcohol 1 part

The specimen is put in this solution for ten minutes. If sublimation solution is used the specimen must be put through an alcoholic solution of iodine, 5 per cent., for one minute, and then rinsed in alcohol, 95 per cent., and allowed to dry before the staining is proceeded with.

Films for trachoma bodies. With an ordinary ear curette the conjunctiva of the lower lid is gently scraped without causing any bleeding, so as to obtain some of the epithelial cells. The material is spread over a slide, allowed to dry in the air and fixed in alcohol, 80 per cent., for fifteen minutes to half an hour. The specimen is then allowed to dry and stained with Giemsa solution, 1 to 20 parts of distilled water, for one half to one hour.

In the different forms of conjunctivitis the etiological factor is generally found by examining the pus cells. However, quite a number of cases, especially of gonorrheal ophthalmia, by this method will be found negative. Under these circumstances the preparation of a slide, as described for trachoma bodies, will often demonstrate the presence of the microorganism in the epithelial cells.

Staining methods. Gram's is by far the best method for staining conjunctival films. There are numerous ways of doing Gram's stain. The following has been found very satisfactory over a period of some years. After the film has been prepared, fixed and allowed to cool, it it is stained with:

1. Aniline gentian violet (filtered), 25 seconds. Wash with water.
2. Gram's iodine solution, 15 seconds. Wash with absolute alcohol until no further blue comes away. Wash with water.
3. Stain with safranin 5 per cent. watery solution, 5 seconds. Wash with water.
Aniline gentian violet consists of,
   Gentian violet, 5 per cent. watery solution 88 parts
   Aniline oil                          2 parts
   Absolute alcohol                    10 parts

Gram's iodine consists of:
   Iodine                                1 part
   Potassium iodide                     2 parts
   Water                                300 parts

It is essential in the beginning to learn the technique of Gram's method of staining, and to become expert at it. As Gram's stain divides microorganisms into two important groups, those stained blue (Gram-positive or plus), and those stained red (Gram-negative, or minus), accuracy is necessary. The following points need to be borne in mind: Gram's stain takes a certain time; hurry will only give unsatisfactory results. The slide must be cool. The gentian violet should be filtered each time before using. The film should be as thin as possible, if it is thick the Gram-positive organisms may not be stained by the gentian violet, but will be by the counter-stain so that by lack of care we defeat the object of the stain. After the absolute alcohol, wash the slide well before adding the safranin, which is a watery solution. If this method is followed out carefully the result is satisfactory. The contrast between the red and blue organisms is striking. (See the plate.)

A second method of doing Gram's stain, which is recommended, is as follows:
1. Methyl violet, 30 to 60 seconds. Wash with water.
2. Gram's iodine, 30 seconds. Wash with alcohol, 95 per cent., until no further blue comes away. Wash with water.
3. Stain with safranin, 5 per cent., 5 seconds. Wash with water.
   Blot.

Methyl violet is made as follows:
Solution 1.
   Absolute alcohol             33
   Aniline oil                  9
   Methyl violet in excess.

Solution 2.
   Saturated aqueous solution of methyl violet.
   Solution 1                  1 part
   Solution 2                  9 parts

The following conjunctival microorganisms are stained by Gram's method: Pneumococcus, streptococcus pyogenes, the staphylococcus
group, the diphtheria group, the bacillus subtilis, majority of the sarcinae, streptothrix and actinomyces.

The following are decolourised by Gram’s stain: The diplobacillus of Morax-Axenfeld, the diplobacillus of Petit, Koch-Weeks bacillus, bacillus influenzae (group), the gonococcus, meningococcus, micrococcus catarrhalis, bacillus pyocyaneous, bacillus Friedlander (group), the bacillus coli communis (group).

The following simple stains are useful in conjunctival work:

1. Loeffler’s methylene blue solution.
2. Carbol fuchsin solution.
3. Nicolle’s thionin.

Loeffler’s blue is made up of saturated alcoholic solution of methylene blue, 30 cc., solution of caustic potash in water (1 to 10,000), 100 cc., stain for half to two minutes, and wash off in water. Loeffler’s blue is a useful and excellent stain which keeps well. It is especially good in staining the gonococcus as it differentiates well between the cell and the microorganism. The bacilli of the diphtheria group also stain well with this solution. A useful point in technique in using this stain for the bacillus diphtheriae is after staining a film to decolourize for ten seconds with a 1 to 1,000 solution of acetic acid. This, by partially decolourizing the body of the cell, brings out the metachromatic granules beautifully.

Carbol fuchsin solution. This consists of saturated solution of fuchsin, 10 cc., and 5 per cent. carbo
calic acid water, 90 cc.

Nicolle’s thionin. Thionin in 50 per cent. alcohol, 10 cc., and 1 per cent. carbo
calic water, 100 cc.

These two latter stains will be found very useful for suspected Koch-Weeks films.

The Jacobsohn method:

Methylene blue (concentrated alcohol solution) 8 drops
Carbol fuchsin 15 drops
Aquæ dest. 20 ccm.

The bacteria are stained dark blue, the cell nuclei light blue, and the protoplasm red. If, as Frankel advises, one adds 45 to 50 drops of carbol fuchsin instead of 15, and stains for five minutes then the cells are stained red and only the bacteria dark blue. This method gives very pretty results (Axenfeld).

Giemsa solution. Giemsa solution in ophthalmic bacteriology is used to stain spirochæta pallida, trachoma bodies, gonococci, and other microorganisms. The scrapings from a lesion are allowed to dry and are fixed in 80 per cent alcohol. To a drop of Giemsa solution
twenty drops of distilled water are added and allowed to stain for one hour. Trachoma bodies will be found well stained in half an hour.

**Modified Giemsa.** The slide is dried in the air, put in a filter dish and covered with the staining fluid (which consists of equal parts of Giemsa solution and pure methyl alcohol) for 30 seconds. Enough distilled water is now added to cover the specimen, 10 to 15 cc., which is agitated until a homogeneous mixture is obtained. After three minutes the specimen is removed.

**Dark stage.** For this method one of the special dark stages, or, more correctly, parabolic condensors, is required. Those supplied by Zeiss, Richert or Leitz are eminently satisfactory. A powerful source of light is necessary, preferably a small arc lamp, though a large Nernst light does almost as well. The condensor is used without the Abbe, and according to type placed on the microscope stage or in place of the sub-stage. Thin slides are necessary, not more than 1 mm. in thickness, and they should be absolutely smooth and clean.

To prepare a specimen for examination for *spirochæta pallida* the lesion is gently irritated by means of rubbing with a swab or a curette. This causes a flow of serum which should be as free from blood cells as possible. A drop of this clear serum is put on the slide and covered at once by a clean cover glass, so that the serum spreads as a thin film beneath it. A drop of cedar oil is now placed between the condensor and the slide and the ray of light may be seen as a bright spot in the center of the black disc. This spot should be examined by means of a high dry system. To commence with, the higher power used the better, the later lower powers give a larger field. The oil immersion may be used, but must have the marginal rays cut off, which can easily be done by inserting a small cone of black paper just behind the objective lenses. All blood cells, bacteria, fibrin, and *spirochæta*, as well as dust and even colloidal particles, stand out as brightly illuminated objects in a dark field, and as they are examined in their unaltered state, the characteristic motion of the *spirochæta pallida* is an additional factor in diagnosing these bodies from other *spirochæta*.

**Dark background.** A single drop of ordinary India ink is put on a slide and the scrapings from a lesion mixed with it. Always have the ink in excess of the serum. Draw another slide over it to smear it. Allow this to dry, and then examine under the oil immersion. In this dark background the *spirochætae* are very easily seen.

Non-*capsulated* bacteria may sometimes appear to be encapsulated. This is caused by retraction of the surrounding medium, due to drying the slide too quickly, especially by heat.
BACTERIOLOGY OF THE EYE

Certain microorganisms, known as capsule bacteria have their outer layers so thickened that they seem to be surrounded by a capsule which stains less easily. This varies in different species. The capsule is much less marked in a pneumococcus from conjunctival secretion than in pneumococci from pneumonic sputum. The demonstration of a capsule is often of assistance in differentiating between organisms.

Capsule staining. 1. Cover slide with glacial acetic acid (a few seconds). 2. Drain and replace with aniline gentian violet, and repeat until all the acid is replaced. 3. Wash in ½ per cent. solution of sodium chloride and mount in the same way.

A modification of Welch's method of capsule staining by H. H. McCordick: 1. Make a thin film, fix for 15 seconds with glacial acetic acid. 2. Pour on methyl violet, stain without washing. 3. Renew stain several times until all the acetic acid is gone. 4. Decolourize first with 50 per cent. alcohol in 2 per cent NaCl. 5. Wash off in 2 per cent. NaCl. solution. 6. Blot and mount in balsam.

Copper sulphate method. 1. A 5 or 10 per cent. aqueous solution of gentian violet or fuchsin is placed on a slide and heated for a few seconds. 2. Wash off with 20 per cent. solution of copper sulphate.

McConkey's method. (Collins and Mayou) Fix a film by heat and flood the slide with stain for seven minutes; wash with distilled water, dry and mount. The stain is prepared as follows:

<table>
<thead>
<tr>
<th>Dahlia</th>
<th>5. grm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl green crystals</td>
<td>1.5 grm.</td>
</tr>
<tr>
<td>Distilled water</td>
<td>100 cc.</td>
</tr>
</tbody>
</table>

Rub together in a mortar and add saturated alcoholic solution of carbol fuchsin, 10 cc., followed by 90 cc. distilled water. Filter and allow to stand in an amber glass bottle for two weeks before using.

Spore formation is a process by which bacteria enter a stage in which they are much better able to resist harmful influences than in the growing condition. A bacillus as a rule produces one spore.

Stain for spores. Abbott's method. 1. Stain the cover-glass preparation deeply with methylene blue, heating repeatedly until the staining solution boils, but do not boil continuously, during one minute. 2. Wash in water. 3. Wash in 95 per cent. alcohol containing 0.2 to 0.3 per cent. hydrochloric acid. 4. Wash in water. 5. Stain for eight to ten seconds in aniline fuchsin solution. 6. Wash in water and mount.

The spores are stained blue and the bodies of the bacteria red.
Involution forms. In old cultures the rapidity of division is lessened and we frequently find irregular or distorted forms due to abnormal division of the cells under unfavorable conditions. These are called involuted or degenerated forms.

Motility. Bacteria frequently have fine hair-like appendages which are called flagella. They occur singly or in numbers, and are the organs of motility. Bacteria exhibit three kinds of movement: 1. Brownian, or molecular. 2. Streaming, due to currents of air. 3. True motility.

Hanging drop. By this means we are able to examine an organism's motility. Special slides, which have a hollow ground on one surface half an inch in diameter, are generally used. The glass around the hollow is smeared with a little vaseline, which prevents the cover-glass from sticking to the slide and the drop from evaporating. A loop full of the culture, if in fluid, is placed on a cover slip, which is carefully inverted over the hollow in the slide. If the culture is in solid media a drop of boullion is put on the cover slide and the bacteria added to it. We then examine with the low and high power, shutting off considerable light with the diaphragm.

While the simple stains may be useful in the large out-patient clinic, where many films must be stained in a short time, one must know well the morphology of the conjunctival organisms before the simple staining will prove at all satisfactory. Simple staining often means a duplication of the work as it is surprising, how like the diplobacillus, the xerosis may look; whereas with Gram's method of staining the colour differentiation between the red-stained diplobacillus and the blue bacillus xerosis, makes the diagnosis very easy. Similarly the Gram method is of great assistance in differentiating between the bacillus influenzae and small Gram-positive cocci and diplococci.

The staining of bacteria in tissues. The aniline dyes are of value in demonstrating bacteria in tissues, especially methylene-blue, gentian-violet, fuchsin. They are employed either in aqueous or dilute alcoholic solutions. The staining power is greatly increased by means of heat and by the addition of certain chemical substances. Heat is obtained by placing the sections in the incubator for several hours, or warming the staining fluid on a slide over a flame for a few seconds, keeping the fluid steaming but not allowing to boil.

Of the chemical substances used to increase the staining power of the aniline dyes, the following are satisfactory: Caustic potash to methylene blue; aniline oil to gentian violet and fuchsin; carbolic acid to fuchsin and methylene blue.
The following are useful decolorizing agents: 1. Acetic acid in dilute aqueous solution, 1 to 100, 1 to 1,000. 2. Alcohol. 3. Iodine in iodide of potash solution with certain dyes only. 4. Mineral acids in various strengths. 5. Chloride of aniline. 6. Acid aniline colours added to the alcohol increases its extractive powers. 7. Aniline and ethereal oils.

In staining for bacteria in tissues the fixation of the tissue is of great importance. The best fixatives are, formaline, Zenker's solution, or Mueller's fluid. Imbedding in celloidin is a drawback to the staining for organisms because the celloidin tends to hold the colour so that the bacteria are not so distinct as they would otherwise be. However, with proper care in carrying out the technique excellent results may be obtained.

**Gram-negative organisms.** For staining these organisms Loeffler's methylene blue solution may be used, as follows: 1. Stain the paraffin sections 20 minutes to 24 hours. 2. Wash in weak acetic acid, 1 to 1,000, ten to twenty minutes. 3. Wash in water. 4. Absolute alcohol, two or three changes to differentiate and dehydrate. 5. Xylol, 6. Xylol balsam.

**Duval's method:** 1. Tissue is fixed in Zenker's solution and embedded in paraffin. 2. Treat in usual way to remove paraffin (or Zenker's fluid and iodine), and place in 95 per cent. methyl alcohol. 3. Remove slide from methyl alcohol and cover evenly with staining solution, using care not to run the stain over the edges. 4. Add to stain-covered slide an equal quantity of distilled water (avoid running over the edges) and allow to stand in the admixture from 15 to 30 minutes. 5. Pour off excess of stain and differentiate in distilled water for 15 to 30 minutes, keeping the water in motion constantly. 6. Blot off excess of water with tissue paper (do not allow to dry) and dehydrate for a few seconds in 95 per cent. methyl alcohol, or dehydrate and clear in aniline oil, first blotting. 7. Clear in xylol. 8. Mount in balsam.

**Staining solution** is made as follows:

Thoroughly dissolve 0.5 grm. of sodium carbonate in 100 cc. of hot distilled water and while hot add 1 grm. of Grubler's methylene blue. The mixture is now steamed in an Erlenmeyer flask over a water bath until there is found on the surface a distinct metallic lustre which usually appears within twenty to thirty minutes. The solution is now cooled and 900 cc. of 0.25 per cent. aqueous solution of Grubler's eosin is added slowly, the flask being thoroughly shaken after each addition. Finally a precipitate forms.

**Wright's stain following Zenker's fixation.** The slide is treated
with the xylol to dissolve the paraffin followed by alcohol. To a drop or two of Wright’s stain add drops of distilled water until one obtains a nice metallic lustre. Allow the stain to remain on for twenty minutes to half an hour and then thoroughly wash in distilled water and mount in the usual way.

Gram-positive organisms. In staining bacteria positive to Gram’s stain the differential Gram-Weigert method will be found to give the most satisfactory results.

For celloidin sections. 1. Stain sections with lithium carmine in the ordinary way. 2. After dehydrating in 95 per cent alcohol stick the section to the slide with ether vapour. 3. Stain in aniline-gentian-violet five to twenty minutes. 4. Wash off excess of stain in normal salt solution. 5. Iodine solution (1:2:100) for one minute. 6. Wash off in water. 7. Blot section with filter paper to remove as much of the moisture as possible. 8. Aniline oil, several changes to dehydrate and to remove all excess of colour. 9. Xylol, several changes to remove the aniline oil completely. 10. Xylol balsam.

For paraffin sections. 1. Stain in aniline-gentian-violet, five to twenty minutes. 2. Wash in normal salt solution or water. 3. Iodine solution, 1:2:300, one minute. 4. Wash in water. 5. Absol- lute alcohol, several changes until no more colour is given off and the section is apparently decolourised. 6. Xylol. 7. Xylol balsam.

Stain for tubercle bacillus. Ziehl-Nielsen-Gabbit method. (Not suited to celloidin sections.) 1. Stain paraffin sections in carbol- fuchs in solution, warming the solution so that it steams, one to three minutes. 2. Wash in water. 3. Decolorize and stain for contrast in sulphuric acid and methylene blue solution one minute. 4. Wash in water. 5. Absolute alcohol. 6. Xylol. 7. Xylol balsam.

To stain tubercle bacilli in celloidin sections. 1. Stain rather lightly in alum haematoxylin. 2. Wash in water. 3. Carbol-fuch- sin five to twenty minutes, one to five minutes’ steaming. 4. Water. 5. Orth’s discharging fluid (and alcohol) one-half to one minute. 6. Wash in several changes of water to remove acid thoroughly, to bring back blue colour to the nuclei. 7. Alcohol 95 per cent until fuchsin is entirely discharged. 8. Aniline. 9. Xylol, several changes. 10. Xylol balsam.

The advantages of this method are, that the celloidin is colourless, the nuclei blue, and the rest of the tissue colourless, hence the tubercle bacilli stand out in sharp contrast.

Culture media. Familiarity with the preparation of culture media is an essential in bacteriological work. Many of the pathogenic organisms of the conjunctiva require specially-prepared media, at special
reactions, for their cultivation, so that some practical knowledge in making up culture media is necessary in this department of special bacteriology.

Of the different media Loeffler's blood serum and hæmoglobin, or serum agar, are the most useful. The preparation of agar agar, gelatine, bouillon and potato, and the ordinary media, will be found in Mallory and Wright's textbook, which I have followed here.

_Bouillon._ Formula for 1000 cc.:

Lean beef.............................. 500 grams
(or extract of beef).................. 3 grams
Peptone ................................ 10 grams
Sodium chloride....................... 5 grams
Water .................................. 1,000 cc.

500 grams, or about 1 and a quarter pounds of lean beef, finely minced, are thoroughly mixed with 1,000 cc. of ordinary tap water and the mixture then boiled in a saucepan over the gas stove for about one-half hour. It is next filtered through filter paper to obtain the clear infusion of the beef free from the coagulated albumin and shreds of tissue. This clear beef infusion is then turned back into the saucepan which should be clean, and to it are added 10 grams of peptone (Witte), 5 grams of sodium chloride, and sufficient water to make the total volume of the mixture 1,000 cc. The mixture is next to be boiled until all these substances are dissolved, stirring frequently with a glass rod, and is then to be neutralized, for it has a decidedly acid reaction from the acid of the meat.

The neutralization is important. The reaction required is that of a very faint alkalinity, as is shown by the production of a blue color on red litmus paper, while no change is produced on blue litmus paper. In neutralizing, a ten per cent solution of caustic soda is added, a few cc. at a time at first, and later two or three drops at a time, while the mixture is kept boiling, the reaction being tested between each addition of alkali after thorough stirring with a glass rod. The test of the reaction is best made by placing a drop of the mixture on a piece of litmus paper by means of the glass rod and then moistening the paper at the water faucet. If the solution becomes too alkaline dilute hydrochloric acid is to be added to correct this.

When the proper reaction has been obtained the mixture is filtered through filter paper into a flask, and sufficient water added to bring the volume of the filtrate up to 1,000 cc., thus replacing the loss by evaporation. The filtrate in the flask is now _bouillon_. If this be heated to the boiling point it will usually become more or less clouded.
by a precipitate of phosphates. It is advisable to steam the flask containing the freshly prepared bouillon in the steam sterilizer for about half an hour, and then if the bouillon be clouded to again filter, so that the subsequent sterilizations in the test tubes will not cause precipitates.

The bouillon is now run into test tubes, sterilized immediately and upon the two following days.

Laëffler's blood serum. The fresh blood, obtained at the slaughter house, is allowed to stand in a cool place in a sterile jar until the serum separates. The serum is then drawn off and one-third of its bulk of grape sugar bouillon is added. It is now tubed and sterilized for half an hour at 60° C: every day for one week. The blood serum prepared in this way is better for conjunctival work than coagulation with moist heat at 100° C. It is necessary that the blood serum be not too alkaline. To prevent this neutral bouillon should be added.

Blood serum plates. These are made simply by putting the blood serum in plates, instead of in tubes, and inspissating in the usual way. They are very useful in diplobacillary conjunctivitis and enable one to get a pure culture of this micro-organism with comparative ease.

Hæmoglobin agar. A base is prepared of agar agar 2 per cent., peptone 1 per cent., sodium chloride 5 per cent., and added to beef infusion—the ordinary preparation of agar agar. This is corrected to 5 per cent. acidity to phenolphthalein, hot titration before sterilization in the autoclave. This sterile agar is now melted and cooled to a temperature of 52° C., when a few drops of defibrinated sterile human blood are added. The tubes are shaken and slanted or poured into petri dishes. By this means a beautiful red, almost transparent, medium is obtained with a moderate amount of water of condensation. If the agar is too hot, 60° C. or higher, when the blood is added, the hæmoglobin is destroyed and a dirty, brownish-coloured material is the result. If the agar is too cool there will be no water of condensation. Is it well to seal up this media by dipping the corks in hot sterile paraffin and keep it a week before using. By sealing it up the water of condensation is conserved, and by keeping it bacteriolytic substances in the blood disappear.

Hydrocele, or ascitic, agar. The 1 per cent. neutral agar, which has been tubed, is liquefied, cooled, and to this is added a fourth or fifth of its bulk of sterile hydrocele ascitic or ovarian cyst fluid. The tubes are slanted and not heated again.

Anaërobie cultivation is not infrequently called for in ophthalmic work. The most satisfactory method is that of Buchner. This consists in cultivating bacteria in an atmosphere from which oxygen has
been absorbed by a mixture of alkali and pyrogallic acid. Tube cultures in petri dishes, may be used. They should be placed in some form of a glass chamber, which is close, air-tight, along with the necessary quantity of alkali and pyrogallic acid mixture. In preparing the apparatus the pyrogallic acid (in powder) is placed first in the chamber, along with the culture tubes or plates, then the necessary quantity of a solution of potassium hydroxide 1 to 10 is run in and the chamber quickly closed. For single tube cultures a large test tube provided with a tightly-fitting rubber stopper, which is sealed in position with wax, may be used for the air-tight chamber. The culture tube is to be elevated above the surface of the reducing mixture by means of a bent wire. The quantity of pyrogallic acid employed should be about 1 gram for each 100 cc. of air space to be exhausted of oxygen and for every gram of pyrogallic acid, 10 cc. of the solution of potassium hydroxide should be used.

The examination of a normal or inflamed conjunctiva would then be conducted in the following manner: First a little of the secretion, best obtained from normal cases at the inner canthus, is smeared well over a glass slide, dried, and "fixed" by passing through the flame three times. When cool the slide is stained by Gram's method, dried, a drop of cedar oil put on, and the examination made with the oil immersion lens.

In normal cases tubes of bouillon, blood serum, agar agar, should be inoculated and placed in the incubator for twenty-four hours. If there is no growth at the end of that time they are left for another twenty-four hours and then examined. Elsching's method is very useful here for the detection of pneumococci.

In conjunctivitis cases the examination of the prepared film will often indicate what media it is best to use. A tube each, however, of bouillon, agar, blood serum and hemoglobin agar, will probably fulfil all the requirements. If diplobacilli are found in the film, the inoculation of agar and serum will differentiate between the Petit diplobacillus and the Morax-Axenfeld form. If Gram-negative diplococci are found, or small Gram-negative bacilli, the inoculation of hemoglobin agar will give the most satisfactory results, as upon this medium gonococci, Koch-Weeks bacilli and the different influenza bacilli are easily cultivated.

**The bacteriology of the normal conjunctiva.** The bacteriology of the conjunctiva, both in health and disease, is a subject of interest and importance to ophthalmologists. A knowledge of the microorganisms of the diseased conjunctiva is important because of its relation to diagnosis, treatment and prognosis. A knowledge of the bac-
teria found in the normal conjunctival sac is of value because of its relation to the methods of ophthalmic surgery. It seems but natural to study the flora of the normal conjunctiva before beginning the study of microorganisms found there under pathological conditions. The conjunctiva is an exposed mucous membrane, with its moist surface continuously bathed with lachrymal fluid, closely associated with the nasal mucous membrane; constantly exposed to infections in various ways which offers every inducement to the lodgment of various microorganisms. It seems, indeed, one of those parts of the body which forms a bacteriological home, ready, easily accessible.

It has been established that numerous harmless, as well as harmful, bacteria are constantly present in the normal conjunctival sac. The researches of Sattler, Fick, Michael, Weeks, Koch, Morax-Axenfeld, Elsching and numerous others have clearly established that fact. Gallenga in 1886, before the Ophthalmological Congress in Genoa, reported his study of the normal conjunctiva. During the next year Peters, Leber, Gombert, Gifford and Sattler published their results. Fick, who examined forty-nine healthy eyes, found the conjunctival sac sterile six times. In another series thirty-six out of fifty were sterile. He isolated the staphylocoecus aureas, micrococcus candidans, streptococcus and sarcina lutea.

Bach wrote of twenty-seven varieties of bacteria which he had isolated from one hundred normal conjunctivae. Thirteen of these had not been described before. Gayet demonstrated the presence of the staphylocoecus aureus in the healthy conjunctival sac, while Gombert isolated twelve species of microorganisms. Marthen described sixteen varieties of cocci and two of bacilli, which he had observed from the healthy conjunctiva. He found the staphylocoecus aureus and albus but not the streptococcus. Franke, in one hundred and fifteen observations, found staphylocoeci ten times. Foote examined ninety-two normal eyes and found the staphylocoecus albus twenty-two times, the citreus five times, the aureus once, the bacillus subtilis once, and unknown bacilli eight times; he had thirty-nine negative results. Lachowiez in sixty-three examinations found the staphylocoecus albus four times and the streptococcus once. Still later valuable papers have been published by Eyre, Hildebrand, Bernheim, Mathen, McFarland and Kneass, Griffith, Randolph, Rosenbach and Tschirkowski.

Eyre's work consisted of: (1) The determination of the average conjunctival sacs which were sterile; (2) The presence or absence of the common pathogenic organisms, and (3) The testing of their pathogenicity in the rabbit's cornea. His method was to stroke
gently the surface of the conjunctiva, especially the lower fornix, with a sterile platinum loop and with the fluid thus obtained to inoculate a tube of nutrient bouillon. In another series he adopted the swab of cotton wool, and with it inoculated a tube of serum, and then put the swab in a tube of bouillon. He says: "The exact position from which the conjunctival fluid is taken is of importance. When one everts the lid by gentle traction with the forefinger of one hand a small quantity of fluid may be noticed in the lower fornix immediately below the caruncle." Into this he dipped his loop or swab, reasoning that the tears after washing over the whole surface of the conjunctiva, in the performance of their duty of flushing out the conjunctival sac, collected here with their cargo of bacteria and débris before passing through the puncta on their way to the lachrymal sac, therefore fluid from this site would contain a larger proportion of organisms than that taken from any other part of the conjunctival sac.

Eyre examined one hundred and fifty conjunctivæ and found seventy-five sterile. His conclusions were as follows: (1) The conjunctival sac frequently contains microorganisms, extremely varied in character, which may or may not be pathogenic. (2) The conjunctival sac of any individual may be sterile at the particular moment an observation is made. (3) The sterility of the conjunctival sac is due to the mechanical flushing of its mucous surface by the lachrymal secretions, aided, perhaps, by the bactericidal action of the fluid.

Griffith in 1901 published his work on The Flora of the Conjunctiva in Health and Disease. He examined two hundred and ten cases in which the conjunctivæ were apparently healthy. Great care was exercised in the selection of the cases, any with abnormal redness or other apparent sign of disease were excluded. His method was to stroke the everted eyelid with a platinum wire and inoculate a tube of serum. In some cases the sterile cotton wool swab was used. Solidified horse-serum was used throughout, as Griffith had noted from previous investigations that the bacillus xerosis was cultivated with considerable difficulty on any of the ordinary media. The principal findings were as follows:

Xerosis bacillus.......................... 120 times
Staphylococcus epidermidis albus (Welch)..... 47 times
Staphylococcus pyogenes aureus................ 8 times
Staphylococcus pyogenes albus................. 14 times
Streptococcus pyogenes brevis................ 12 times
Streptococcus pyogenes longus................ 8 times
Pneumococcus ........................................... 2 times
Sarcina lutea ........................................... 3 times
Bacillus mucosus capsulatus ....................... 1 time
Bacillus subtilis ....................................... 1 time
Bacillus coli communis ................................. 1 time

These results show that pathogenic microorganisms do not occur very frequently in the normal conjunctiva and experimentation with them on animals demonstrated that they had to some extent lost their virulence.

The writer, during 1902-3, examined at the Royal Victoria Hospital a series of normal conjunctivae. The method was as follows: Having gently drawn the lower lid, the palpebral conjunctiva was stroked with a sterilized platinum loop until some lachrymal fluid was obtained. Tubes of agar, bouillon, and blood serum were then inoculated and placed in the incubator for twenty-four hours or more. The cases examined were patients coming to other departments of the hospital, orderlies in the hospital and medical students. All cases of hyperemia of the conjunctiva were rigidly excluded. Of one hundred and forty cases examined forty gave negative results. The organisms isolated in the one hundred positive cases were as follows:

Staphylococcus pyogenes albus ....................... 48 times
Staphylococcus epidermidis albus ................... 9 times
Staphylococcus pyogenes aureus ..................... 2 times
Streptococcus pyogenes ............................... 16 times
Bacillus xerosis .......................................... 42 times
Bacillus of diphtheria group ......................... 1 time
Sarcina lutea ............................................. 1 time

As the above table shows, the staphylococcus, streptococcus and bacillus xerosis were frequently found. Most of the negative cases were among the first fifty inoculated and were from cases where the irritation of the lid did not give rise to the usual flow of tears. Where I obtained a good loopful of lachrymal fluid I invariably obtained a growth. Throughout the experiment I used the platinum loop, believing it to be cleaner and more accurate than the swab. The percentage of positive tubes was large and I attribute this to the media used. The agar and bouillon was made after the method described in Abbott’s System, that is, using beef instead of beef extract. This agar was found an excellent medium. The xerosis bacillus has been found by others to grow best on blood serum.
Randolph examined the conjunctiva in one hundred patients who had typhoid fever. He found:

- Micrococcus albus .................................. 59 times
- Micrococcus albus with other bacteria .......... 23 times
- Micrococcus aureus .................................. 13 times
- Micrococcus aureus with other bacteria .......... 13 times
- Streptococcus pyogenes .............................. 3 times
- Diplobacillus ........................................ 1 time
- Bacillus xerosis ...................................... 3 times
- Bacillus pyogenes ................................... 1 time
- Bacillus subtilis ..................................... 4 times
- No bacteria ............................................ 2 times

In forty-eight cases of lobular pneumonia his results were:

- Micrococcus albus .................................. 24 times
- Micrococcus albus with other bacteria .......... 14 times
- Pneumococcus ......................................... 1 time
- Pneumococcus with micrococcus albus .......... 1 time
- Bacillus subtilis ..................................... 3 times
- Bacillus subtilis with micrococcus albus .......... 1 time
- Micrococcus aureus .................................. 10 times
- Micrococcus aureus and albus ....................... 9 times
- Diplobacillus ........................................ 1 time
- Bacillus xerosis ...................................... 1 time
- No bacteria ............................................ 3 times

The striking feature in these two series is the almost entire absence of the xerosis bacillus.

Heimersdorff working in Axenfeld's laboratory found the following:

- Bacillus xerosis ...................................... in 83 per cent. of the cases
- Staphylococcus albus ................................ in 65 per cent. of the cases
- Staphylococcus aureus ................................ in 11 per cent. of the cases
- Pneumococcus .......................................... in 5 per cent. of the cases
- Streptococcus .......................................... in 3 per cent. in the cases
- Sarcinae ................................................ in 1 per cent. of the cases
- Other single organisms ............................... in 5 per cent. of the cases

The following statements by Axenfeld express in a satisfactory way some important points about the bacteriology of the normal conjunctiva: (1) The method of examination which is used is of great importance in determining the bacteria present. (2) Variations in the media, and the technique employed, are to a great degree respon-
BACTERIOLOGY OF THE EYE

sible for the tremendous variations in the results of former years. (3) The flora of this area, being subject to many contaminating influences, can, as a matter of fact, vary in quantity and quality according to the surroundings, to external conditions and to personal habits. (4) We can now take it as definitely proved that the normal conjunctival sac contains regularly or almost regularly (i) the so-called bacillus xerosis, and (ii) the non-virulent, or slightly virulent, staphylococcus.

Within certain limits the results of the numerous early examinations made vary considerably. Franke, for instance, found the bacillus xerosis only once, Bach never found it, while Axenfeld found it constantly. Gasparini claimed to have found the pneumococcus in eighty per cent. of the cases he examined, while scores of others have never isolated the pneumococcus from the normal conjunctival sac. The cause of the variation must surely lie in differences in technique and media.

All the results have been similar, however, in this respect, viz., that large numbers of organisms have been isolated. The results show that in the normal conjunctival sac there are both harmful and harmless bacteria, that the different forms of staphylococci and the bacillus xerosis are frequently present, and further we must consider the possibility of the streptococcus, pneumococcus, Morax-Axenfeld and other pathogenic organisms being present.

The last few years have not added much to our knowledge of this subject. From time to time the presence of pathogenic bacteria in the normal conjunctival sac has been reported. During routine work I have found a bacteria of the diphtheria group, a meningococcus, and on numerous occasions the pneumococcus and diplobacillus of Morax-Axenfeld. The flora of the normal conjunctiva may differ in different sections. Compare the finding of streptococcus pyogenes in 16 per cent. of the cases in Montreal with the finding of the pneumococcus in 38 per cent. of the normal conjunctivae in Freiburg.

Gasparini in 1895 reported having found virulent pneumococci in 80 per cent. of normal conjunctivæ examined. These figures have never been corroborated. The experience of later writers has been that the pneumococcus is present in about 1 to 10 per cent. of the normal cases. Ertzen had 4 per cent., Rymoviez 9 per cent. and Heinersdorff 5 per cent.

Elshnig and Ulbrich in their systematic examination, using Elshnig's medium, found in 231 cataract patients the pneumococcus present relatively in 30 to 40 per cent. Imrie in 1910, using Eschnig's
methods, found the pneumococcus present in about 38 to 40 per cent. So that the results of Elschnig, Ulbrich and Imrie, which have lately been confirmed by Metafane and Albanese, teach us that in normal conjunctivæ about 30 to 40 per cent. of the cases have pneumococci.

Rosenbaum examined the conjunctivæ of 200 new-born infants and found that immediately after birth the conjunctival sac is absolutely clean, that microorganisms are first found twenty-four hours after birth and that then the bacterial flora is constant and not to be differentiated from that of the adult.

I agree entirely with Axenfeld that regularly, or nearly so, careful examination will reveal the presence in the normal conjunctiva of (1) the bacillus xerosis, and (2) the staphylococcus albus. These microorganisms have been the cause of many fallacies. It is abso-

A Smear made from a Twenty-four Hour Culture of the Bacillus Xerosis; which shows many Involved Forms.

olutely essential to any one undertaking ophthalmic bacteriology to become intimate with the characteristics of these two organisms and to understand that they are constant inhabitants of the normal conjunctiva.

The bacillus xerosis is a straight, or slightly curved, organism about 1.75 microns long by 5 microns broad, which in morphology is similar to the Klebs-Loéfler bacillus. In film preparations from the conjunctiva, short thick forms are frequently met with; on the other hand, the curve of the longer forms is a very characteristic point of its morphology. It is positive to Gram’s stain and stains well with the aniline dyes.

The bacillus xerosis grows well on blood serum at incubator temperature and after twenty-four hours the growth is seen as white, round colonies. The growth on blood serum may be very slow and in this way it differs materially from the bacillus of diphtheria. On agar the growth is slow and may not appear until after forty-eight
hours, or even some days later. The growth on bouillon remains clear, without formation of acid. It does not liquefy gelatin.

The bacillus xerosis has no pathogenicity for the conjunctiva of the guinea-pig.

The Klebs-Loeffler bacillus is a straight or slightly curved rod, one to six microns long, by .3 to .8 microns broad, appearing frequently in pairs and in chains. The bacilli are not uniformly cylindrical and vary in size and shape. It stains well with Gram's stain, and in a characteristic way with Loeffler's alkaline methylene blue, and Neisser's stain. The latter stain demonstrates the characteristic granules seen best at the poles. If yellowish-brown bodies, arranged characteristically at the ends of long slender bacilli from fresh cultures are found a positive diagnosis of diphtheria may be given.

The most suitable medium is blood serum. After eight to twelve hours one finds greyish-white, raised points which finally fuse into one mass. Upon agar the growth is less certain and not so profuse as on blood serum. In bouillon the growth remains clear; gelatin is not liquefied.

The bacillus of diphtheria is very pathogenic for the human conjunctiva and for the laboratory animals.

Pseudo-diphtheria bacilli. A microorganism of this variety is found on the conjunctiva, the Hoffman bacillus. It is short, plump, and more uniform than the bacillus of diphtheria; is smaller than either of the other two; has little tendency to club-shaped formation; does not show Neisser's bodies, and tends to lie in groups of three, four, or five, parallel to each other. It stains readily with the aniline dyes and is positive to Gram's method.

On blood serum the growth is similar to the bacillus of diphtheria. While tabulated forms are often seen, clearly differentiating between the microorganisms of the diphtheria and pseudo-diphtheria group, it is to be remembered variable strains of all these forms may present themselves. The development of acidity, and the agglutination tests are not absolute points of difference. In morphology the bacillus xerosis and bacillus of diphtheria are quite easily differentiated from the bacillus of Hoffman, which is smaller, does not show the dumb-bell shape, or Neisser's bodies. The bacillus xerosis is thicker than the bacillus of diphtheria and does not show Neisser's bodies.

If we suspect that we have a culture of the bacillus diphtheriae, two cem. of the culture should be injected subcutaneously into a guinea-pig. In forty-eight hours the inoculation with this bacillus will kill the pig with local necrosis, while an inoculation with the bacillus xerosis will have no effect. Such a test, while sure, neces-
sitates a loss of valuable time, so that it is necessary for one doing ophthalmic bacteriology to learn what most men doing bacteriological work do, that is, to recognize by morphology the bacillus diptheriae. Most bacteriologists will agree that where we have Neisser’s polar staining, we have to deal with toxic diphtheria bacilli.

The staphylococcus albus. One meets with a variety of white staphylo cocci in the normal conjunctiva. The commonest is the staphylococcus non-liquefaciens, or micrococcus albus. This micro-organism does not liquefy gelatin and is a non-pyogenic coccus. Regarding the use of the term “pyogenes” Axenfeld very aptly says,

"It is undeniable that the term ‘pyogenes’ is far too freely used in the literature.” In the majority of cases the staphylococci found are between the ordinary staphylococcus pyogenes and the staphylococcus epidermidis of Welch. The innumerable white staphylococci of the conjunctiva, such as staphylococcus albus non liquefaciens, staphylococcus epidermidis, micrococcus albus non liquefaciens, staphylococcus brevis, micrococcus candidans, may be considered, for routine purposes, identical with the staphylococcus albus. Many of these forms in the prepared film are seen as Gram-positive diplococci and have been called by Axenfeld, Gram-positive pseudo-gonococci. This again shows one the necessity for doing the Gram stain, which readily differentiates between the Gram-positive pseudo and the Gram-negative gonocci. Of the staphylococci of the conjunctiva the non-pyogenic forms are by far the most common, and of low virulence.

Staphylococcus pyogenes albus. This is one of the common bacteria found in the normal conjunctiva, as well as upon other mucous membranes. In the film it is seen as small round cells, .7 to .9
microus in diameter. They occur singly, especially from the conjunctiva, and very frequently in pairs, or may be grouped in other ways. The staphylocoecus pyogenes albus stains readily, and is positive to Gram's method. It is an aerobic, facultative, micrococcus which grows at room or incubator temperature and readily upon the ordinary media.

In bouillon the growth is profuse causing the medium to become turbid, later a sediment forms. Upon agar agar and potato the growth has a milk-white colour. Upon blood serum the growth is profuse. Upon gelatin the surface is deepened immediately about the growth, due to liquefaction. Milk is coagulated in one to eight days.

The staphylococcus epidermidis of Welch. This is almost identical with the above in appearance, and differs only in liquefying gelatine more slowly and not causing coagulation so quickly in milk. It is also much less virulent.

The staphylococcus pyogenes aureus. Identical in morphology with the albus and in biological characters is not to be distinguished from it, except in the production of pigment. Upon agar the growth is at first white, this changes to a rich, golden-yellow. The pigmentation is produced only with the presence of oxygen.

The staphylococcus pyogenes citreus likewise differs only in the production of a pigment of a lemon-yellow colour.

The pneumococcus. Gasparini in 1895 reported having found virulent pneumococci in 80 per cent. of normal conjunctivae. These figures have never been verified. The experience of later years has been that the pneumococcus is present in about 1 to 10 per cent. of normal cases. Latterly in Friburg it has been found by Imrie that the pneumococcus is present in no less than 38 per cent of normal eyes.

Elschnig’s method of detecting the pneumococci is as follows: The medium is composed of one part of horse serum to three parts of bouillon, without peptone. With a sterile pipette a few drops of the medium are drawn up and flooded into the conjunctival sac, the edge of the lower lid being held slightly away from the eyeball. While alternate pressure and relaxation are made over the sac region, the end of the pipette is rubbed lightly over the conjunctiva of the tarsus and plica. The fluid is sucked back into the pipette and then mixed with the remainder of the medium in the test tube. This process may be repeated a second time. It is necessary to flush out the conjunctival sac with salt solution afterwards since otherwise the pneumococcus might readily grow in the trace of medium left therein. The tube is inoculated for 24 hours and examined for organisms by
Gram-stained smear and hanging drop methods. By means of the hanging drop chain formation of the pneumococcus is easily detected. The usual rubbing on a glass slide tends to destroy chain formation.

The pneumococcus occurs as oval cocci, usually in pairs surrounded by a capsule. The pairs are commonly pointed at one end, hence the term 'diplococcus lanceolatus.' Variation in form and arrangement of the cocci is common, especially in pneumococci from different sources.

It is not decolorized by Gram’s method, and stains readily with the ordinary aniline stains. The pneumococcus grows well on the ordinary media, made at neutral, or slightly alkaline, reaction, at 25 to 42° C., best at 37° C. The pneumococcus is closely related to the streptococcus and is classed as such by some.

*Pneumococcus from a Twenty-four Hour Culture in Blood Serum.*

*The streptococcus pyogenes.* This is found in the normal conjunctiva in 1 to 10 per cent of cases. This microorganism is a coccus which divides in one direction only, forming pairs and chains with eight to twenty or more cocci. Some varieties have capsules, and the term "streptococcus" includes a considerable number of distinct groups. They are cocci which stain well by aniline dyes, and are positive to Gram. They grow readily on ordinary media, best at a temperature of 37° C.

The comparison between streptococcus and pneumococcus would take us too far afield for a work of this kind, suffice it here to mention that they are in many respects similar and by some investigators are classed as one group.

There will also be found on the normal conjunctiva sarcinae, a large number of non-pathogenic organisms, both cocci and bacilli, streptothrix, moulds, and hefa colonies (Axenfeld).

The routine examination of a large number of normal conjunctiva will readily convince the most skeptical of the great necessity for aseptic methods in ophthalmic surgery. While, undoubtedly, many
of the organisms here are non-pathogenic and of low virulence, we have, nevertheless, pus-producing organisms which, while benign in the conjunctiva, are undoubtedly able to destroy an eye if allowed entrance.

The solutions used in trying to make the conjunctival sac aseptic are manifold. For many years I have used nothing but a sterile solution of boracic acid with which to flush out the conjunctival sac. Upon examining a series of twenty-five cases I found the conjunctival sac by flushing could be made practically sterile. Cases were taken where there was no conjunctivitis or dacryocystitis, or any other contraindication to operation, and cultures made in the usual way on blood serum and agar. The conjunctival sacs were now thoroughly flushed out with sterile boracic acid solution for a period of five minutes by the watch. Twenty minutes later tubes of serum and agar were inoculated in a similar way, that is, by passing the wire along the conjunctival surface of the upper and lower lids. The cultures taken previously to washing gave very profuse growths of staphylococcus albus and bacillus xerosis. The cultures taken after flushing were in many cases sterile and in no case was there more than three colonies of organisms over the whole surface of the medium. So that while the conjunctival sac ordinarily contains microorganisms which may endanger intraocular operative procedures, my own experience has been that the conjunctiva is a sac which can be made surgically clean.

In spite of the presence of organisms in the normal conjunctiva it is remarkable how rarely infection takes place here. This is no doubt due to many factors. According to Mayou, the lacrimal secretion having little or no bactericidal action keeps the eye cleansed mechanically. The epithelium presents an important barrier to infection. It has been proved that such organisms as the tubercle bacillus, staphylococci, pneumococci, cannot attack the conjunctiva without a break in the epithelium. Such gaps may be the result of mucoid changes in the cells, a fact which probably helps to account for the comparative frequency of purulent conjunctivitis in the newborn and recurrent attacks in patients the subjects of other forms of chronic conjunctivitis. The poor basement membrane of the conjunctiva, compared with that of the cornea, no doubt is a factor in determining why the conjunctiva is much more frequently infected than the cornea. The latter may be bathed in pus without infection taking place. The laxity of the tissue, together with a large blood supply, allows the conjunctiva to be filled with tissue fluids containing protective bodies. The phagocytosis of the cells forming
the lymphoid layer on the conjunctiva offers an additional barrier
to infection.

The conjunctiva is therefore a membrane highly resistant to infec-
tive processes so that virulent organisms are able to remain on its
surface without infection taking place.

The bacteriology of conjunctivitis in general. Bacteriological sta-
tistics. Bacteriology had no sooner made its appearance in medical
science then ophthalmologists looked in this direction for knowledge
to help clear up misunderstood conditions of the diseased conjunctiva.

In 1883, Koch, while working on the cholera epidemic in Alexandria,
examined the conjunctival discharge in some cases of Egyptian oph-
thalmia. He found there two micro-organisms, a diplococcus very
similar to the gonococcus, and a very fine bacillus which resembled the
bacillus of mouse septicæmia. Two years later Weeks, of New York,
had an opportunity of seeing numerous cases of acute conjunctivitis
in the conjunctival discharge of which he constantly found this short,
fine bacillus which Koch had seen in Egypt. Weeks proved this bacil-
lus to be the etiologic factor in this form of conjunctivitis.

In 1886, Morax and Axenfeld separately described a diplobacillus
which they believed was the cause of a chronic form of blepharo-con-
junctionitis. This opinion was shortly afterward concurred in by
Peters and Gifford.

In 1894 appeared the work of Parinaud and Morax on pneumococ-
cus conjunctivitis, followed two years later by reports from Axen-
feld, Gasparini and Gifford.

From this beginning, some thirty years ago, the study of the bac-
teriology of the conjunctiva, both in health and disease, has gone
steadily on, until today in many of the larger clinics a thorough bac-
teriological examination of the conjunctival secretions forms part
of the routine work.

At the Montreal General Hospital we have been following this
work in bacteriology for some years. All cases of conjunctivitis,
hyperemia of the conjunctiva, and cases for operation, are examined
by means of smears and the inoculation of media.

Conjunctivitis in its different forms constitutes one of the com-
monest diseases met with in ophthalmic practice. Its frequency varies
according to race, climate and environment, but when one considers
how exposed the conjunctiva—a mucous membrane—is, to external
influences, and how subject to involvement in nasal and post-nasal
inflammations, an average of 30 per cent. of all ophthalmic cases does
not seem high. In diseases of the eye, as in affections of other parts
of the body, we look to etiology before prescribing or giving a prog-
nosis. The widening of bacteriological methods in ophthalmology during the past few years has been extensive and has enabled us to demonstrate the definite etiologic factor in most of these cases.

While we have not progressed far enough to discard the old classification of conjunctivitis from the clinical appearance into catarrhal, purulent and membranous, with their numerous subdivisions, we can nevertheless, with considerable satisfaction, divide all cases into two groups:

1. Conjunctivitis with no known bacteriological cause.
2. Conjunctivitis in which there is a definite bacteriological cause.

The first group includes such cases as exposure to winds, irritant gases, dust, eye-strain, rhinitis, inflammation of the lachrymal sac, smoke, gouty diathesis, trichiasis, alcholism.

The second group includes those forms due to specific microorganisms such as the Morax-Axenfeld diplobacillus, the Koch-Weeks bacillus, the bacillus of diphtheria, the gonocoecus, pneumoecoccus, streptocoecus pyogenes, staphyloecoccus, microecoccus catarrhalis, bacillus coli communis, the bacillus influenzae and bacillus mucosus capsulatus groups and the meningococcus.

The method of finding these microorganisms is simple and quite within the reach of all. It consists in making a smear from the conjunctival discharge, staining and examining it. Further examination of the conjunctival discharge is made by the inoculation of suitable culture media. In making a smear preparation considerable care is needed in obtaining a small particle of conjunctival secretion. Often the patients constantly wipe their eyes, so that it is almost impossible to obtain enough secretion for examination. Again, many cases of catarrhal conjunctivitis do not at certain times show any discharge. In either case, with a small platinum loop one may "pick out" from the inner canthus a loopful of conjunctival secretion. When this is smeared well over a glass slide and properly stained and examined, pathogenic microorganisms will be found, if present.

A knowledge of the pathogenic microorganisms can be obtained only by seeing a large number of cases of conjunctivitis. While much satisfactory work can be done by a study of smear preparations, the real differentiation of the organisms must come from a study of their cultural characteristics—the especial difficulty of conjunctival bacteriology. The bacteria pathogenic for the conjunctival sac require special media in nearly every case. Even on special media the growths are usually sparse and likely to be overgrown by more easily cultivated organisms.
BACTERIOLOGY OF THE EYE

But what are the commonest pathogenic microorganisms met with in the different forms of conjunctivitis? In the Freiburg clinic, during 1902 to 1905 inclusive, 900 cases of acute and chronic conjunctivitis were examined, with the following results:

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morax-Axenfeld diplobacillus</td>
<td>519</td>
</tr>
<tr>
<td>Koch-Weeks bacillus</td>
<td>41</td>
</tr>
<tr>
<td>Pneumococcus</td>
<td>34</td>
</tr>
<tr>
<td>Gonococcus</td>
<td>12</td>
</tr>
<tr>
<td>Loeffler’s bacillus</td>
<td>6</td>
</tr>
<tr>
<td>Streptococcus</td>
<td>5</td>
</tr>
<tr>
<td>Friedlander’s bacillus</td>
<td>2</td>
</tr>
<tr>
<td>Pfeiffer’s bacillus</td>
<td>3</td>
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<tr>
<td>Morax-Axenfeld diplobacillus</td>
<td>185</td>
</tr>
<tr>
<td>Koch-Weeks bacillus</td>
<td>10</td>
</tr>
<tr>
<td>Pneumococcus</td>
<td>10</td>
</tr>
<tr>
<td>Streptococcus</td>
<td>5</td>
</tr>
<tr>
<td>Staphylococcus</td>
<td>83</td>
</tr>
</tbody>
</table>

Gonin, in the clinic at Lausanne examined 310 cases of catarrhal conjunctivitis with the following results:

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morax-Axenfeld diplobacillus</td>
<td>258</td>
</tr>
<tr>
<td>Koch-Weeks bacillus</td>
<td>121</td>
</tr>
<tr>
<td>Pneumococcus</td>
<td>18</td>
</tr>
<tr>
<td>Gonococcus</td>
<td>6</td>
</tr>
<tr>
<td>Loeffler’s bacillus</td>
<td>2</td>
</tr>
<tr>
<td>Staphylococci</td>
<td>6</td>
</tr>
<tr>
<td>Unknown</td>
<td>10</td>
</tr>
</tbody>
</table>

Pollock, of Glasgow, examined 361 cases of conjunctivitis with the following results:

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koch-Weeks bacillus</td>
<td>189</td>
</tr>
<tr>
<td>Morax-Axenfeld diplobacillus</td>
<td>62</td>
</tr>
<tr>
<td>Pneumococcus</td>
<td>9</td>
</tr>
<tr>
<td>Pneumococcus and diplobacilli</td>
<td>3</td>
</tr>
<tr>
<td>Gonococcus</td>
<td>17</td>
</tr>
<tr>
<td>Gonococcus and other organisms</td>
<td>3</td>
</tr>
<tr>
<td>Staphylococci and streptococci</td>
<td>15</td>
</tr>
<tr>
<td>Koch-Weeks bacillus and bacillus subtilis</td>
<td>1 case</td>
</tr>
<tr>
<td>Negative</td>
<td>62</td>
</tr>
</tbody>
</table>

Morax, of Paris, reports as follows:

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koch-Weeks bacillus</td>
<td>175</td>
</tr>
<tr>
<td>Morax-Axenfeld diplobacillus</td>
<td>258</td>
</tr>
<tr>
<td>Gonococcus</td>
<td>121</td>
</tr>
<tr>
<td>Pneumococcus</td>
<td>18</td>
</tr>
<tr>
<td>Influenza bacillus</td>
<td>6</td>
</tr>
<tr>
<td>Loeffler’s bacillus</td>
<td>2</td>
</tr>
<tr>
<td>Staphylococci</td>
<td>6</td>
</tr>
<tr>
<td>Unknown</td>
<td>10</td>
</tr>
</tbody>
</table>
Lundsgaard, of Copenhagen, examined 107 cases with the following results:

- **Morax-Axenfeld diplobacillus**: 36 cases
- **Pneumococcus**: 15 cases
- **Gonococcus**: 5 cases
- **Koch-Weeks bacillus**: 3 cases
- **Staphylococcus**: 5 cases
- **Diphtheria bacillus**: 1 case
- **Bacillus coli**: 1 case

Bach and Neumann report on 110 cases as follows:

- **Morax-Axenfeld diplobacillus**: 35 cases
- **Pneumococcus**: 15 cases
- **Staphylococcus**: 53 cases

Veasey in 64 cases of acute catarrhal conjunctivitis found:

- **Pneumococcus**: 53 cases
- **Koch-Weeks bacillus**: 3 cases

Kuffler reports in 727 cases of conjunctivitis and diseases of the lachrymal sac, as follows:

- **Morax-Axenfeld diplobacillus**: 306 cases
- **Diplobacillus and pneumococcus**: 26 cases
- **Pneumococcus**: 55 cases
- **Bacillus xerosis**: 41 cases
- **Staphylococcus**: 13 cases
- **Gonococcus**: 7 cases
- **Klebs-Löffler bacillus**: 5 cases
- **Pneumo-bacillus**: 1 case
- **Negative**: 274 cases

In Chemnitz, Verhagen found:

- **Morax-Axenfeld** in 50 per cent. of the cases
- **Pneumococcus** in 20 per cent. of the cases
- **Koch-Weeks bacillus and bacillus influenza** not found

Von Mende, in 234 cases examined at Riga, found:

- **Koch-Weeks bacillus**: 57 cases
- **Morax-Axenfeld diplobacillus**: 37 cases
- **Gonococcus**: 19 cases
- **Pneumococcus**: 17 cases
- **Streptococcus**: 2 cases
- **No particular findings**: 26 cases
- **Negative**: 76 cases
Scholtz and Vermes report:
- Morax-Axenfeld diplobacillus: 227 cases
- Koch-Weeks bacillus: 76 cases
- Pneumococcus: 23 cases
- Streptococcus: 6 cases
- Gonococcus: 9 cases
- Friedlander’s bacillus: 1 case
- Staphylococcus and bacillus xerosis: 68 cases
- Bacillus xerosis: 45 cases
- Negative: 45 cases

Edwards, in Manila, found in 21 cases of conjunctivitis:
- Koch-Weeks bacillus: 9 times
- Staphylococcus aureus and albus: 4 times

T. Harrison Butler, while in Palestine, found in simple ophthalmia during the endemic period:
- Morax-Axenfeld diplobacillus: in 18.3 per cent. of cases
- Koch-Weeks bacillus: in 18.3 per cent. of cases
- Pneumococcus: in 18.3 per cent. of cases
- Mixed: in 16.7 per cent. of cases
- Gonococcus: in 8.4 per cent. of cases
- Sterile: in 20 per cent. of cases

During the epidemic period:
- Koch-Weeks bacillus: 66 per cent. of cases
- Pneumococcus: 22 per cent. of cases
- Mixed: 6 per cent. of cases
- Morax-Axenfeld diplobacillus: 4 per cent. of cases
- Gonococcus: 0 per cent. of cases
- Sterile: 2 per cent. of cases

In Egypt in 304 cases of acute purulent conjunctivitis Meyerhof found the following:
- Koch-Weeks bacilli: 157 times
- Gonococcus: 80 times
- Diplobacillus Morax-Axenfeld: 37 times
- Pneumococci: 10 times
- Streptococci: 4 times
- Müller’s bacillus: 2 times
- Pneumobacillus: 1 time
- Negative: 7 times
In New York in a series of 132 examinations by Duane and Hastings the principal findings were

- Koch-Weeks bacillus ........................................ 45 times
- Pneumococcus ............................................. 22 times
- Diplobacilli .................................................. 5 times
- Staphylococcus albus ....................................... 23 times

In St. Louis Luedde found among 226 cases of conjunctivitis

- Koch-Weeks bacillus ........................................ 74 times
- Diplobacilli .................................................. 126 times

During the last few years at the Montreal General Hospital, the following organisms have been found:

- Diplobacillus of Morax-Axenfeld ................................ 1015 times
- Pneumococcus .................................................. 177 times
- Gonococcus ..................................................... 35 times
- Koch-Weeks bacillus ......................................... 10 times
- Bacillus McKee ............................................... 52 times
- Bacillus influenza ............................................ 31 times
- Streptococcus pyogenes ...................................... 52 times
- Micrococcus catarrhalis .................................... 52 times
- Bacillus xerosis and Gram-positive cocci .................... 537 times
- Staphylococci of different kinds ................................ 372 times
- Bacillus coli communis ....................................... 5 times
- Bacillus subtilis .............................................. 5 times
- Bacillus pyocyaneus ......................................... 1 time
- Bacillus mucosus capsulatus ................................ 1 time
- Proteus .......................................................... 1 time
- Diplobacillus and pneumococcus ................................ 3 times
- Diplobacillus and bacillus influenza .......................... 3 times
- Pneumococcus and bacillus influenza ........................ 1 time
- Negative films .................................................. 413 times

In cases of ophthalmia neonatorum the following results were obtained:

- Gonococcus ..................................................... 39 times
- Streptococcus pyogenes ....................................... 6 times
- Pneumococcus .................................................. 7 times
- Staphylococcus ................................................ 5 times
- Micrococcus catarrhalis ..................................... 2 times
- Diplobacillus Morax-Axenfeld ................................ 2 times
- Bacillus coli communis ....................................... 1 time
- Trachoma bodies .............................................. 6 times
- Negative ........................................................ 1 time
In cases of purulent dacryocystitis:
- Pneumococcus .................................................. 21 times
- Streptococcus pyogenes ...................................... 4 times
- Diplobacillus Morax-Axenfeld ............................. 5 times
- Bacillus influenzae ........................................... 2 times
- Bacillus xerosis ............................................... 2 times

In cases of phlyctenular conjunctivitis:
- Diplobacillus Morax-Axenfeld ............................. 27 times
- Staphylococcus .................................................. 14 times
- Bacillus xerosis ............................................... 2 times
- Negative ........................................................... 22 times

In cases of conjunctivitis occurring in cases of epidemic meningitis the following organisms were found:
- Meningococcus .................................................... 3 times
- Staphylococcus aureus ........................................ 1 time
- Bacillus influenzae ............................................ 2 times
- Diplobacillus Morax-Axenfeld ................................ 1 time

The so-called trachoma bodies were found in 19 cases of trachoma and in 6 cases ophthalmia neonatorum.

*Bacteriology of Morax-Axenfeld or diplo-bacillary conjunctivitis.*—Perhaps the commonest and most widely spread disease of the conjunctiva is what is known as diplo-bacillary, or Morax-Axenfeld conjunctivitis. Described first in 1896 by Morax, in Paris, and Axenfeld in Marbourg, it has since been reported from almost every clime. From the various parts of Europe, Asia, Africa and America, its presence has been made known. In Japan it constitutes 10 per cent of the cases of conjunctivitis (Hottas), while in St. Louis, Luedde reports that 22 per cent of the acute and 30 per cent of the chronic conjunctivitis cases are of this type.

Axenfeld says phlyctenules are often seen especially in strumous children. I have had twenty-seven cases where diplobacilli were found in the conjunctival sac and where the phlyctenular condition cleared up quickly when the diplo-bacillary conjunctivitis received proper treatment.

E. W., an adult male, was referred to me complaining that for four days his left eye had been sore and very painful. The eye showed marked congestion of the palpebral conjunctiva, at the outer corneo-sclerotic margin was seen a small greyish elevation surrounded by an area of conjunctival hyperæmia—a typical phlyctenule. A little
conjunctival secretion was taken from the inner canthus, smeared well over a glass slide, and stained. To my surprise the field was covered with diplo-bacilli. Further examination showed a like infection of the right eye and on questioning the patient it was found that he had suffered at intervals from sore eyes. The left eye was well flushed out with some weak solution of the sulphate of zinc and drops of the same solution were prescribed for the patient to use freely four or five times a day.

Many cases show enlarged follicles, especially of the lower tarsal conjunctiva. In many cases the presence of the follicle in a thickened velvety conjunctiva makes a clinical picture very like trachoma. Treatment, however, with the proper remedies for twenty-four or forty-eight hours, will give one an entirely different picture, showing catarrhal conjunctivitis without the supposed trachoma.

In many cases of ectropion of the lids, trichiasis and distichiasis, diplo-bacilli will be found in the conjunctival sac. In many cases of blepharitis and eczema of the lids, the bacteriological examination will give one entirely negative results. In these cases a thorough examination of the patient’s refraction I believe to be of more importance and will give more satisfactory results than the bacteriological examination. I have seen case after case of blepharitis where thorough bacteriological examination gave negative results, persistent cases, now slightly improved, now worse, when the error or refraction was corrected, then only were satisfactory results obtained.

Diplo-bacillary infection is frequently found associated with old cases of trachoma. In our series there were twenty-eight such cases. According to Gonin and Axenfeld diplo-bacillary conjunctivitis appears oftest during warm and dusty weather. In Montreal we have had a considerable percentage during the cold and winter months. Of two hundred and fifty consecutive cases seen at the Montreal General Hospital, 17 per cent were in January, while in the months of November, December, January, February, March and April 48 per cent of the series presented themselves.

Morax-Axenfeld conjunctivitis is no respecter of age or nationality. Our clinic is a fairly cosmopolitan one for a Canadian city and gives the following percentages:

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 10 years of age</td>
<td>9 per cent</td>
</tr>
<tr>
<td>10 to 20 years</td>
<td>25 per cent</td>
</tr>
<tr>
<td>Over 20 years</td>
<td>66 per cent</td>
</tr>
</tbody>
</table>

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Of more interest perhaps are the figures showing the nationality of these cases:

- Hebrews .................................................. 54 per cent
- Canadians ................................................ 38 per cent
- Italians ................................................... 5 per cent
- Greeks ..................................................... 3 per cent

These figures show it is not confined to our foreign colonies and I have no doubt this common form of conjunctivitis is quite as prevalent in other Canadian cities.

According to observations by Bardelli, Axenfeld, and Rymovitch, an iritis from absorption of toxins can be associated with a pneumococcal conjunctivitis, and that without any affection of the cornea. The following case leads me to believe that we may have Morax-Axenfeld conjunctivitis complicated in a similar way:

Z. H., male, aged sixty years, came under observation after treatment for some time for an iritis of the left eye. He had received both anti-rheumatic and anti-syphilitic medication. Progress was unsatisfactory and the patient complained bitterly of pain which radiated over his forehead and greatly disturbed his rest. There was marked photophobia and lacrimation. The lids were swollen and there was an active conjunctivitis with muco-purulent discharge. The pupil, under atropine, was moderately dilated, the iris was congested and altered in colour. Pericorneal injection was very marked.

A slide prepared from the conjunctival discharge showed a mass of Gram-negative diplo-bacilli. The growth upon blood serum was typical of the Morax-Axenfeld diplo-bacillus. Cultivation upon plain agar proved negative.

There was no history of syphilis, a very indefinite one of rheumatism or other likely cause of the iritis, except recurrent inflammations when the lids would be adherent in the morning.

I believed that the iritis was secondary to the conjunctivitis so medication was stopped and the conjunctivitis treated energetically. The conjunctival sac was irrigated three times for ten minutes with some one-quarter per cent solution of the sulphate of zinc. He was given a similar solution to instill four or five drops every two hours and told to continue with the atropine in one per cent solution three times daily. When he returned two days later the improvement was marked and his facial expression was very different. The pain was much less, the conjunctivitis was greatly improved, the pericorneal injection and the appearance of the iris showed marked diminution in the inflammation. At the end of a week the eye had made such progress that the
BACTERIOLOGY OF THE EYE

iris seemed normal and the instillation of atropine was stopped. Knowing how persistent some of the diplo-bacillary infections are, it was thought best to continue the application of zinc to the conjunctiva for one week more when the patient was discharged cured.

The examination of 1,015 cases in Montreal has been an interesting experience. I am inclined to believe the subjective symptoms in this form of conjunctivitis are more severe than we have thought. I have been struck with the number of acute cases that have been seen here, cases which clinically were Koch-Weeks or pneumococcus conjunctivitis, where examination of the discharge showed them to be diplo-bacillary. I reported three cases of acute purulent conjunctivitis, seen within a short time of each other, where the clinical signs pointed to gonococcus infection. One case was caused by the gonococcus, one by the Koch-Weeks bacillus and one by the diplo-bacillus. The latter was a nurse, aged twenty, who, with the children of a family, went to the country on a Friday. Monday morning, on awakening, her eyes were painful and inflamed. Later in the day she was referred to me in private, to see if her presence was dangerous to the children's eyes. When seen Monday afternoon both eyes were involved, there was marked swelling of the lids with edema of the conjunctiva and profuse purulent discharge. She complained too of severe pain in the eyes. After treatment with sulphate of zinc, gr. ¼ to the ounce, she made rapid progress, and one week later was allowed to resume her duties as the children's nurse.

No epidemic of conjunctivitis, due to the Morax-Axenfeld diplo-bacillus, has as yet been reported, but I have noted, time and again, one or two members of a family present themselves at the clinic, to be followed shortly after by one or more members of the same family.

With clinical types so varied, and with such numerous associations as has diplo-bacillary conjunctivitis, it will be readily understood a diagnosis can only be made by bacteriologic methods. The cause of this form of conjunctivitis is a diplo-bacillus which has very characteristic morphological and cultural features. From a case of Morax-Axenfeld conjunctivitis one takes with a platinum loop a little secretion from the conjunctival sac, smears it well over a glass slide. It is then fixed and stained, preferably by Gram's stain, using as a counter-stain a weak solution of safranin. If now examined with the oil immersion lens, the etiologic factor of this form of conjunctivitis will be found.

Over the field a multitude of Gram-negative bacilli, lying chiefly in pairs, will be seen. They are two to three microns long by one and a half wide. They vary in size, look square at the ends, but closer
examination will show them to be somewhat rounded. They lie either free or within the pus cells; where there is much purulent discharge they will be found frequently within the pus cells. Whether the Morax-Axenfeld diplo-bacillus has a capsule or not has been a much disputed question, but I think the majority of persons acquainted with this micro-organism, now believe it to be encapsulated.

The Morax-Axenfeld bacillus is easily recognized. The only bacilli likely to be mistaken for them in the smear are the bacillus ozaena, bacillus Friedlander and Petits diplo-bacillus. These are all very rare inhabitants of the conjunctival sac, however, and are readily differentiated in media. From bacilli of the diphtheria group, from

zur Neddens bacillus, the Koch-Weeks bacillus, and other pathogenic conjunctival microorganisms, it is easily distinguished. For practical purposes the cultural characteristics of the Morax-Axenfeld diplo-bacillus are not so necessary. In the vast majority of cases the diagnosis can be made from the film preparation.

When it is to be differentiated from Petit's diplo-bacillus cultivation is necessary.

The Morax-Axenfeld diplo-bacillus grows only at the body temperature on blood serum, ascitic or hydrocele agar, or hæmoglobin agar,
Shows Involved Diplo-bacilli, and Streptococci.
Koch-Weeks Bacillus from the Conjunctiva.

Koch-Weeks Bacillus in Pure Culture.
Drawn double scale.
serum agar, and serum bouillon. It has been cultivated, too, on glycerine agar, but the most satisfactory medium is blood serum. After twenty-four hours one sees over the surface of the serum tiny moist depressions. These gradually spread, increasing in depth and width, gradually liquefying the blood serum. This appearance on blood serum is characteristic; liquefaction continues for about two weeks; even on the second day one finds the prepared slide filled with involution forms.

On serum agar media the colonies show themselves as flat, grayish bodies, which resemble somewhat the appearance of the bacillus xerosis. On serum bouillon the growth produces a turbidity. Upon the ordinary agar the Morax-Axenfeld diplo bacillus does not grow as a rule, although both Axenfeld and Erdmann have cultivated the organism upon this medium. Loeffler's neutral and slightly alkaline blood serum has been recommended as the most serviceable medium for the Morax-Axenfeld diplo bacillus, but in many ways it is unsatisfactory. The initial tube is nearly always a mixed growth of staphylococci,

xerosis, or some of the other conjunctival bacteria, with the diplo bacillus. I have seen in print: "With the ordinary staphylococci of the conjunctival sac, growth does not seem to be impeded," and further: "One may frequently find the diplo bacillus in the conjunctiva in pure culture." In my limited experience I have rarely found the Morax-Axenfeld diplo bacillus in pure culture on blood serum in the initial growth; I have generally found it with some of the pyogenic cocci, commonly the staphylococcus epidermidis albus. The growth of the cocci by changing the reaction always interfered
with the growth of the diplo-bacillus, and it was only after a great deal of transplanting that I obtained it in pure culture.

Because I found this way so inconvenient I tried growing the diplo-bacillus on blood serum plates and on alkaline human hæmoglobin agar. Upon these tubes one finds over the surface separate colonies of the different pyogenic cocci, generally the staphylococcus epidermidis albus, which on this media has a bluish, glistening appearance. Between these, one finds small, raised, greyish-coloured colonies which resemble very closely the colonies of the bacillus xerosis. With the greatest ease the diplo-bacillus may now be obtained in pure cultures by picking off one of these colonies and transferring to other hæmoglobin agar or blood serum media. This is by far the simplest way of obtaining the Morax-Axenfeld diplo-bacillus in pure culture, and is a method which I have not seen reported.

The cultural characteristics of the Morax-Axenfeld diplo-bacillus differentiate it easily from the other known pathogenic conjunctival bacteria. There is, however, another diplo-bacillus which must be considered, the diplo-bacillus liquefaciens of Petit. In morphology it is strikingly similar to the Morax-Axenfeld, but on media it is very different. It grows readily and profusely on the ordinary culture media and liquefies gelatin, two characteristics which the Morax-Axenfeld does not, as a rule possess. I have grown the Morax-Axenfeld diplo-bacillus on agar-agar but the appearance of the growth is very different from that of Petit's diplo-bacillus. On hæmoglobin agar the Morax-Axenfeld diplo-bacillus is a fine, raised, colorless or greyish growth, while the Petit shows itself as a profuse raised greyish growth.

The diplo-bacillus of Morax-Axenfeld is not pathogenic for the ordinary laboratory animals. I have inoculated the conjunctival sacs of rabbits, guinea-pigs and mice, with negative results; later I abraded the corneal epithelium in the guinea-pig and inoculated the sac and cornea with negative results. For man, however, it is pathogenic. Morax set up a typical conjunctivitis in a colleague's eye. Some time ago I inoculated a conjunctiva which I had proved to be free from bacteria with a loopful of a twenty-four-hour growth of the diplo-bacillus. When I saw the patient a week later he had a well marked typical diplo-bacillary conjunctivitis. Smears were made which showed the diplo-bacillus which was obtained later in pure culture.

Erdmann has shown that the diplo-bacillus stands drying well. From pieces of dried gauze, which fourteen days previously had been soaked in a bouillon culture and later subjected to dry heat, he was able to obtain cultures.

The diplo-bacillus of Morax-Axenfeld has been found in the lachry-
mal sac (Axenfeld) and in odd cases in the normal conjunctiva. This fact is of interest where operations on the globe are being considered. Once I operated on a case which I saw for the first time in the operating room. The operation was enucleation for a ruptured eye-ball. The day following, on dressing the case, I found a discharge coming from between the lids. The latter and the surrounding parts were enormously swollen. Only then did I find out that the patient was the subject of a Morax-Axenfeld conjunctivitis. How closely the diplo-bacillary infection and the enormous post-operative swelling were associated I am not prepared to say. On the other hand, Axenfeld saw a severe perforating wound in a case of diplo-bacillary conjunctivitis heal quietly.

The diplo-bacillus of Morax-Axenfeld is frequently found in the noses of patients suffering from this form of conjunctivitis. I have examined many cases and demonstrated the presence of diplo-bacilli in the nose. When we consider how chronic this form of conjunctivitis is, and how full of diplo-bacilli we find the tears in the conjunctival sac, does it seem extraordinary that they should be carried into the nose?

For some years it has been admitted that a complication very liable to occur in diplo-bacillary conjunctivitis, was ulceration of the cornea; the ulceration, however, was always of the superficial type, generally
at the corneo-sclerotic margin, and the proportion of cases was small. That the diplo-bacillus might be responsible for ulcers of the cornea as severe in type as the ulcer serpens from pneumococcus infection, has not until of late been recognized. In 1897 zur Nedden described twenty-three cases of ulceration of the cornea complicating diplo-bacillary conjunctivitis. In the same year Uhthoff and Axenfeld described a case and Peters saw five cases where diplo-bacilli were found. In 1899 Sweet described two cases complicated by ulceration of the cornea. This work was important, in that, while some of his with the same etiologic factor. Paul, at the Breslau clinic, had an opportunity of seeing a large number of cases of diplo-bacillary conjunctivitis and among these he found twenty-six cases of ulceration of the cornea. This work was important in that while some of his cases were of the ordinary superficial type others were so similar clinically to the ulcer serpens from pneumococcus infection, that only bacteriological examination differentiated them.

Weigeln has reported a purulent keratitis complicating a case of Morax-Axenfeld conjunctivitis in an infant of two months. Later, Erdmann, from the Rostock clinic, reported thirty cases of diplo-bacillary conjunctivitis complicated by ulceration of the cornea. Among his cases, too, was seen the form resembling ulcer serpens.

In January, 1906, Hanford McKee before the Montreal Medico-Chirurgical Society, exhibited a case of ulcer serpens from diplo-bacillary infection. Agricola, from the Freiburg clinic, reported a series of cases of ulceration of the cornea from the diplo-bacillus.

In 1,015 cases of diplo-bacillary conjunctivitis here I have seen sixty-two cases of ulceration of the cornea complicating the conjunctival disease. Seven of these cases showed very well the different qualities of ulceration of the cornea by the diplo-bacillus.

In all these cases the same technique was followed. First the ulcerated surface was stained with solution of fluorescin, then with a keratome some of the pus from the surface of the ulcer was removed, tubes of serum and agar were inoculated and smear preparations were made.

These cases were all treated by instillation of drops of the sulphate of zinc, ¼ gr. to the ounce, four or five times daily; between times the surface of the cornea and the conjunctival sac were flushed with warm boracic solution and the solution of the sulphate of zinc. At night a little bland ointment, generally boracic ointment, x.gr. to the ounce, was smeared along the edges of the lids. When necessary to dilate the pupil a solution of scopolamin hydrobromate was used.

The first description of the tissue changes in diplo-bacillary conjunctivitis was given us by Stock, who found hypertrophy of the
epithelium in the region of the lid margins and macerated skin with
development of glandular ingrowths. He also found a widespread in-
filtration of the mucosa with enormous numbers of goblet cells. Mayou
stated that in this condition it was only the less resistant plasma cells
which were multiplied in the sub-epithelial tissues. Morax and Petit
examined a fresh ulcerated and perforated leucoma adherens, and
found in the infiltrated margins numerous diplo-bacilli, which stained
best with Nicolle’s carbol-thionin. Pusey confirmed Stock’s report and
went further by finding the diplo-bacilli in the tissues. Miyashita
published an account of his examination.

From time to time during the last few years I have examined tissue
taken from suitable cases. The tissue was taken from the palpebral
conjunctiva of adult patients who had a marked conjunctivitis and
where diplo-bacilli were present in large numbers. The tissue was
all fixed in Zenker’s solution and hardened in alcohol. Extra pieces
were fixed by different methods. All the tissue was imbedded in par-
affin and stained with eosin-methylene blue. A description of each
piece would be somewhat of a repetition so I shall give a microscopic
description of six of the cases which together bring out the different
points I wish to emphasize.

The examination of a series of cases shows:

1. The whole histological picture is that of a chronic inflammation
upon which an acute one has been superimposed. The epithelial layer
is everywhere infiltrated with polymorphonuclear leucocytes. The
sub-epithelial tissue shows (see the plate) a profuse infiltration with
lymphoid and plasma cells which are denser immediately about the
blood vessels. The plasma cell type predominates. There are also a
few scattered eosinophiles of the mononuclear type. The capillaries
are dilated and show great numbers of polymorphonuclear leucocytes.
These can be traced in a broken line from the vessels to the epithelium.
At one part of the section the epithelium is diverticulated forming a
well-defined pouch which is completely filled with detached epithelium,
nuclear fragments, red blood cells, fibrin and detritus. There is
some evidence of organization of this mass in the invading fibroblasts
which apparently come from the sub-epithelial layer where there are
numerous masses of young connective tissue cells.

2. A striking feature in this specimen (see plate) is the multiple
cyst formation in the epithelial layer. These cysts vary in size, and
for the most part are filled with serum and polymorphonuclear
leucocytes. Some of them show direct communication through small
openings with the surface. The cyst wall consists of flattened out epi-
thelium. They are presumably the result of mucoid accumulation
which has not been discharged and subsequently invaded by polymorphonuclear leucocytes, and are rather unique, as this is the only case in which they are seen in this series. The subepithelial tissue is diffusely infiltrated with lymphoid and plasma cells, the latter predominating, while eosinophiles are not infrequent here. There is an entire absence of polymorphonuclear leucocyte infiltration in the subepithelial layer.

3. The cells of the epithelial layer are for the most part ballooned or swollen with ὀΣεδema. This condition is seen only in a moderate num-

ber of the epithelial cells, but is the characteristic feature of the section. The subepithelial layers contain aggregations of lymphoid and plasma cells, which lack the characteristic appearance of the trachoma follicle. One of them is about a Meibomian duct. Many of the lymphatics are engorged with lymphoid cells. There are a few eosinophiles, but polymorphonuclear infiltration is absent.

4. The striking feature here, is the close proximity of the lesion to the epithelial layer. There is a dense lymphoid and plasma cell infiltration confined to the connective tissue, just beneath the epithelial layer. The cells are largely of the type seen in trachoma, large light-staining cells with vesicular nuclei. A second striking feature, is the great distension of the underlying lymphatics with lymph cells. There are numerous mononuclear eosinophiles throughout the section. Polymorphonuclear infiltration is practically absent.
5. The epithelial cells contain large spherical or ovoid masses of what looks like mucous. Many of them have the appearance of goblet cells. The epithelium is everywhere invaded with polymorphonuclear leucocytes. At one part of the section the subepithelial tissue is densely infiltrated with lymphoid and plasma cells. Immediately between this area and the underlying epithelium there is a large number of young connective tissue cells. They in places invade the epithelium which at this point is thrown into furrows. The subepithelial tissue is thickly beset with eosinophiles.

6. Many of the cells in the epithelial layer represent the so-called goblet cells because of their mucous contents. The epithelium in places shows a rather marked polymorphonuclear infiltration. This is seen only in a moderate number of the epithelial cells, but is the characteristic feature of the section. The absence of polymorphonuclear leucocytes in the subepithelial tissue suggests that they are from the conjunctival sac. A mild grade of chronic inflammation is seen in the subepithelial tissue. The vessels are dilated and injected, and the perivascular tissue edematous. In one part of the section, there is a beginning new growth of connective tissue just beneath the epithelium. The conjunctiva is thickened because of this increase in the connective tissue of the subepithelial layer. This connective tissue, like any connective or scar tissue, sooner or later contracts but does not do so equally. This contraction pulls down the epithelial covering at various points and explains the fold-like appearance of the epithelial layer. This has the appearance of a tube, but it is not a tubule. All end blindly and in no sense are they connected with secretory glands.

Stock did not find bacteria in the tissue which he examined, but expressed the opinion that the diplo-bacilli were probably restricted to the surface of the epithelium. Morax and Petit found numerous diplo-bacilli in the infiltrated margin of an ulcerated leucoma adherens. They stained best with Nicolle’s carbol-thionin. The following is from Pusey’s article: “Between the superficial cells of the epithelial cell layer occasionally one finds diplo-bacilli. The organisms within the epithelial cell layer are rare, and apparently do not penetrate deeply, for in a search through many sections I did not find them below the second layer of cells. In the subepithelial tissue I did not find bacteria.”

Miyashita was not able to demonstrate the diplo-bacilli in the tissue. In the first six cases examined I stained a series of slides with Wright’s stain. The demonstration of the diplo-bacilli was very easy. They were found on the surface of the epithelial cells in large numbers.
and between the epithelial cells were seen in smaller numbers. The
diplo-bacilli were further found in the subepithelial tissue. They
were not intracellular but found lying free here and there in the tissues.
They were seen in the deepest parts of the subepithelial tissue. The
demonstration of the diplo-bacilli in the deep parts of the subepithelial
tissue may help to explain the chronicity of this form of conjunctival
infection.

Conclusions:—The true appearance of the tarsal conjunctiva in this
form of inflammation, is a nodular one. The essential lesion here is in
the subepithelial layer, and consists of a mild chronic inflammatory
process, as shown by the increased connective tissue, the infiltration
with lymphoid and plasma cells, and the larger number of eosinophiles.
Occasionally a section through a Meibomian gland goes through the
duct, but this is a normal occurrence and shows no contraction of
the connective tissue. Diplo-bacilli may be demonstrated on the sur-
face of the epithelial cells and in the deep parts of the subepithelial
tissue.

My experience with diplo-bacillary conjunctivitis differs in some
ways from that of others, e. g.:

1. Many of the patients had severe subjective symptoms.
2. Many of the cases were acute simulating blepharorrhea. (I have
been struck with the frequency with which acute diplo-bacillary con-
junctivitis has been met with here). Cases which clinically resembled
Koch-Weeks or pneumococcus conjunctivitis where examination of the
discharge demonstrated diplo-bacilli.
3. The form has been seen very often during the cold and wintry
weather.
4. The cases associated with trachoma reacted well to zinc sulphate.
5. Cases complicated with ulceration of the cornea were cured with
instillations of zinc.
6. A series of cases of phlyctenular conjunctivitis in adults com-
plicated by diplo-bacillary infection, were seen.
7. Diplo-bacilli were found constantly in the noses of patients suf-
fering from this infection.
8. One patient, a boy, was seen with excoriation about the nostrils,
the examination of a little secretion showed the presence of diplo-
bacilli.
9. In no case of diplo-bacillary conjunctivitis have I seen the sul-
phate of zinc fail.

I have treated cases with silver nitrate and argyrol to no purpose.
I have seen cases, especially among children, return without improve-
Shows the Result of Doing Gram's Stain Improperly. Some of the Xerosis Bacilli are Gram Negative; Some are Positive.

Film made from the Normal Conjunctiva, Showing a Few Gram Positive Cocci and Diplococci. Gram's Stain.
Morax-Axenfeld Conjunctivitis.

Morax-Axenfeld Diplo-bacillus on Smear. Gram Stain.
ment, but here the failure was not due to zinc but the inability to instil the drops. I have treated with silver salts cases of trachoma in which diplo-bacilli were found in the conjunctival sac and noted great improvement only when the sulphate of zinc was started. Therefore the treatment, par excellence, in Morax-Axenfeld conjunctivitis is frequent irrigations of the conjunctival sac with a weak solution of the sulphate of zinc. Thorough irrigation with the instillation of drops of gr. ½ to the ounce, three or four times daily, will give exceedingly satisfactory results.

In no case of Morax-Axenfeld conjunctivitis, where the patient has followed the directions, have I seen the sulphate of zinc fail.

Where diplo-bacillary conjunctivitis is found associated with trachoma, I would advise treatment of the trachoma with silver nitrate, or whatever measure is thought best. Such cases treated only with nitrate of silver will not make satisfactory progress until zinc sulphate solution has been added to the treatment.

In a recent letter to me Blaauw advised the trial of the salicylate of zinc in the diplo-bacillary infections. Kelly showed argyrol and protargol to be quite inefficacious in Morax-Axenfeld conjunctivitis. Treatment was continued for a month with no apparent improvement.

In trying the various solutions of the sulphate of zinc drops in the eye, night and morning, Kelly found that in using the gr. i to the ounce solution the diplo-bacilli were present six weeks later. With a solution of grs. iv to the ounce, after three weeks diplo-bacilli could not be found, while with the solution of grs. viii to the ounce, the average duration of the presence of the organism was 13.5 days.

Silva, in Axenfeld's clinic, could not prove a diffusion of the sulphate of zinc through the cornea, and showed, as we have found clinically, that zinc checks the bacilli but does not kill them.

We have then, in Morax-Axenfeld conjunctivitis, an exceedingly common affection of the conjunctiva, a form which varies so in its clinical picture from mild catarrhal to acute purulent conjunctivitis, that a diagnosis must be made from the bacteriological methods. It is a form of conjunctivitis that is exceedingly chronic, but will be found to react surely and well to its specific, the sulphate of zinc.

Bacteriology of Koch-Weeks. conjunctivitis. In 1885 when in Egypt, working on Egyptian ophthalmia, Koch found in the purulent conjunctival discharge two micro-organisms. One was a diplococcus, which was very similar to the gonococcus, while the other was a small bacillus similar to the bacillus of mouse septicemia. In 1887 Weeks, of New York, reported having seen this bacillus in many cases of acute epidemic conjunctivitis which seemed prone to occur in the
spring and fall of the year. In the secretion from these cases he constantly found many fine bacilli which he believed were the cause of the conjunctivitis, though he was unable to cultivate them in pure culture. With a mixed growth of this micro-organism and the bacillus xerosis he was able to set up a typical conjunctivitis, while inoculation with the bacillus xerosis was negative. He rightly concluded that the small Gram negative bacillus was the pathogenic agent. In 1890, at Berlin, Weeks reported that he had been able to grow the small bacillus in pure culture, and that he had observed it in over 1,000 cases. In 1894 Morax published his work on the cultural characteristics of the Koch-Wecks bacillus. He inoculated his own conjunctiva and described the course of the disease. In the same year Wilbrand, Saenger and Staehlin, reported a large epidemic which they had observed in Hamburg. Weichselbaum and Muller also reported an epidemic. They made a number of inoculations of the human conjunctiva with positive results. They also were able to cultivate the bacillus quite easily on human serum agar. In 1897 Greeff had an opportunity of studying this form of conjunctival infection at the Charité clinic in Berlin.

Again in 1899 a big epidemic in Czernovitz was reported by Kamen, who was able to grow the bacillus, to many generations, on media containing human serum. From this beginning the conjunctivitis set up by the Koch-Wecks bacillus has been reported from almost every quarter. In Egypt, Italy, Belgium, Switzerland, the various parts of Europe and the British Isles, in numerous cities in the United States, and in Montreal its presence has been made known, until it is now recognized as one of the commonest causes of acute epidemic conjunctivitis. That different forms of conjunctivitis predominate in different places, is well shown by comparing Koch-Wecks and pneumococcus conjunctivitis. In New York, Paris and Glasgow the Koch-Wecks bacillus is by far the commonest cause of the epidemic conjunctivitis, while in Omaha, Philadelphia, and Montreal, the pneumococcus is the factor in the great majority of the acute cases.

Koch-Wecks conjunctivitis, as originally pointed out by Weeks, tends to occur in the spring and fall of the year. It is very contagious, and when it appears in schools, asylums, etc., where large numbers of persons are brought together, it spreads rapidly. It seems too to run a more severe course in adults than in children.

After an incubation period of thirty-six to forty-eight hours, Koch-Wecks conjunctivitis presents the following clinical picture. It is almost always in both eyes, the lids are reddened and slightly swollen with a muco-purulent discharge between them. The conjunctiva is chemotic, and in very severe cases the clinical picture may closely
resemble a gonorrhœal ophthalmia. The conjunctiva, especially the bulbar, is intensely congested and in many cases small hæmorrhages are seen. Morax believed these rather characteristic of Koch-Weeks conjunctivitis, but they are very common in pneumococcus infections, too. The reddened, swollen lids, with considerable muco-purulent discharge, are very characteristic of this form of conjunctivitis. It is indeed an acute purulent conjunctivitis. Phlyctenular-like nodes are often found at the limbus conjunctivae. Morax distinguishes these from true phlyctenules in that they are true vesicles filled with fluid,

Koch-Weeks Bacillus from the Conjunctiva, x 2000.

while phlyctenules are nodules of leucocytes. In several members of a family infected from the same source, the symptoms may vary considerably in severity and in children especially they are often much milder than in adults.

Cases of moderate severity run a course of two to four weeks, depending upon treatment. The acute condition may subside, and be followed by a mild, chronic conjunctivitis, which is, however, capable of infecting others.

Koch-Weeks conjunctivitis is sometimes complicated by ulceration of the cornea and by iritis, but fortunately these are seldom seen. As this form of conjunctivitis is so very contagious these patients should be
isolated. Treatment consists in the application of cold compresses, which will allay the œdema, and the application of silver nitrate. This was shown by Morax to greatly diminish the numbers of the bacilli.

Film preparation.—Having smeared some of the conjunctival discharge over a glass slide, fixed it, and stain it by Gram’s method, careful search will reveal tiny Gram-negative bacilli, single or in groups, lying free or within the pus cells. Their length varies between 0.5 microns and 2.0 microns, while their breadth is constant. The ends are rounded, but what strikes one in seeing them for the first time is how comparatively long and thin they are. They resemble the bacillus of mouse septicaemia and the bacillus of influenza but are much thinner and longer than the latter. The Koch-Weeks bacillus does not stain as easily as some of the other conjunctival micro-organisms. Axenfeld advises a weak solution of carbol-fuchsin. It is rapidly decolourized by Gram’s stain, is aerobic and non-motile. (See the plate.)

The Koch-Weeks bacillus is cultivated with considerable difficulty. Specially prepared media are an essential, in fact this micro-organism will only grow on haemoglobin, ascitic, hydrocele and such agars. On such media Morax, Usher and Fraser, obtained prolonged growths. After twenty-four hours in the incubator the colonies appear as moist, transparent drops not unlike the colonies of the bacillus influenza. These bacilli are rarely obtained in pure culture in the initial tube. The presence of the bacillus xerosis or staphylococcus albus seems to help the growths of the Koch-Weeks bacillus.

Slides prepared from the growth show the bacillus of the same size and shape and with the same staining qualities as the bacillus obtained from the conjunctival discharge. The cultures remain viable for a very short time, three to five days at the outside.

The Koch-Weeks bacillus is easily differentiated from such conjunctival organisms as the xerosis bacillus and the diplo-bacillus of Morax and Axenfeld. It is much more like the bacillus influenzae but can be differentiated from this fairly well by its morphology. The Koch-Weeks bacillus is a Gram-negative, long, thin bacillus. The bacillus influenzae is also Gram-negative but is short and thick. In many cases, especially in the film and primary growth, it may very closely resemble a cocccus. Koch-Weeks is a difficult organism to cultivate even with specially prepared agars while the bacillus influenzae on hemoglobin, is very easily cultivated.

Bacteriology of pneumococcus conjunctivitis.—Pneumococcus conjunctivitis was first described by Morax and Parinaud in 1894. Two
Pneumococci from a Conjunctivitis Case.
Pus from the Conjunctiva Containing Gonococci.

A Typical Film from the Initial Culture, Showing the Gonococcus and Xerosis Bacillus.
years later the reports of Gasparini, Axenfeld, Gifford and Pichler appeared. Gasparini in 1893 had reported having found pneumococci on the conjunctiva in hypopion keratitis cases. The pneumococcus conjunctivitis described by Parinaud was unilateral, of varying virulence and associated with inflammation and stenosis of the lachrymal duct. Gasparini, Axenfeld, and Gifford saw many cases and Gifford furnished definite proof of its infectiousness by inoculations on the healthy human conjunctiva. These reports were later confirmed by numerous writers and while the pneumococcus has not, as yet, produced such large epidemics as the Koch-Weeks bacillus, and while pneumococcus conjunctivitis is probably not so widespread as the diplo-bacillary form, nevertheless it has produced small epidemics in many different parts of the globe.

This form of conjunctivitis is supposed to occur more often in northern climates and at the cold seasons of the year. This latter statement is not borne out by our experience in Montreal. Here pneumococcus conjunctivitis occurs as the acute epidemic form of the spring and early warm season. As Koch-Weeks conjunctivitis is very rare here a provisional diagnosis of pneumococcus infection is verified in short order by the bacteriological examination. In our series of examinations 177 cases of pneumococcus conjunctivitis were found.

The onset is generally acute and both eyes are soon involved. As pointed out by Axenfeld the clinical picture varies in severity from a mild catarrhal conjunctivitis to a severe blennorrhœa. Pneumococcus conjunctivitis seems to vary considerably in different places. Gifford has frequently met with the severe form in Omaha. In Montreal some of our cases were very similar, in clinical appearance, to gonococcus infection. In other places this severe form has not been observed. In our series of one hundred and seventy-seven cases many were of the severe form with a tendency to recurrence. With us the clinical picture has been one of an acute purulent conjunctivitis occurring chiefly in the spring among children and adults alike. The inflammatory signs may be slight, however, and the disease may last but a short time. As a rule there is a swelling of the lids, intense congestion of the conjunctiva, both palpebral and bulbar, with profuse muco-purulent discharge. Small conjunctival haemorrhages are very commonly seen in this form of infection and phlyctenules at the cornea-scleral margin are not uncommon. Among epidemics there is a disposition to attack children, according to Axenfeld, who has also noted that this inflammation may subside by "crisis."

Film preparation.—(See the plate).—The diagnosis can be easily effected by making a film preparation in the way already described
and staining by Gram’s method. During the onset of the disease pneumococci in large numbers will be found, giving one very pretty specimens. The Gram-positive lanceolate diplococci will be found lying free or in the leucocytes. They are elongated and vary in size. The difference in size of the two cocci of a pair is often very noticeable. They may occur in chains and vary a great deal according to their source. The pneumococcus stains readily with any of the aniline dyes and is positive to Gram’s stain. It has a definite capsule which is generally well marked in the film preparations. The appearance of the film may be very characteristic but I believe it is necessary here, more than in any other form of conjunctivitis, to inoculate media. On more than

Pneumococci from a Case of Conjunctivitis.  x 1500.

a few occasions I have seen pus that gave negative results in the film preparation give pure cultures of the pneumococcus.

The pneumococcus grows well at incubator temperature on a medium consisting of human or animal blood serum, ascitic or hydrocele fluid, with agar. It grows well on ordinary alkaline or neutral agar, blood serum or bouillon. Upon agar after twenty-four to forty-eight hours the colonies are hardly visible. With a lens they are seen to be finely granular and colored slightly yellow or brown. In bouillon
the growth is not profuse and is usually lost after two or three transfers. The medium is at first cloudy owing to the development of the cocci. These subside after a day or two and the medium becomes clear. On blood serum pneumococci may be cultivated for an extended period. The growth is similar to that on agar but is much harder. Of the special media used for the cultivation of the pneumococcus hemoglobin agar is highly recommended, as the organism grows well on it and the cultures retain their viability well. Another special medium which is of diagnostic value is the Hiss serum medium, with and without inulin. The inulin is fermented by typical pneumococci with coagulation of the serum, while most streptococci fail to ferment the inulin. This is of considerable diagnostic value. The pneumococcus is moderately pathogenic for laboratory animals, mice and rabbits being very susceptible.

"As among all other micro-organisms minutely studied different strains of pneumococci show quite a wide range in variation, in morphology and virulence. Some of the variations are so marked, and so constant, that they make it necessary to recognize several distinct varieties of the pneumococcus and to class as pneumococci certain varieties which have before been classed as streptococci, e.g., the so-called streptococcus mucosus capsulatus (streptococcus mucosus Schott.müller), when first isolated from pneumonic exudate or elsewhere and planted on artificial media containing serum grows as a rounded coccus with a small dense distinct capsule principally in short or medium chains. It produces a large amount of mucus-like zooglia, forming very large spreading colonies; it promptly coagulates fluid serum media containing inulin. It is also very virulent for mice and but moderately virulent for rabbits. After a number of culture generations on ordinary nutrient agar it apparently loses most of these characteristics. It then grows in small colonies principally as naked diplococci which may be elongated and pointed, produces no zooglia and loses most of its virulence for mice and rabbits. It still coagulates inulin serum media, and when transferred to serum media regains its former morphological characteristics. For these reasons we consider this organism a distinct variety of the pneumococcus. Another group of pneumococci quite constantly produces large forms and large capsules. Still another group produces principally small forms and small capsules. Another group might be made of morphologically typical pneumococci which do not coagulate inulin serum media" (Park.)

In the severe cases pneumococcus conjunctivitis seems to reach its height in five to six days, and after this there is a decided lessening in the symptoms and appearance of the eyes. Corresponding to this
change Axenfeld has shown that there is a lessening in the number, or a complete absence, of pneumococci. Here is where error as to the etiological factor is liable to occur. Examining the discharge at this time we shall find the ordinary pyogenic organisms and the xerosis bacillus with the result that they will probably be put down as the cause of the conjunctivitis.

The ordinary course of a pneumococcus conjunctivitis may be complicated by ulceration of the cornea, or by a toxin iritis. The former is a very serious complication and one requiring the closest attention and care. Happily the infiltration of the cornea so often seen here rarely advances to ulceration. Toxin iritis without any abrasion of the cornea was noted by Gasparini. The onset was marked by severe pain and swelling of the pre-auricular glands. Axenfeld and Rymovitch report that the iritis may last some time after all conjunctival symptoms have disappeared. The possibility of either of these complications deserves more than a passing note, especially ulceration of the cornea, for it is now well recognized that eyes which have undergone a severe ulceration of the cornea are dangerous eyes inasmuch as there is the possibility of their setting up sympathetic ophthalmia.

The treatment in pneumococcus conjunctivitis consists in the use of some germicide and the ordinary measures adopted in conjunctivitis cases. In some clinics pneumococcus serum is used as a routine in the severe cases.

*Bacteriology of gonococcus conjunctivitis.* This exceedingly acute purulent inflammation of the conjunctiva is seen in one of two forms: (1) Adult purulent conjunctivitis and (2) Ophthalmia neonatorum. It is caused by the gonococcus which was discovered by Neisser in 1879. Transferrence of the gonococcus to the conjunctiva may occur in many ways. The course of the disease may be divided into three parts, infiltration, purulent discharge and convalescence.

After an incubation period, varying from a few hours to five or six days, the symptoms develop quickly and the clinical picture in the severe forms is as follows: The lids are red and swollen so that they are opened with considerable difficulty. Chemosis of the bulbar conjunctiva is marked, and there is now an abundant discharge of thin fluid, some coloured with blood, and containing a little pus. The eye feels hot, is tender to the touch and usually there is some constitutional disturbance. During the second stage a copious, purulent discharge is the chief feature. The pus is thick and creamy and constantly escapes through the lids. There is now diminution in the pain in the eye, and hardness in the lids, but the chemosis of the conjunctiva remains. In the third stage, that of convalescence, there is more or
less of a chronic inflammation of the lids with a serous discharge which sometimes tends to be persistent.

Ophthalmia neonatorum or infantile purulent conjunctivitis is an acute purulent conjunctivitis occurring in the new-born, which in the great majority of cases is due to infection by the gonococcus and which has similar symptoms and runs a similar course to the gonococcus infection in the adult.

Gonococci. x 1500.

If some of the discharge be examined the films will be found to be covered with Gram-negative diplococci lying mostly within the pus cells. It is best to stain two slides, one with methylene blue the other by Gram’s method. By the former the morphology of the microorganism is well demonstrated, and by the latter the question of the action to Gram’s stain is settled. The gonococcus is a micrococcus which appears generally in the form of diplococci. The cocii are somewhat elongated, the surfaces facing one another flattened, so that the diplococcus assumes a characteristic shape described as kidney or coffee bean. The gonococcus stains readily with the aniline dyes. For film preparations from pus, Leffler’s methylene blue is one of the best stains. With this the gonococcus is stained more deeply than the cell protoplasm. Staining with methylene blue and eosin gives very pretty preparations. The gonococcus is decolourized by Gram’s stain. The
latter is the best routine method for staining the gonococcus, serving to differentiate it quickly from the common pyogenic cocci. This is the distinctive characteristic of the staining properties of the gonococcus, and as a routine test, will be found most useful. Films from pus show in the early stages of the disease, gonococci free in the serum, or upon the epithelial cells. Later they are found almost entirely in or upon the pus cells. Sometimes single pus cells show an innumerable number of this micro-organism. From culture, the gonococcus is seen to lose somewhat its bean shape. The involuted forms sometimes have a granular appearance, and are irregular in shape.

The gonococcus grows best at blood temperature from 25 to 40° centigrade. It is a facultative anaerobe, is nonmotile, and produces no spores. It requires for its growth, especially from pus, the addition of blood serum, or its equivalent, to nutrient agar. Hydrocele, ascitic, pleuritic or human haemoglobin agar all make satisfactory media. Upon a favorable medium, such as haemoglobin agar, cultures frequently die in forty-eight to seventy-two hours, if kept at room temperature. They may be kept viable in the ice chest for several weeks. The growth upon haemoglobin agar as upon all the special media, is a delicate one, which shows itself at the end of twenty-four hours, in the incubator as finely granular translucent colonies of greyish white colour. From the conjunctiva the initial growth is invariably mixed with the xerosis bacillus. The gonococcus has little resistance against outside influences, and is non-transmissible to all animals.

"In the gonococcus cells substances are present which are toxic after heating and contact with alcohol. Injected in considerable amounts into rabbits, they cause infiltration and often necrosis. Applied to the urethral mucous membrane there is produced an inflammation of short duration. In gonorrhoea the secretion is believed to be due to these intracellular toxines. Repeated injections give no appreciable immunity. The filtrate of recent gonococcus cultures contains little or no appreciable toxin. The typical incubation and symptoms of the disease resulted in all subjects experimented upon."

Some months ago, while searching for the trachoma bodies in the male urethra, I examined a patient who was thought about cured of his gonorrhoea. When a film was prepared so that the epithelial cells could be examined, masses of organisms identical in morphology with the gonococcus were found within them. Many of the cells had the cytoplasm completely filled. Shortly after this two cases of ophthalmia neonatorum were brought to the clinic. Examination of the pus in the usual way gave negative results. In one cell only, there were inclusions which from the clinical appearance of the conjunctiva I
thought were gonococci. Films were then prepared after the method used in trachoma cases, so that the epithelial cells could be examined. With an ear curette the palpebral conjunctiva was gently stroked, and the material spread carefully over a glass slide. It was dried in the air, and fixed in eighty per cent. alcohol for ten minutes and then stained with Giemsa solution, one in twenty parts of distilled water, for twenty minutes. In each of these cases where by examining the pus the results were negative, the epithelial cells were found crowded with biscuit-shaped diplococci. Hæmoglobin agar, inoculated with discharge containing epithelial cells, gave a profuse growth of the gonococcus.

The usefulness of this method of preparation has been verified in pneumococcus and diplo-bacillary conjunctivitis, although in the latter it is extremely rare for the old method to give negative results. Giemsa’s new method of staining will also be found useful in these cases. The prepared slide is dried in the air and put in a petri dish and covered with staining fluid, which consists of equal parts of Giemsa stain and pure methyl alcohol, for thirty seconds. Enough distilled water is now poured in to cover the specimen, ten to fifteen c.c., which is agitated until a homogeneous mixture is obtained. After three
minutes the specimen is removed. I feel sure that this method of preparing films, showing the epithelial cells, will demonstrate the presence of the gonococcus in many cases, which by the old method, would have been negative.

There are a number of micrococci described by Bumm which resemble the gonococcus in morphology and staining reactions and which are important because they occur on the inflamed conjunctiva, and may be mistaken for gonococci. Thorough cultural examination is

Gonococci in the Epithelial Cells. x 1500.

the only means of differentiating the Gram-negative diplococci of the conjunctival sac. Of more importance, because they are more frequently met with, are the micrococcus catarrhalis, and the meningococcus.

Bacteriology of influenza conjunctivitis. Mueller first reported having found a small bacillus in the secretion of trachoma cases, which he differentiated from Koch-Weeks bacillus, but did not recognize as the bacillus influenza. With careful examination and exact methods it will be found that the bacillus influenza is frequently the pathological factor in cases of conjunctivitis. In our series at the Montreal General Hospital, we found the bacillus influenza in 21 cases of conjunctivitis, 11 cases of trachoma, 2 cases of conjunctivitis occurring in
epidemic meningitis, 2 cases of dacryocystitis, 3 cases of diplo-bacillary conjunctivitis and 1 case of pneumococcus conjunctivitis. The bacillus influenzæ is a very small, moderately thick micro-organism, with small round ends, which occurs singly or quite frequently in pairs. They look very like small diplococci. It is an anaërobic, non-motile bacillus, has no capsule, does not form spores, and grows only between 26 and 34°. The bacillus influenzæ is cultivated with certainty only on media containing blood, especially of pigeons, which is rich in hæmoglobin. Human hæmoglobin agar is also a very satisfactory medium, also glycerin agar, or blood serum streaked with rabbit or human blood. After eighteen or twenty-four hours in the incubator, the surface of the medium will be seen covered with small round colonies, which appear as shining homogeneous spots, which tend to keep separate.

In the original culture made from the conjunctiva the growth is generally a mixed one. Between colonies of the staphylococcus albus the smaller colorless colonies of the bacillus influenzæ will be readily seen. After cultivation for a few days on media containing hæmoglobin, the bacillus influenzæ can be very easily cultivated on hæmo-
globin free agar. The cultures live but a few days, as the bacillus influenza is very sensitive to dessication.

There are probably a number of micro-organisms which make up an influenza group. In this group may be included the so-called pseudo-influenza bacillus, which is distinguished from the form just described by its larger size and a tendency to grow out into long threads. Also the bacilli found in whooping-cough differs but slightly from the influenza bacilli. There are also the so-called influenza bacillus of Mueller and the pseudo-influenza bacillus of zur Nedden.

To this group the author wishes to add another. In the Journal of Medical Research, vol. 16, number 3, p. 527, July, 1907 and the Ophthalmic Record of October, 1907, the writer, under the title A New Pathogenic Micro-organism of the Conjunctival Sac reported the finding in a few cases of conjunctivitis, of a small Gram-negative bacillus which he believed was a new pathogenic micro-organism. Since that report, similar cases have been observed, and the micro-organism has been cultivated from the conjunctiva fifty-two times. The cases have all been in infants, and very similar to the first case seen. On April 6th, 1907, a mother brought her infant of nine months, and complained that the baby's eyes had been "sore and running" for five days. The clinical picture was as follows:

Both eyes were involved, upon the lashes there was much dried secretion. The palpebral conjunctiva was intensely congested, while the bulbar conjunctiva was quite normal. The lids were not red or swollen. From the conjunctival sac there was a profuse muco-purulent discharge freely mixed with tears.

A little of the discharge was smeared well over a glass slide, fixed and stained by Gram's method, using as a counter-stain a weak solution of safranin. Upon examining the slide I saw here and there tiny Gram-negative bacilli which seemed too short and thick for the Koch-Weeks bacillus and too thick for the bacillus influenza. This same bacillus I had seen before, but in the hurry of a large outdoor clinic I had not pursued it further, contenting myself with the thought that it was the bacillus influenza.

Tubes of blood serum, plain agar, bouillon and haemoglobin agar were then inoculated and put in the incubator. After twenty-four hours a growth was seen upon the haemoglobin agar. The other tubes were negative. Smears showed this same small Gram-negative bacillus with staphylococci. The bacillus, after a few days, was obtained in pure culture. A conjunctival sac was now inoculated, a conjunctivitis set up, and from the conjunctival discharge the same small bacillus was obtained.
During the last few years fifty-two such cases have presented themselves at the outdoor department. They have all been infants and all from among the Jewish colony here. They have all shown definite characteristic clinical features and from each case this same bacillus has been isolated.

**Smear preparations.** In making a smear a loopful of the conjunctival discharge should be teased well over a glass slide, fixed, and stained preferably by Gram, using as a counter-stain a 5 per cent. watery solution of safranin. Examining the smear one finds here and there tiny bacilli. They are short and thick, their rounded ends giving the appearance of elongated cocci. They may be found in groups, but seem to lie preferably singly. They will be found both within and without the leucocytes, generally without.

From culture the bacillus seems to be slightly larger and tends to appear as diplo-bacilli. It is short and thick, with very pointed ends, is 0.5-2.0 microns long by 0.3-0.4 microns wide. The bacillus shows uniform staining, has no capsule, is non-motile and does not form spores. It is decolorized by Gram's stain, but stains well with weak solutions of carbol fuchsin or methylene blue.

**Cultural features.** The tubes of hemoglobin-agar inoculated with some of the conjunctival discharge gave a pretty and characteristic result, which was constant in all cases. After twenty-four hours in the incubator one sees over the surface numerous separate colonies of the staphylococcus albus. Around each of these separate colonies radiating out from them as centers are seen very fine colorless shiny rounded colonies. These colonies are exceedingly fine, seem to keep separate and extend over the whole surface. The original cultures from all the cases were as the one described and showed how well this bacillus grows in commensal relationship with the staphylococcus.

From the original tube the bacillus was obtained in pure culture by surface seeding a plate of hemoglobin-agar. In trying to obtain it in pure culture by transferring from tube to tube the growths were always contaminated by the staphylococcus. Over a plate of hemoglobin-agar, however, by smearing a loop inoculated from one of the small colonies as far from the albus as possible the bacillus in pure culture was readily obtained.

The growth of the bacillus on hemoglobin-agar is characteristic: After twenty-two to twenty-four hours in the incubator the slant will be seen covered with a mass of tiny colonies. They remain separate and distinct, are colorless, and, as will be seen from the tubes, the colonies are no larger than the sharp end of a pin. Indeed, the growth, though profuse, is at times exceedingly difficult to recognize. It is
seen much better by artificial than by daylight, especially with the proper reflection of light. The growth of the bacillus is very easily affected even upon hemoglobin-agar, upon which it grows best. Upon freshly-made hemoglobin-agar it will not grow in less than forty-eight hours. The reaction of the media, too, is of the greatest importance. Hemoglobin-agar, neutral, 1.0 alkaline, .65 acid, 1.0 acid and 1.75 acid to phenolphthalein was made up. Upon alkaline media it would not grow. Upon the neutral and .65 it was with great difficulty transferable. The most satisfactory reaction and the one which has been latterly used is the 1.0 and 1.75 acid.

The cultivation of this bacillus on media, upon which it seemed to thrive best, has been at times unsatisfactory and extremely difficult. Upon the same batch of hemoglobin-agar sometimes it will take forty-eight hours before there is any sign of a growth. At other times cultivation is comparatively easy. Upon glycerin agar, after twenty-four hours in the incubator, a growth is seen. The surface of the agar is covered with these same tiny pin-point colorless colonies. They are here hardly perceptible, but a smear from the surface will show their presence in quantity. Upon hydrocele agar the growth is exceedingly fine and is only perceptible with a proper reflection of light. From behind no growth will be seen, but smears from the surface will show the presence of the organism. Upon plain agar the appearance of the growth is similar to that upon hydrocele agar. The growth upon plain agar is by no means constant. Upon blood serum the results have been negative. In bouillon there has never been any growth; indeed, even in the water of condensation from a slant where there is a profuse growth the bacilli are very few in number.

To tubes of litmus agar were added dextrose, dextrin, maltose, lactose, saccharose, gelatose, inulin and mannite. The growths here were sparse. Over the surface of the agar were seen tiny colorless pin-point colonies. To similar litmus agar tubes to which sugars had already been added were added a few drops of blood. The growth here was profuse, with no change in the reaction. The bacillus, too, has been cultivated upon dorset egg medium. The appearance of the growth is as if the surface of the medium had been slightly roughened with a swab stick.

To sum up its cultural characteristics, this bacillus grows only at the body temperature and is aërobic. It grows best upon hemoglobin-agar of 1.0 and 1.75 acid reaction. The growth upon the hemoglobin-agar is very easily affected and the cultivation of the bacillus is at times difficult. In commensal relationship with staphylococcus albus the bacillus grows well. It grows on dorset egg medium, glycerin and
hydrocele agar and has been cultivated upon plain agar. It does not grow in bouillon, any liquid medium or upon blood serum. It does not produce gas, does not ferment any sugars and has no chromogenic characters.

The cultures on hemoglobin-agar remain viable from two to three weeks, provided there is sufficient water of condensation in the tubes. One culture inoculated on April 11 was transferable April 25 but not on May 3. It had not been kept in the cold nor in any way taken especial care of.

For the human conjunctival sac this bacillus is pathogenic. A conjunctival sac which was found to be free from micro-organisms was flushed out well with warm water. Fifteen minutes later the sac was inoculated with a loopful of a twenty-four hour growth. Twelve hours later there was a feeling of "something in the eye," and six hours later the eye showed a marked catarrhal conjunctivitis. The palpebral conjunctiva of the lower lid was especially involved. The posterior conjunctival vessels were somewhat dilated, otherwise the bulbar conjunctiva was not involved. From the muco-purulent discharge, which was here, too, freely mixed with tears, the organism was obtained.

With the washing from a slant on hemoglobin-agar an ordinary house mouse was inoculated intraperitoneally; eighteen hours later the mouse was unable to move and six hours later was dead. At autopsy the peritoneum was found injected and filled with a gelatinous, sticky exudate. Smears showed the pus cells filled with the bacilli and little or no fibrin. Inoculations from the peritoneum on hemoglobin-agar gave pure growths of the bacillus.

This tube was washed down and inoculated intraperitoneally into a white mouse. Twenty hours later the mouse was dead. Post-mortem was found marked peritonitis of the gelatinous type similar to above. From the peritoneum here was obtained the bacillus in pure culture. A different strain of the bacillus on hemoglobin-agar was now taken and the wash similarly injected into a white mouse. Sixteen hours later the mouse seemed very ill and was unable to stand up or move, and four hours later was dead. From the peritoneum, which showed a marked peritonitis similar to the previous cases, two tubes of hemoglobin-agar were inoculated, which twenty-four hours later gave pure growths of the bacillus. Hemoglobin-agar was also inoculated with the heart's blood, which twenty-four hours later gave a pure growth of this same bacillus. Two house mice were inoculated with two different strains; twenty-four hours later they were both dead. Post-mortem was found the marked gelatinous peritonitis, from which
pure cultures were obtained, also pure cultures from the heart's blood. In one case two tiny loopsful from the heart's blood gave a growth covering the entire surface of the agar. To check these experiments on April 29 four mice, two white and two house mice, were inoculated intraperitoneally with four different strains of the bacillus. The inoculations were done at 4 p.m. on April 29. At noon the following day one white mouse and one brown one were dead. The other two were unable to move or stand. Post-mortem the peritoneum was found in all cases involved as before. From the peritoneum and from the heart's blood in each case pure growths were obtained.

This micro-organism then, a cause of conjunctivitis, needs to be differentiated from the different known bacteriological causes of conjunctivitis. Differentiation from Morax-Axenfeld's diplobacillus, Petit's diplobacillus, Friedländer's bacillus and bacillus coli and bacillus subtilis may be dealt with in a few words. It is far too different morphologically and culturally to necessitate going into minutiae here. The pathogenic micro-organisms of the conjunctival sac, which it must be differentiated from, however, are the Koch-Weeks bacillus and the different influenza bacilli, namely, the influenza bacillus of Pfeiffer, the so-called influenza bacillus of conjunctivitis of Müller and the pseudo-influenza bacillus of zur Nedden.

While the different bacteriological factors causing conjunctivitis do not always, yet in the majority of cases these organisms do, give rise to well-marked characteristic clinical pictures. In Koch-Weeks conjunctivitis one finds reddened and edematous lids, intense injection of the bulbar conjunctiva, with profuse muco-purulent discharge. In influenza conjunctivitis there is a well-marked involvement of the bulbar conjunctiva and signs of influenza elsewhere. The bacillus influenzae has been found in the normal conjunctival sac and in odd cases of conjunctivitis where there were no general signs of influenza, but in the majority of cases influenza conjunctivitis accompanies systemic influenza. Clinically, Koch-Weeks, influenza, and the form of conjunctivitis here described are very different.

Differentiation by morphology is unsatisfactory and here unnecessary. While the Koch-Weeks bacillus may be differentiated from the bacillus influenzae, I am ready to admit that morphologically they are strikingly similar. On media these organisms differ widely. The Koch-Weeks bacillus does not grow well on hemoglobin agar as here used, it grows best on hydrocele or ascitic agar. When growing even with the bacillus xerosis it is hardly perceptible and dies out very quickly in forty-eight hours or a little longer.

The bacillus influenzae in the presence of hemoglobin after twenty-
four hours shows a profuse raised growth of round whitish colonies. The growth is easily seen, the colonies being the size of an ordinary pin head. Older colonies show some change in color.

The bacillus here described on hemoglobin agar gives a very characteristic appearance; over the surface of the agar, with a proper reflection of light, is seen a mass of tiny pin-point colorless colonies. The growth is not easily seen. This organism has also been cultivated on media free from hemoglobin.

The Koch-Weeks bacillus, while pathogenic for the human conjunctival sac, is not pathogenic for animals. The bacillus influenzae is slightly pathogenic for some animals. Pfeiffer found by injecting the bacillus influenzae intravenously into rabbits a characteristic effect was produced. He attributed these results to toxic products present in the culture, and in none of his experiments was he ever able to obtain effects resembling septicemic infection. Cantani by injecting the bacillus influenzae into the anterior portion of the brain of rabbits succeeded in producing an acute encephalitis. The bacilli, however, were never found in the blood or other organs.

This bacillus is pathogenic for mice. In every case where injected intraperitoneally a marked peritonitis was set up and a septicemia, as evidenced by pure cultures of the bacillus being obtained from the heart’s blood.

This organism then is similar to the different influenza bacilli in morphology and in its growing well in commensal relationship with the staphylococcus.

It is not bacillus influenzae for the following reasons:

The form of conjunctivitis set up differs from influenza conjunctivitis. This bacillus on hemoglobin-agar differs widely from bacillus influenzae. On this media, under most favorable conditions and with the media at a most suitable reaction, the growth is hardly perceptible and differs from the bacillus influenzae on the same media in size, color and appearance. The bacillus has been cultivated on media free from hemoglobin. It is viable for a much longer period than the bacillus influenzae. It is pathogenic for mice causing a septicemia.

We have then to deal with a new form of conjunctivitis, set up by a new etiological factor. That factor resembles the bacillus influenzae, and probably belongs to the influenza group, but differs from it widely on media, and in viability and pathogenicity. Whether the form of conjunctivitis set up by this micro-organism is a local condition at Montreal or not, I am not prepared to say. Fifty-two cases is not a large number, but it is larger than any other form seen here,
in the same period, with the exception of the Morax-Axenfeld. From a clinical standpoint, the type is a very definite one—a catarrhal palpebral conjunctivitis occurring in infants. In all its cultural features this bacillus is widely different from the Koch-Weeks bacillus. In the majority of the features described it is vastly different from the bacillus influenzae.

**Bacteriology of staphylococcus and streptococcus conjunctivitis.** In examining a series of conjunctivitis cases, one will be struck with the large percentage where apparently no bacteriological factor is found. In some of these the cause is not bacterial but due to one of many other factors. However, in many of the negative film cases, cultural methods will demonstrate the presence of the staphylococcus in large numbers, and if the conjunctivae are now inoculated with some of the growth, a very definite inflammation will be set up. I have followed this procedure in a number of cases and am confident that the staphylococcus aureus is a common cause of conjunctivitis.

The streptococcus pyogenes is a very important micro-organism in ophthalmic bacteriology. By the necrotic process which it causes, it is a great menace to the cornea. In a certain percentage of cases of ophthalmia neonatorum, the streptococcus will be found as the cause. Very frequently it is found in pseudo-membranous cases, either alone, or with the bacillus diphtheriae. It is found in such cases generally in poorly-nourished children. The lachrymal conjunctivitis (Pari-
naud and Morax) due to stenosis of the nasal duct, is also a streptococ-
cus conjunctivitis. This is a severe inflammation, with swelling of the pre-auricular glands, followed by a toxin iritis.

**Bacteriology of rare forms of conjunctivitis.** These are chiefly caused by bacillus diphtheriae, bacillus coli communis, bacillus subtilis,
A Small Gram Negative Bacillus Obtained from Case of Infantile Conjunctivitis.

Small Gram Negative Bacillus in Pure Culture.
Streptococcus Pyogenes, Gram's Stain.

Bacillus Coli Communis
bacillus pyocyaneus, the pneumobacillus of Friedlander, micrococcus catarrhalis, meningococcus and the spirochaeta pallida.

Conjunctivitis caused by the bacillus diphtheriae is no longer a common disease. Before antitoxin came into use, this was considered one of the most serious of ocular diseases because of the rapidity with which an eye was destroyed. In the severe cases treatment seemed almost powerless. This form of conjunctivitis is still occasionally met with, and has very definite clinical characteristics. It is caused by Loeffler’s diphtheria bacillus.

The bacillus coli communis has been found in cases of ophthalmia neonatorum, in milder forms of conjunctivitis, in dacryocystitis, panophthalmitis, and hypopion keratitis. It is a short rod, with rounded ends 0.4 to 0.7 microns in diameter by 1 to 3 microns in length. The bacilli may be seen as very short rods resembling micrococci. They may appear also in pairs and even in chains. The colon bacillus stains readily with the ordinary aniline dyes, and is negative to Gram’s stain. It grows well on all the ordinary media, at 20° to 37° centigrade. On blood serum the colonies are round, greyish-white, and slightly elevated. It is differentiated from the typhoid bacillus by motility, its appearance on potato cultures, by gas production on media containing glucose, and its action in litmus milk cultures.

Bacillus Subtilis.

The bacillus subtilis is a large motile rod 2 to 2.5 microns long by 0.5 to 0.5 microns thick. It is rounded at the ends, is Gram-positive and in old cultures spores are found placed centrally. A characteristic feature of its growth is the appearance in bouillon, where a scum forms which easily sinks to the bottom. On agar the growth gradually
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stains the medium a brownish colour. The bacillus subtilis has been found in cases of conjunctivitis and by zur Nedden in two cases of ulcerous serpens.

The _bacillus pyocyaneus_ has been reported as the pathological agent in a number of cases of purulent keratitis, and by G. S. Derby in conjunctivitis. The bacillus is a slender rod, frequently seen in pairs or chains. It is actively motile and does not form spores. It stains readily with the aniline dyes and is negative to Gram’s stain. It is an aerobic, liquefying, motile bacillus, which grows on all the ordinary media at room or incubator temperature, and in gelatine imparts a fluorescent green colour to the medium. This bacillus is widely distributed in nature.

_Friedlander’s pneumobacillus_, discovered in 1883, is now known as the cause of infection in cases of conjunctivitis, dacryocystitis, and hypopion keratitis. It is a large bacillus similar to the Morax-Axenfeld diplobacillus in morphology and staining reactions. The bacillus varies considerably in length, with a very obvious capsule. It is an aerobic, non-motile, non-liquefying bacillus which does not form spores. On blood serum there is an abundant greyish-white viscid growth. In gelatine stick cultures it presents the “nail-shaped” growth, and in old cultures the gelatine takes on a distinct brownish colour. The above cultural features readily distinguish this bacillus from the Morax-Axenfeld form.

_Micrococcus catarrhalis_. In fifty-two cases of conjunctivitis examined at the Montreal General Hospital, this micrococcus was isolated and identified by cultural tests. The cases ranged clinically, from catarrhal to purulent inflammations. The following case will serve to illustrate: Smears from the conjunctival discharge showed numerous Gram-negative intracellular diplococci. This was thought to be an exceedingly virulent infection, but when the patient was brought back three days later the condition had almost entirely subsided. The inoculated tubes explained it. The organisms seen in the smear preparations were not gonococci, but the micrococcus catarrhalis.

The micrococcus catarrhalis is a frequent inhabitant of the conjunctiva, and occurs in pairs and fours. Like the gonococcus, it is coffee-bean shaped, and negative to Gram’s stain. It grows well on ordinary agar-agar in greyish or yellowish white colonies, and is differentiated from the meningococcus, gonococcus, and other Gram-negative diplococci by cultural tests.

_Spirocheta pallida_. Primary and secondary syphilis of the conjunctiva has at different times been reported. A patient, H.R., aged 25 years, the subject of syphilis, was examined by me for a swelling
of her right lower eyelid, which had been noticed the day previously. She did not complain of any pain or unpleasantness about the eye. The right lower lid was swollen, especially along the edge at the outer quarter.

The eye was watery and the conjunctiva markedly congested. Upon pulling down the right lower lid there was seen on the palpebral conjunctiva, upon the outer quarter of its surface, an area which had a decidedly different color from the rest of the conjunctiva. The peculiar pale-blue hue contrasted so plainly with the reddened conjunctiva that the whole border of the patch was very definitely shown. Somewhat oblong in shape, it extended laterally from the middle fourth of the lid to almost the outer canthus, and from before backwards from the edge of the lid to the fornix. The diagnosis from the clinical condition of the patient and the appearance of the lid was mucous patch of the conjunctiva.

Slides were prepared from the mucous patch by Dr. R. P. Campbell, and stained by Giemsa and modified methods. In all, the spirochaeta pallida was found in quantities. Some fields showed as many as six or seven. Slides prepared from the mucous patches of the throat showed spirochaeta pallida and refringens.

Burnett, in Norris and Oliver’s System says: “There would seem to be no reason why mucous patches should not occur during the regular course of the disease on the conjunctiva as well as on other mucous surfaces and several such cases have been reported. One case at least has been reported in which a true gumma had its seat on the conjunctiva.” The only reference which Fuchs makes to syphilis of the conjunctiva is on syphilitic ulcers, which he says are among the greatest of rarities. Still rarer is soft chancre of the conjunctiva.

The relations of the spirochaeta pallida to eye conditions are as follows: (1) The finding of the spirochaeta pallida in apparently healthy eyes of infants who have died from congenital syphilis. (2) Its discovery in lesions set up experimentally in the eyes of monkeys and rabbits by the inoculation of syphilitic material. (3) Its discovery in actual syphilitic lesions of the human eye.

Stephenson found the spirochaeta pallida in the aqueous humor of a woman with irido-cyclitis during secondary syphilis, also in the scrapings from three cases of keratomalacia in syphilitic infants. He believes in the discovery of the spirochaeta pallida we have the strongest possible proof of the syphilitic nature of any disease of the eye.

**Meningococcus conjunctivitis.** Conjunctivitis as a complication of epidemic cerebro-spinal meningitis has long been recognized. Among 111 cases of meningitis, Councilman saw ten complicated with cor
junctivitis, among thirty, Davis saw eight with the same complication. Robinson stated that purulent conjunctivitis was a not infrequent complication of meningitis, but unfortunately the bacteriological examination was not often reported. Ballantyne in a paper on *Ocular Symptoms in Cerebro-spinal Meningitis* stated that hyperaemia of the bulbar and palpebral conjunctiva occurred in many cases. A certain degree of bulbar injection is quite common even in the first few days and may persist for some time. Among the seventy-three cases examined thirteen had acute catarrhal conjunctivitis with more

Meningococcus from the Conjunctiva x 2000 diam.

or less purulent discharge. In the majority it was a symptom of the early acute stage, but in several appeared in late stages and might well have been due to outward infection from the incomplete closure of the lids. No attempt was made to work out the bacteriology of the discharge. In two cases conjunctival hæmorrhages were present. McGregor, who mentioned this symptom to Ballantyne, saw conjunctival hæmorrhages quite frequently in the earlier cases of the Glasgow epidemic. They were usually during the acute stage and even in the absence of such spots on the skin. They go so far as to suggest (1) as conjunctival hæmorrhages are rare in acute illnesses except whooping-cough, their presence in a patient suspected should carry some weight, and (2) conjunctivitis which occurs as an early symp-
tom would most likely help to distinguish this from other forms of meningitis.

The fact that the meningococcus has been isolated from the conjunctival discharge in a few cases has added interest to conjunctivitis as a symptom. According to Axenfeld, Frankel reported a severe pseudo-membranous conjunctivitis in three children of one family due to a diplococcus which he thought was the meningococcus. Hagland also described a case of meningococcus conjunctivitis. Both these cases are now discredited. Wintersteiner reported a case of ophthalmia occurring in the course of meningitis. In cover-slip preparations from the conjunctiva an organism identical in morphology with the meningococcus was obtained. Weichselbaum studied Wintersteiner's preparations and although no cultures were made he considered the finding positive. Wintersteiner believed the infection a metastatic one. According to Axenfeld, Koplick in Washington in 1904 reported finding the meningococcus in the conjunctival sac in a case of epidemic meningitis. D. Smith in the Archives of Ophthalmology reported among 100 cases of conjunctivitis one due to the meningococcus. No differential diagnosis, however, was given. Gabrielines in a child of twenty-five months with meningitis found in the conjunctiva, xerosis bacilli, pneumococci and Gram-negative diplococci, intra and extra cellular, which coincided in every way with the Gram-negative diplococci from the cerebro-spinal fluid. E. S. Thompson at the meeting of the American Medical Association, 1906, reported finding the meningococcus three or four times among 400 cases of blennorrhea. Differentiation here is, however, unsatisfactory. Robinson from one case of meningitis isolated the meningococcus from the purulent discharge. In three other cases of conjunctivitis the finding was negative. In spite of these reports at a meeting of the Ophthalmological Society of Paris, December 31, 1907, when Moissonnier reported a case of meningococcus conjunctivitis, Morax said: "As yet there has been no authentic case of meningococcus conjunctivitis reported. The case reported by Moissonnier is neither clinically nor bacteriologically satisfactory."

During the last year I have had an opportunity of seeing six cases of epidemic meningitis with conjunctival symptoms:


Child aged 7 years. Catarrhal conjunctivitis both eyes. Smear Gram-negative diplococci and Gram-negative diplobacilli. Culture diplobacilli and bacillus xerosis.


In each case the diagnosis was made by cultural tests. In cases 3 and 5, although characteristic Gram-negative diplococci were found in the smear preparation, the conjunctivitis has been placed as due to the organisms cultivated. In all the cases the conjunctivitis was in the early stages of the disease. In only one case was there much purulent discharge. This was, strangely enough, one of the meningococcus cases. In all the meningococcus was cultivated from the cerebrospinal fluid.

The diagnosis of conjunctivitis due to the staphylococcus, diplobacillus and the bacillus influenzae is a simple matter, but not so with the meningococcus. The latter can only be diagnosed by careful cultural examination. All Gram-negative diplococci in conjunctivitis in meningitis cases are not meningococci, as from Axenfeld’s clinic there has been reported the finding of the micrococcus catarrhalis from a conjunctivitis in a patient with meningitis. Leaving out of consideration the Gram-negative diplococci described by Bumm and those of Lingelsheim, the three Gram-negative diplococci to be discussed in differentiating conjunctival micro-organisms are the gono-coccus, the meningococcus and the micrococcus catarrhalis. The differentiation between these three has been carried out in our cases by a comparison of the following points: Growth by room temperature, growth on plain agar, hæmoglobin agar, gelatine, Læffler’s blood-serum, potato, bouillon, litmus milk, a comparison of their action on the sugars and a comparison of their length of viability.

Where Gram-negative diplococci grow by room temperature and are viable on plain agar for weeks or months, the gonococci and the meningococci are excluded. The micrococcus catarrhalis is so easily differentiated the question comes to be really a decision between the gonococcus and the meningococcus. In the initial tube a growth of the meningococcus upon plain agar is not rare whereas a growth of the gonococcus upon this medium is. Upon hæmoglobin agar they each have a characteristic appearance which is constant. The meningococcus grows profusely with a large raised growth which has somewhat of a bluish tinge. The gonococcus, on the other hand, has a fine, slightly
Micrococcus Catarrhalis from a Pure Culture.

Micrococcus Catarrhalis from Conjunctiva. Gram's Stain.
Mucous Patch of the Conjunctiva.

raised, moist-looking, colorless growth, vastly different in appearance. After considerable experience with the cultivation of different cultures of these two micro-organisms I feel convinced the most satisfactory medium for their cultivation is human haemoglobin agar. They each grow profusely upon this and I believe the appearance of each upon this medium will help to a considerable extent in their differentiation. Upon gelatine they do not as a rule grow. Upon blood-serum the meningococcus grows fairly well, while the gonococcus does not. Upon potato the meningococcus grows at times, the gonococcus never. In bouillon the meningococcus grows with turbidity of the medium, the gonococcus does not grow. In litmus milk the meningococcus sometimes give a slight growth, the gonococcus never. On the sugars the meningococcus ferments maltose and dextrose, while the gonococcus only the dextrose. The period of viability is much less in the meningococcus than in the gonococcus. To insure cultivation the meningococcus must be transplanted every forty-eight hours. Without this precaution very frequently the culture will be lost. The gonococcus, however, can be carried along very nicely by transferring every forty-eight hours and after cultivation for some time transplanting may be deferred for a day or two longer. These are some points noted during the last few years while having the gonococcus and the meningococcus in different strains under constant cultivation. The strains differ in detail, but the gonococcus and the meningococcus when their cultural features are compared give ample ground for differentiation.

The first report of meningococcus from the conjunctival sac of a patient not ill with meningitis was from Axenfeld’s clinic by Brons. The case was one of keratomalacia from pneumococcus infection. From the conjunctiva meningococci were isolated for a period of two weeks. The third case of meningococcus from the conjunctival sac which I have to report is the isolation from an apparently normal eye. A young Jewish boy (Number 279, 1908,) came to the out-door clinic to have his eyes tested for glasses. As I was examining a series of normal conjunctiva at that time I chose his conjunctiva to take cultures from. Tubes of haemoglobin agar, bouillon and plain agar were inoculated. The growth on haemoglobin was profuse, so much so I believed it to be micrococcus catarrhalis, but in putting it through the tests given above I proved it to be the meningococcus. This I believe is the first instance reported of the cultivation of the meningococcus from a normal eye. While the cultivation of the meningococcus from the conjunctiva of patients ill with meningitis is interesting, the cultivation from a normal conjunctiva is even more so. The presence of the meningococcus
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on the nasal mucous membrane of supposed healthy individuals has been shown. Is the presence on the conjunctiva secondary to its presence in the nose or may the conjunctiva, too, be a point of entrance?

Briefly, then, we have seen at the Montreal General Hospital seven cases of epidemic cerebro-spinal meningitis with ocular symptoms. These seven cases consisted of one of metastatic ophthalmia and six of conjunctivitis. From the pus in the anterior chamber of the hypopion iritis case and from the conjunctiva in two cases of conjunctivitis were cultivated Gram-negative diplococci which were carefully studied and shown to be meningococci. To this is to be added the cultivation of the meningococcus once from the normal conjunctival sac.

Bacteriology of Parinaud's conjunctivitis. The bacteriological findings in cases of Parinaud's conjunctivitis have been, the different staphylococci, streptococci, and the xerosis bacillus. Scholtz reported having found a Gram-negative bacillus with polar staining, which grew on all the ordinary media except potato. Verhoeff in the Arch. Ophthal. xliii. p. 375, has recently reported on Parinaud's Conjunctivitis, a Mycotic Disease due to a Filamentous Organism. His conclusions are in substance as follows: 'In eleven out of twelve consecutive cases, each having the clinical features described by Parinaud, and each presenting essentially the same characteristic histological picture, a minute filamentous micro-organism was found. The absence of any other demonstrable micro-organisms in the lesions, the unusual character of the micro-organisms found, their great abundance, and the fact that they were so situated as to explain the lesions, leave no reasonable doubt that they were the cause of the disease. Since no branching of the filaments could be made out, the micro-organism may for the present be classed as a leptothrïx.'

Bacteriology of spring catarrh. Bacteriological examination in the reported cases of spring catarrh, has revealed only the every-day inhabitants of the conjunctival sac. Even in the secreting cases Axenfeld says that he has not made any findings of etiological value.

Bacteriology of phlyctenular conjunctivitis. In many cases of phlyctenular conjunctivitis lacrimation is so severe that the conjunctival sac is being constantly flushed, consequently the bacteriological examination is often negative. In a series examined at the Montreal General Hospital, the following results were obtained: Morax-Axenfeld diplobacillus, 27 times; staphylococci, 14 times; bacillus xerosis, 3 times; negative, 23 times.

What strikes one here is the comparatively large number of nega-
tive results. It is not necessary here to discuss the reported positive results such as phlyctenular conjunctivitis due to staphylococci. To my mind it is just as sound to attribute many cases of conjunctivitis to the bacillus xerosis, because this organism is very frequently found in the inflamed conjunctival sac, as it is to attribute phlyctenular conjunctivitis to staphylococci, because the latter are found in many of these cases. As the figures cited above show, many cases of phlyctenular conjunctivitis give negative results, but I wish to cite the following case to encourage further examination, believing that the results will repay the clinician for his trouble: E. W., an adult male, was referred, complaining that for four days his left eye had been sore and very painful. The eye showed marked congestion of the palpebral conjunctiva; at the outer corneo-sclerotic margin a small grayish elevation was seen surrounded by an area of conjunctival hyperæmia—a typical phlyctenule. A little secretion was examined and to my surprise the field was covered with diplobacilli. Examination showed a like infection of the right eye, and on questioning the patient it was found that he had suffered at intervals from "sore eyes." Three days later he returned very much improved. Five days later the bulbar conjunctiva was quite normal.

Within a few years I have examined twenty-seven such cases; that is, twenty-seven cases of phlyctenular conjunctivitis, where diplobacilli were found in the conjunctival sac. The phlyctenular condition was what stood out prominently, and was what the patients came to consultation for. That they were subjects, too, of diplobacillary conjunctivitis was only found by following routine methods. I do not wish to be understood as believing that these cases of phlyctenular conjunctivitis were caused by this infection. Whether phlyctenular disease of the conjunctiva is due to bacterial infection or not, is questionable. These cases are cited to show that even in phlyctenular conjunctivitis it is worth while to examine the conjunctival secretion.

*Bacteriology of follicular conjunctivitis.* Follicular conjunctivitis is found most frequently in school children. The disease often exists in a latent form, and is sometimes only discovered during a physician's routine examination. Many of these cases are probably due to other than bacterial causes, while in many there is undoubtedly a bacterial infection. The bacteria most commonly found in these cases are: Morax-Axenfeld diplobacillus, Koch-Weeks bacillus and the pneumococcus.

In many cases the film examination does not reveal any bacteria.
Inoculation of media will generally show profuse cultures of staphylococci.

_Bacteriology of trachoma._ Progress in diagnosis of diseases of the conjunctiva has been marked during the last few years, thanks to the help of ophthalmic bacteriology. In spite of that, trachoma in some form seems as difficult of diagnosis today as it was many years ago. One does not refer to the typical case, with pannus and scar-formation, but to the condition of ophthalmia where the palpebral conjunctiva is found thickened, succulent, and granular, conditions all of which are accentuated in the retrotarsal folds. Papillary hypertrophy is by no means limited to trachoma. The hypertrophied follicles are the result of the reaction of the conjunctiva to continued irritation whether that be caused by microorganisms, or by physical, mechanical, or chemical means. Many of these forms are not contagious, and are in but slight degree related to trachoma.

The diplobacillus of Morax-Axenfeld is able to set up a clinical condition identical, as far as the conjunctiva is concerned, with trachoma. Likewise, the pneumococcus sometimes gives a picture similar to the acute form. The relation between gonococcus infection and trachoma may be closer than we think. As Axenfeld has said: "The sequence in many cases is striking."

The discovery of the etiological factor of trachoma has been reported more than once. Generally, these announcements have represented "wild flights of the investigators." Not so with the report of Halberstädt and v. Prowazek, who in 1907 described inclusions which they had observed in the epithelial cells of the conjunctiva. After staining with Giemsa the smear preparations from a trachoma patient, they found, near the nuclei of the epithelial cells, round or oval, dark-blue or violet, non-homogeneous masses. Within these bodies they discovered very sharply defined, small granules of a distinctly red colour. They also noted irregular masses of blue stain, the reaction product of the cell-plastin clots. Halberstädt and v. Prowazek believed these small bodies parasites because:

1. They were always found in the same characteristic way.
2. Inoculation on to the conjunctiva of the orang-outang infected it, with the production of these bodies in the epithelial cells, and transference from orang-outang to orang-outang was possible.

They suggested the name "Chlamydozoa." Their findings have been verified from many quarters. In this country, Verhoff, of Boston, and myself, have demonstrated the cell inclusions in trachoma.

There is no doubt that the Halberstädt and v. Prowazek bodies are constant in all cases of fresh trachoma. Are they present in con-
Figs. 1, 2, 3 and 4.—Trachoma bodies in smear preparation from a case of acute trachoma. Giemsa's stain. 1,500 diameters.

Figs. 5, 6, and 7.—Bodies in smear preparations from two cases of slight conjunctivitis in infants. Giemsa's stain. 1,500 diameters.

Figs. 8 and 9.—Trachoma bodies in surface epithelium from a case of trachoma. Tissues fixed in Giemsa's fixative and stained in sections by a modification of his method. The epithelium, in both instances, consists of a single layer of cells, the long diameters of which are parallel with the surface. 1,500 diameters.

Fig. 10.—Large size trachoma body in surface epithelium, showing the peripheral distribution of the granules. The body also contains a small amount of bluish reticulum. Technic same as above. 1,500 diameters.

Fig. 11.—Detached cell in a section, shows the distribution of the granules and a small amount of bluish reticulum. Technic the same as above. 1,500 diameters.

Fig. 12.—Surface epithelium showing a trachoma body containing a relatively large amount of bluish reticulum and a small number of granules. Technic same as above. 1,500 diameters.
ditions other than trachoma? Before proceeding to the examination of the diseased conjunctiva, Herford examined 100 films of non-trachomatous cases with negative results. Stargardt reported having seen the bodies in one case of non-bacterial ophthalmia neonatorum; Lodato, in cases of spring catarrh; and Stanculeanu, in chalazion.

Heyman, in his study as to their specificity, reported that of nine positive cases, five were from acute trachoma and four from gonorrhœal ophthalmia neonatorum. In these four cases the gonorrhœal nature of the disease was established and the possibility of infection with trachoma excluded. The bodies were so typical that experienced microscopists were unable to differentiate the inclusions seen in the ophthalmia neonatorum cases from those supposedly typical of trachoma. He therefore concluded that it was impossible to declare the v. Prowazek bodies as specific for trachoma, and that their presence was of no value in diagnosis, unless every suspicion of gonorrhœa was removed. Later, Flemming, among 32 cases of infantile conjunctivitis observed for some months, found the trachoma bodies in 12. He also demonstrated these inclusions from a case of gonorrhœal conjunctivitis in an adult. Wolfrum examined 28 cases of gonorrhœal ophthalmia and obtained negative results. Of eight cases of catarrhal conjunctivitis of the new-born, four had inclusions. Secretion inoculated into an adult's conjunctiva was one week later followed by follicles, and after nine days, typical inclusions were found in the smear. The further course of the case was that of genuine trachoma. From these observations Wolfrum concluded that Heyman's findings were from mixed infections of trachoma and gonorrhœa, and that his own cases of catarrhal inflammation were trachoma of the new-born, presenting a very different clinical picture from trachoma in the adult.

Lindner and Hofstätter found trachoma bodies from the vaginal mucous membrane, while Lindner and Fritsch demonstrated them from the inflamed male urethra. Halberstädtter and v. Prowazek, following Heyman's report, made similar examinations with regard to infantile ophthalmia. They concluded that there was a group of non-gonorrhœal ophthalmias characterised by the presence of chlamydozoa where the infection took place ante-partum, which they looked upon as a special infectious disease—"Chlamydozoa blennorrhœa." They also found bodies in the genito-urinary tract of some of the mothers, and also in the urethra of males suffering from a non-gonorrhœal inflammation. In a former report they stated that they believed the chlamydozoa of ophthalmia were in morphology identical with those of trachoma, but that the two might be differentiated biologically.
As Lindner and others have since produced typical experimental trachoma with vaginal secretions, they now believe that the origin of trachoma is derived from the epithelium of the genital sphere, and support Lindner’s view that the disease of the conjunctiva, male urethra, and female genitals, are caused by one and the same virus.

Heyman, continuing his researches, states that he has found the trachoma bodies only in trachoma, in infantile conjunctivitis, and in a suspicious conjunctivitis in an adult female. He often found the bodies and the gonococci in the same preparation. In 15 cases of fresh trachoma the bodies were found in 10; in 15 cases of relapses the inclusions were found three times; while in 23 cases of old trachoma no bodies were found. Of 43 cases of infantile conjunctivitis 14 were pure gonorrhoeal inflammations, 10 were inclusion conjunctivitis with no pathogenic organisms, while 12 were mixed blennorrhoeas.

In 15 examinations of the inflamed urethra in men and women the trachoma bodies were found in two, while in controls the examination was negative. Heyman offers nothing new as to the nature of these inclusions, but states that he believes the bodies point to the presence of a virus which is transmissible to apes, and to which the eyes of the new-born are very susceptible.

During the past few months I have made upwards of 150 examinations at the Montreal General Hospital. The smears may be prepared, fixed, and stained within one hour, making the examination in an out-patient department practicable. I have had negative results in: 3 cases of active trachoma, 13 cases of old trachoma with scar formation, 60 cases of catarrhal conjunctivitis, 28 normal eyes, 5 cases of gonorrhoeal ophthalmia neonatorum, 11 inflamed tonsils, 5 from the vaginal mucous membrane.

The trachoma bodies were found in: 14 cases of active trachoma, 1 case of catarrhal conjunctivitis (pneumococcus) in an infant of ten days, 2 cases of purulent conjunctivitis, in babies of two weeks, 2 infants with no conjunctivitis, and 1 adult male with no conjunctivitis.

It will be noted that in three cases of active trachoma we had negative results in the smear preparations. To show that the bodies may be present in the conjunctiva and missed in the smears, I may say that in one of these cases, examined every day for a week, no bodies were found, but were later demonstrated in the tissue preparations. A striking result of my examinations was the finding of the trachoma bodies is the normal conjunctiva. That has been reported, and need not be dwelt upon here, except to say that since that report another such case in an infant has been observed. Of the positive results,
Fig. 13.—Initial body of Lindner in stratified epithelium. Modified methyleneblue and eosin stained; Zenker fixed tissue. 1,500 diameters.
Fig. 14.—Initial body of Lindner in depth of stratified epithelium. Technic same as above. 1,500 diameters.
Fig. 15.—Mucous cells in human appendix. Formaline fixation; methyleneblue-eosin stain; colophonium differentiation. 1,500 diameters.
Figs. 16 and 17.—Mucous cells in section of rat's jejunum. Giemsa's fixation. Giemsa's stain. 1,500 diameters.
Fig. 18.—Human appendix; two mucous cells showing granules and definite outline of the secretion mass. Formaline fixation; methylene-blue and eosin stain; colophonium differentiation.

Figs. 19 and 20.—Initial bodies of Lindner, from a case of trachoma. Technic same as Figs. 13 and 24.

Figs. 21 and 22.—Smear preparations stained by Giemsa's method, from a case of trachoma.

Figs. 23 and 24.—Smear preparations from the conjunctivae in infants; not trachoma.

Figs. 25, 26, 27, 29, and 30.—Made from sections taken from three cases of trachoma; fixed and stained by Giemsa's method. The individual cells drawn are mucous secreting cells taken from the normal part of the conjunctiva; that is from epithelium which still retains its stratified structure.

Figs. 25 and 26.—Show approximately normal mucous secretion. Similar reddish granules may be found in mucous cells from the rat's intestine.

Fig. 27.—Represents a greater disturbance in that the mucous granules have not coalesced.

Fig. 29.—Shows a condition closely simulating a trachoma body. The figure represents two cells; one filled with mucous granules. The nucleus of this cell lies in another section.

Fig. 30.—Shows a type of mucous secretion which is almost constant in inflamed conjunctiva. Giemsa section.

Fig. 28.—Typical trachoma body in a section showing a few basic stained granules. Giemsa's fixation.

(For these drawings I am indebted to Miss E. R. Piotti. They were drawn objectively, and without instruction. The dimensions were secured with the camera lucida. The smear preparations were drawn with two millimeters, Zeiss apochromat and No. 4 compensating ocular. For the sections, a 1.5 millimeters, Zeiss apochromat and No. 4 compensating ocular.—S. H. M.)
one of great interest to me was as follows.—A baby of two weeks was brought to the out-patient department of the Montreal General Hospital some three weeks ago. It had a purulent conjunctivitis of four days' standing. Smear examination was negative, while culture showed the presence of the staphylococcus pyogenes albus and the bacillus xerosis. To verify the reports of others on infantile conjunctivitis, prepared smears were stained with Giemsa. The epithelial cells were crowded (in many cases the cytoplasm of the cells was broken) by masses of trachoma bodies. The whole microscopic picture was a much more exaggerated one than I had ever seen in the most virulent cases of trachoma.

The figures (see cuts) are micro photographs of 1,500 diameter, taken from these three cases. The masses of trachoma bodies about the nuclei of the epithelial cells in each picture need no explanation. These three cases have been under observation for a number of months and during that period have shown no signs of beginning trachoma, or of any conjunctival inflammation. They demonstrate again that the trachoma bodies are present in non-trachomatous cases, that the trachoma bodies are not the cause of trachoma, and that these bodies are not even pathognomonic of trachoma.

Recent publications by Heymān, Herzog, McKee, and others have established the non-specificity of the trachoma bodies of Halberstädtter and Prowazek. We have regarded the solution of the origin of these
bodies to be of great importance; first because of its bearing upon the study of the etiology of trachoma, and secondly because the discovery of trachoma bodies was the occasion for the introduction of the new term "chlamydozoa," expressive of a possibly new group of intracellular protozoa, including the bodies found in variola, vaccinia, scarlet fever, contagious epithelioma of fowls, molluscum contagiosum, rabies and other diseases of animals. The work resulted in the finding of bodies identical in every respect with the trachoma body in five cases of slightly inflamed or normal conjunctivæ in infants and one in an adult. These cases have been followed for months, and the absence of trachoma, and indeed the possibility of exposure to trachoma have been absolutely excluded. This result, together with the evidence now accumulated in the literature, has stimulated a careful study of tissue already at hand, with the intention of determining the nature of the trachoma body.

The material consisted of tissue excised from ten cases of trachoma; most of them acute. The first five were fixed in Zenker’s fluid and formaline; the remaining five were fixed in Giemsa’s fixative as well as in Zenker and formaline. Various staining methods were employed, but it was found a modification of the eosin-methylene-blue stain and Giemsa’s stain, as applied to sections, were the most useful. Giemsa’s stain was also slightly modified in that a twenty-per cent. solution of colophonium in acetone was used for differentiation, in place of the
xylol-acetone mixture, recommended by Giemsa. The eosin-methylene-blue stain both for formaline and Zenker fixation, was differentiated with an alcohol colophonium mixture; about ten per cent. for formaline fixed tissues, and one to three per cent. for Zenker fixed tissues. The presence of colophonium in the alcohol seems to insure against the decolorization of structures stained with eosin; for example, we found it to be a very effective means of staining the granules of Schridde in plasma cells. The tissues were imbedded in paraffin, via cedar oil. Serial sections were cut at three, four, and five microns.

Assuming that the trachoma bodies are not parasitic, the following possibilities suggest themselves; that the trachoma bodies consist of:

1. Extruded nuclear material. 2. Remains of granular leucocytes, which may have invaded the epithelial cells. 3. Degeneration of the cytoplasm. 4. Products of disturbed cell secretion.

All of these hypotheses, excepting the last, could be quickly excluded by careful study of sections. The last hypothesis required more elaborate study, and particularly a study of mucous secretion in normal and pathological tissues.

The palpebral conjunctiva is covered by a stratified epithelium, in which there are numerous mucus secreting cells. In trachoma, as in other inflammatory processes, the epithelium becomes destroyed in places, and the defects repaired by regeneration. It is also possible that complete destruction of the epithelium is prevented by rapid
multiplication of the lowermost cells, and either explanation may account for the finding of areas of epithelium, consisting of but a single layer of cells overlying densely infiltrated areas.

The first result, from the study of the tissues, was the discovery that the trachoma bodies, with the exception of the initial form of Lindner, were found only in the thinned epithelium; that is, in places where the epithelium consisted of but one or two layers of cells, the long axes of which are horizontal instead of vertical, as in the normal epithelium of the conjunctiva. This was regarded as significant, because if the bodies were parasitic there should have been some evidence of the invasion of the more normal epithelium, and also because it introduced the question of the effect upon mucous secretion under the altered cell conditions.

The initial bodies of Lindner (see plate) are best seen in eosin-methylene-blue sections of Zenker preserved material. They consist of vacuoles containing small, brightly-blue-stained granules with a tendency to peripheral distribution; with Giemsa's stain, the granules take a purplish-blue color. A border of increased refractivity suggests a capsule. The size of the granules, the staining reaction and the refractive border are so similar to that of the clusters of granules in early mucous secretion that we are forced to the conclusion that the initial bodies of Lindner are merely products of early mucous secretion, in evidence of which see photomicrographs, made from a normal human appendix and normal rat's small intestine. The granules of the Lindner bodies are so closely identical in size and staining reaction to early mucous secretion that no other conclusion seems possible.

While Giemsa's stain is a fair method of demonstrating these mucous granules, we prefer the eosin-methylene-blue stain, with colophonium differentiation, after formaline fixation. The granular appearance of early mucous secretion is well known and is stated in most textbooks of histology. The demonstration, however, is a more difficult matter and seems to be dependent upon conditions in fixation, which cannot be perfectly controlled. After concluding that the bodies of Lindner were products of mucous secretion, it was only logical to attempt the solution of the bodies of Prowazek and Halberstaedter along the same lines, bearing in mind, however, that mucous secretion, if it did occur in the thinned epithelium, must be under greatly altered conditions.

A careful study of the trachoma bodies in smears and the exactly similar bodies found in smears from non-trachomatous cases shows that the basic staining material, the "plastin" of Prowazek and Halberstaedter is distributed in the form of small masses, markedly
irregular in size and shape, but reminiscent of the contents of mucus secreting cells. The red granules, which are supposed to be the parasitic elements, lie between these masses of blue-stained material.

In the early part of our work we had noticed certain vagaries in the behavior of mucus to Giemsa’s stain. In some instances the completed product of mucous secretion consists of a mass of coarse, bright red granules. The appearance of the mucus after discharge from the cell is usually that of a purplish-stained material. The contents of many mucus secreting cells, throughout all of the material stained with Giemsa’s stain, consist of bluish reticular or granular material interspersed with red granules of varying size, so that it became evident that in the more normal portions of the conjunctiva, the two elements of the trachoma body could be found in the process of mucous secretion. In areas of marked injury to the epithelium, where the mucous secretion is disturbed, the contents of the mucous cells are smaller, the red dots more numerous, and the basic staining material more prominent, up to a certain point. As the contents of the cell increase in amount the basic material disappears, and the red granules are left; occasionally with small fragments of bluish-stained material. One peculiarity of the trachoma bodies in the sections is the irregular distribution of the granules in the cell, when the trachoma body is of large size.

Trachoma bodies are not specific of trachoma, nor are they parasitic in nature. In sections, they are found only in the most injured portions of the epithelium, where typical mucus secreting cells are absent. On the other hand, in the more normal portions of the epithelium, where mucous cells are present, trachoma bodies cannot be found. Granules identical in size and staining reaction with the red granules of trachoma bodies may be found in disturbed mucous secretion. The so-called plasin material of trachoma bodies is similar in staining reaction and arrangement with certain forms of mucous secretion. We have come to the conclusion that trachoma bodies are the product of mucous secretion under pathological conditions.

**Bacteriology of metastatic gonorrheal conjunctivitis.** We recognize today two distinct forms of gonorrheal infection of the conjunctiva: (1) gonorrheal ophthalmia, due to direct transfer of virulent pus to the conjunctiva; (2) metastatic gonorrheal conjunctivitis, a form which occurs in subjects with systemic gonorrhea, and which is due to infection carried to the eye by some internal means.

The cause and results of gonorrheal ophthalmia in infants or adults is only too well known. Bacteriology has placed our knowl-
edge of its cause on a sound basis, thanks to the work of Neisser and Pirringer.

The second type has been seen for many years, in fact, the metastatic was the first of these forms to be recognized, and at one time all cases of gonorrhœal conjunctivitis were attributed to infection by metastasis. It has a characteristic clinical appearance. Early in the course of a gonorrhœa, or after some months; or during a relapse, the patient suddenly finds both eyes inflamed, with more or less muco-purulent discharge. Shortly after this gonorrhœal rheumatism makes its appearance. The inflammation occurs among males, tends to recur, may remain a conjunctivitis or involve other parts of the eye. While metastatic conjunctivitis has been well understood clinically, its etiology has been the subject of much speculation and discussion. Bacteriological work has been practised to a very limited degree, and in the majority of cases has consisted in the examination of a prepared smear. Many of these cases, too, were reported before we were acquainted with the pathogenic conjunctival organisms and before conjunctival bacteriology had been brought to its present standard. As was to be expected, the results were largely negative, to such an extent, in fact, that the presence or absence of the gonococcus has been taken as the important point in the differential diagnosis of the metastatic from the direct infection.

If not due to the gonococcus, to what then shall we attribute it? According to Carroll, there are three principal theories. Axenfeld, in discussing van Moll’s paper at the congress in Utrecht in 1899, advanced the theory that this form was not due to the gonococcus, but rather to the action of the gonotoxin on the conjunctival tissue. A second theory is that the inflammation is due to a mixed infection. That the gonococcus, or its toxin, prepares the way for the ordinary pyogenic bacteria, so frequently present in the conjunctiva, to set up an inflammation. The third theory is, that the infection is a true metastasis, that the infection is set up by the gonococcus, carried by the blood vessels to the conjunctiva, as we know it can be carried to different parts of the body. The evidence in favor of this view consists in Lipski, Morax, van Moll, Burchardt, Kurka and Knapp, having found the gonococcus in the conjunctival secretion. Whether differentiation from the other Gram-negative diplococci took place or not in these cases, I am unable to say.

Sidler-Huguenin of Zurich, last year reported some very interesting observations on metastatic ophthalmia. There were fourteen cases, twelve of which were of gonorrhœal origin. In five of the twelve cases, gonococci were found in the blood, and in one case, he
cultivated gonococci from the aqueous in pure culture. That gonococci are the active agents in some of these cases at least, was shown by the fact that Sidler-Huguenin found gonococci or Gram-negative diplococci in a piece of conjunctival tissue.

Diagnosis of metastatic conjunctivitis depends largely upon clinical evidence. E. B., a young man aged 19 years, was referred for treatment for gonorrhœal conjunctivitis. He had been under treatment for some months for gonorrhœa, but in spite of that had spent a Thursday night in sexual excess. On Friday his eyes felt "peculiar," and he noticed they were blood-shot. During the following two days the redness increased, and on the next evening he came to consultation. He complained that his eyes were painful, especially the right, though both had become involved simultaneously. There was no swelling of the lids, and but very slight chemosis of the bulbar conjunctiva of the right eye. Intense congestion of both palpebral and bulbar conjunctiva was present, though a ring about the corneosclerotic margin was of normal color and contrasted very markedly with the rest of the conjunctiva. There was a profuse muco-purulent discharge especially from the right eye, the whole being a typical picture of a severe acute catarrhal conjunctivitis of pneumococcus or Koch-Weeks type. After examining the media, fundi and vision, which were normal, slides were examined and media inoculated.

Patient was a well-nourished, well-developed young man, with sallow complexion. There was no urethral discharge. He had had a discharge for three months, but with the onset of the inflammation in his eyes this had stopped. There was no evidence of scar on the penis, no pain on micturation, but a large quantity of pus in the urine. There was marked swelling and redness of the metatarso-phalangeal joint of the great toe of the left foot. Great pain on movement of the foot, and marked tenderness over the joint. The other joints of the body were normal. He had, in both eyes, a severe catarrhal conjunctivitis. Previous history negative. The treatment ordered was irrigation of the conjunctival sac with warm boracic solution, with local applications to the painful joint.

The diagnosis of metastatic conjunctivitis was made from: The onset and course of the inflammation, the absence of clinical signs of exogenous infection, the coincidence of the conjunctivitis with other systemic gonorrhœal manifestations and the bacteriological report.

When the patient was first seen, one slide after another was prepared and examined, until in one, three Gram-negative diplococci were seen either within or upon three leucocytes. Eighteen slides had been carefully prepared and searched through before this result was
obtained. Tubes of plain agar, blood serum, haemoglobin and hydrolele were examined. No growth was perceptible. Twenty-four hours later they were examined again. In the tube of haemoglobin agar a profuse growth was seen. The surface was thickly dotted with small, raised colonies of whitish color, which upon examination were seen to be the bacillus xerosis. In the midst of this growth two colonies of different appearance were seen. They were larger, moist looking and colorless. Upon examination these were found to be Gram-negative diplococci. These two moist colonies with the surrounding growth necessary, were then transferred to other tubes of haemoglobin agar. From day to day the growth of the Gram-negative diplococcus increased, so that at the end of seven days, we had a profuse, mixed growth of the Gram-negative diplococcus, and the bacillus xerosis. They were then easily obtained in pure culture.

Blood cultures were taken upon two occasions; the first was negative. The second, taken at a time when the systemic infection was marked by severe pain and high temperature, gave us, after 48 hours, tiny points over the haemoglobin agar. These were found upon examination to be Gram-negative diplococci, which, however, we were unable to transfer.

The Gram-negative diplococcus obtained from the conjunctival secretion was compared with a microoccus catarrhalis, obtained from the nose, a meningococcus from the cerebro-spinal fluid, and a gonococcus from the urethra. It grew only at the body temperature, did not grow on plain agar, gelatine, blood serum, bouillon or milk. It grew well on haemoglobin agar, with typical appearance; it fermented dextrose. So that, in morphology, cultural features, sugar reaction, this diplococcus was differentiated from the meningococcus, the microoccus, catarrhalis and the saprophytic Gram-negative diplococci.

The microoccus catarrhalis and other Gram-negative diplococci are frequently found on the normal and inflamed conjunctiva. This makes differentiation necessary. The Gram-negative diplococci found on the conjunctiva in purulent ophthalmia are not always gonococci, or those on the conjunctiva in meningitis cases not always meningococci. Every case of catarrhal conjunctivitis occurring in a patient with systemic gonorrhoea is not metastatic. Careful bacteriological examination is necessary, and where Gram-negative diplococci are found, careful differentiation should be made.

It may be asked why, with gonococci in the conjunctival sac, was there such a mild clinical course? Stock has shown organisms causing a metastatic inflammation produce a much milder form than when introduced in some other way. Again, if gonococci were present in
smear and culture, why call the conjunctivitis metastatic? The clinical history and course answer this. The ectogenous type of gonorrhoeal ophthalmia varies considerably in severity. The virulence of the urethral infection may have been attenuated before the eye became inoculated. Mild cases undoubtedly occur, but it is to be remembered that some of these mild infections are not due to the gonococcus, but to the micrococcus catarrhalis and other causes.

The interesting points in this case which gives us a classical picture of a metastatic conjunctivitis in gonorrhoea are as follows: The retropulsion of the old writers was very definite. Although urethral discharge had been present from three to four months, with the onset of the eye symptoms the discharge stopped. Subjective symptoms were present three to four days. The onset of the conjunctivitis was indefinite, and simultaneously in both eyes following sexual excess. The previous history was good; no rheumatism. The clinical picture and the course of the conjunctivitis, almost without treatment, was mild, as compared with the exogenous type. The tendency of the conjunctivitis was to recur and to remain a conjunctivitis as it does in 65 per cent. of the cases. The rheumatism occurred after the conjunctivitis and ran a typical course. Our interest, however, in this case centres in the bacteriological report. As has been stated, some writers give the absence of the gonococcus in the secretion as an important point in the differential diagnosis, and attribute the metastatic inflammation to a toxin. More likely the gonococci were present, but through faulty methods were not found. The organisms must necessarily be few in number, and a bacteriological report from the examination of one or two slides shows one how easily error may creep in. In this case eighteen slides were examined before any definite result was obtained.

That I was able to cultivate the gonococcus I attribute to having seen the case in its early stage and to having used media upon which the gonococcus would grow as profusely as would the contaminator. That I obtained it in pure culture was due to a frequent transplanting for days, when I really felt the task was hopeless.

Axenfeld, in his book, says: "Morax in his exact bacteriological research stated that scattered gonococci may be found in such cases. Parinaud made the same observation, and their results were confirmed by van Moll. We must not, therefore, conclude from a negative examination for gonococci that the inflammation is due to a pure toxin metastasis, and not metastases of the organisms themselves, though the former cannot be definitely excluded. Certain proof, however, is not yet available."
Metastatic ophthalmia occurring in epidemic cerebro-spinal meningitis is not a rare condition. Many of these cases are mild and undoubtedly have in the past been often overlooked. Many of them have been discovered only at autopsy. The percentage of cases of meningitis complicated by metastatic ophthalmia is given by Knapp as 4 to 5, by Heine as 5 and by Uhthoff as 4. The affection occurs as a rule in one eye, but has been reported in both by Knapp in one of ten cases, by Kreitnaier in one of twelve cases, by Seggel in one of four, by Uhthoff in two of eleven, by Heine in two of five, by Marcuse in one case and by von Graefe in three cases. The clinical picture is a characteristic one and has been well recognized for years. Early in the course of the disease, generally between the first and third weeks, there suddenly appears a hypopion iris with exudation in the pupillary area. This condition very quickly assumes the well-known picture of pseudo-glioma. Often the characteristic yellowish appearance in the pupillary area is the first symptom pointing to any ocular complication.

While the condition has been well recognized clinically, a bacteriological examination has been made in only a very few cases. Uhthoff upon three occasions tried to obtain the micro-organism by aspirating the vitreous, but with negative results. Axenfeld aspirated the anterior chamber and found microscopically Gram-negative diplococci. Cultivation was, however, unsuccessful. From an eye examined at post-mortem Axenfeld later cultivated the meningococcus. Hanke and Tertsch, have lately reported an interesting case. A seven months' old child was referred to the eye clinic from the children's hospital with the diagnosis of "inflammation of the lungs." The mother stated that eight days after the beginning of the illness she had noticed "an opacity of the right eye and the pupil had disappeared." At the first visit to the eye clinic a metastatic ophthalmia was diagnosed. (Irido-choroiditis chronica, with pupillary and vitreous exudation.) In the lower quadrant near the equator a bulging was noticed. When the child was brought back eight days later a thick, yellowish discharge was seen, coming from the former prominent part. Marcuse has also reported spontaneous perforation of the globe by a suppurative process caused by the meningococcus.

Axenfeld in writing on metastatic ophthalmia cites a case of Wintersteiner's and one of his own. There are also doubtful cases reported by Saltini, Silcock, Treacher Collins, Mayou and others. Wintersteiner saw, in cut sections of a bulbus, from a meningitis case, Gram-negative diplococci, both intra- and extra-cellular. Uhthoff also found in sections, Gram-negative diplococci. Weischselbaum mentions
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the above case of Wintersteiner's and a case reported by Stevenson. The latter was a case of panophthalmitis, in the pus of which, associated with other bacteria, were found meningococci.

It will be seen that a bacteriological examination with a differentiation of the Gram-negative diplococci has been made in only three cases, that of Axenfeld, that of Hanke and Tertsch, and one observed by myself. The mere stating that meningococci were found is not sufficient. In discussing Gram-negative diplococci found in the eye, it is necessary to differentiate between the gonococcus, the micrococcus catarrhalis, and the meningococcus. That the gonococcus is a frequent factor in inflammation of the eye is well known. The micrococcus catarrhalis has been isolated from some catarrhal conjunctival conditions, and from some cases of purulent ophthalmia, while the meningococcus has been cultivated both from the pus of the anterior chamber and from the conjunctiva, so that for diagnostic purposes the examination of a smear alone is of practically no value, unless followed by cultivation and study of the micro-organisms. One would think the finding in a smear, of Gram-negative diplococci, in eye conditions complicating meningitis, ought to be proof of their being meningococci, but such is not the case. From Axenfeld's clinic last year, was reported the isolation of the micrococcus catarrhalis from the conjunctiva of a patient ill with epidemic cerebro-spinal meningitis. Had the diagnosis been left to the morphology of the organism, it would naturally have been diagnosed meningococcus conjunctivitis. So much careless eye bacteriology has gone on record it is high time we demanded from ophthalmologists the same proof of their results that we receive from others. When one finds, in recent publications, "Weichselbaum's biscuit-shaped coccus" being described as "surrounded by a clear space very much the same as that found between the organism proper and its containing capsule," or when one sees a photograph of beautiful lanceolate diplococci described as meningococci, the necessity for greater care in diagnosis will be readily seen. The finding of diplococci or "bodies in the tissues resembling the meningococcus" is not sufficient to warrant the statement that these were meningococci. The staining of Gram positive organisms in tissue is a simple procedure; on the other hand, the staining of Gram-negative bacteria, and especially the meningococcus, is a matter requiring special technique and very great care. If in staining tissue by one of the ordinary methods, diplococci are found, we may be sure they are not Gram-negative organisms. For obvious reasons Gram-negative bacteria will not be stained by such methods. Duval has recently described a method of staining Gram-negative organisms
in tissue. I have seen some very pretty slides showing gonococci stained in the tissues and would advise its use for the meningococcus, but the latter organism will be found even harder to stain than the gonococcus. The demonstration of Gram-negative diplococci in smears, especially in eye bacteriology, is not sufficient to name the organism. Only lately I obtained upon three occasions the micrococcus catarrhalis from inflamed conditions of the conjunctiva. In the smears they were intra- and extra-cellular and without cultivation would have been diagnosed gonococci, so that to differentiate the Gram-negative diplococci of the conjunctiva, even in cases of epidemic meningitis, a study of the cultural features of the organism is necessary.

_Bacteriology of dacryocystitis._ The inflamed tear sac has long been recognized as a bacteriological home, where the most important resident is undoubtedly the pneumococcus. Gerstenberger in 12 cases of dacryocystitis found streptococci 3 times, staphylococci 5 times, pneumococci 4 times.

_Pneumocococcus from the Lachrymal Sac. x 1500._

In thirty cases of dacryocystitis examined in Axenfeld's clinic by Brons the following were the results: Sixteen cases of pneumococci, 7 cases of staphylococci and 5 cases of Gram-negative bacilli.

In a series examined at the Montreal General Hospital, the figures were: Pneumococcus 19 times, streptococcus 4 times, Morax-Axenfeld
diplobacillus 5 times, influenza bacillus 2 times, xerosis bacillus 2 times, and negative 1 time.

From these figures it will be seen, as stated above, that the pneumococcus is by far the most frequently met with, and most important micro-organism found in purulent dacryocystitis. The pneumococci from a purulent lacrymal sac are much more virulent than pneumococci from the conjunctival sac. This is well shown in the malignancy of the corneal lesions infected with lacrimal discharge.

Among rare findings in the lacrimal pus, the diplobacillus the typhoid bacillus, bacillus coli communis, Friedländer's pneumobacillus, proteus, bacillus influenzae, typhoid bacillus and the bacillus pyocyaneus may be mentioned.

*Mould concretions streptothricae (Actinomycosis) in the canaliculi.* "In the region of one of the canaliculi, generally of the lower, a red swelling slowly develops, accompanied by catarrhal symptoms. In the complete statistics of over fifty cases, most of which were in women, the upper canaliculus was only four times affected. At its greatest the swelling reaches the size of a hazel nut, and generally is less. When the canaliculus is opened in the usual manner, a peculiar mass either comes out at once or does so with a very slight pressure. Its color is mostly grayish-green or grayish-yellow. The microscopical examination of the later stages is of special interest. In the sections a dendritic, net-like structure was very evident, produced by radially-arranged, needle-shaped crystals; the most peripheral layers of the individual crystalline masses were stained dark-brown. The streptothrix elements were no longer visible; still, the concretion had probably developed on such an organic basis." (Axenfeld.)

**Bacteriology of panophthalmitis.** The list of micro-organisms found in cases of panophthalmitis is naturally a large one. The different kinds of staphylocoeci, the bacillus xerosis, bacilli belonging to the diphtheria group, pneumococci, streptococci, the ozena bacillus, and other. In this list the pneumococcus is much the commonest, and is by far the most important micro-organism in panophthalmitis following wounds of the eye. The foreign body often carries with it the micro-organism which causes the suppuration. Streptococci and staphylocoeci are most frequently met with in these cases.

**The bacteriology of ulceration of the cornea.** Infection of corneal tissue may be either exogenous or endogenous but probably in all ulcerative processes, pathogenic micro-organisms play an important role. The bacteria which are most responsible for destructive processes in the cornea are: Gonococcus, pneumococcus, streptococcus pyogenes, diplobacillus of Morax-Axenfeld, diplobacillus of Petit, bacillus of
zur Nedden, bacillus pyocyaneus, bacillus ozaena, staphylocoecus, bacillus influenzae, Herbert's intra-epithelial capsulated bacillus and the mould fungi.

In a series examined at the Montreal General Hospital the following results were obtained: Morax-Axenfeld diplobacillus, 62 times; pneumococcus, 26 times; staphylocoecus aureus, 5 times; streptococcus, 2 times; Petit's diplobacillus, 1 time; bacillus pyocyaneus, 1 time; negative, 2 times.

To prepare a film from an ulcer of the cornea, a drop or two of cocain solution is first instilled and then with a stiff platinum wire, a little pus is obtained from the abraded cornea, not from the conjunctiva. Among the bacteria found in ulcerative conditions of the cornea the pneumococcus holds a very important place. Infection of the cornea with the pneumococcus causes the well-known serpiginous type of ulcer. In a series of eight-five cases of hypopion keratitis examined by Axenfeld fifty-five were caused by the pneumococcus and twenty-five by the diplobacillus.

Ulceration of the cornea is an important complication of diplobacillary conjunctivitis. The ulceration was at first supposed to be only of the superficial type. It is now well recognized that the diplobacillus of Morax-Axenfeld is capable of setting up an ulcerative process in the cornea as severe in type as the ulcus serpens of pneumococcus infection. In twenty-five cases examined by Axenfeld about half were serpiginous and to some extent showed a definite infiltrated border. Our series of sixty-two cases examined at the Montreal General Hospital gives one an idea of how common this form of ulceration is in certain districts.

Besides the diplobacillus of Morax and Axenfeld there is the organism described by Petit in 1898 (diplobacillus of Petit), which is very similar. In three cases of superficial serpiginous hypopion keratitis, Petit found a Gram-negative diplobacillus, which very closely resembled the Morax-Axenfeld form. It is possibly slightly smaller, but morphologically and in staining qualities they are identical. The distinctive characteristics of the Petit form are that it grows readily upon ordinary agar at 20° to 37° C., and secondly its power of liquefying gelatine. The Petit form was only found by Petit in cases of hypopion keratitis, but Axenfeld considers it established that it can also produce a conjunctivitis.

In 1904 zur Nedden described a bacillus (zur Nedden's bacillus) which he had found in superficial marginal corneal ulcers. He was able to differentiate it from previously described micro-organisms. The bacillus is straight, or slightly curved, and often found in pairs. It
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is 0.7 micron long and 0.6 broad. It resembles rather the bacillus xerosis in morphology, but differs in being Gram-negative. Vacuoles may be seen when the bacilli are faintly stained. It has no capsule. The bacillus grows profusely on agar. The colonies tend to run together after twenty-four hours, forming a thick mucous slime. On Loeffler’s serum, the growth shows itself as a thick, grayish-white scum.

According to Axenfeld, isolated cases of purulent keratitis from the bacillus pyocyaneus have been reported by Gallenga, Bietti, Macnab, De Berardinis, Szezbalski, D. Smith, Callan and O. Ewing.

An adult male of twenty-eight consulted me and complained of a painful right eye. The history was that for three or four days his eyes had been inflamed, with the lids adherent in the mornings, and for one day his right eye had been very painful. Examination showed a severe purulent conjunctivitis in each eye. Just above the center of the right cornea an ulcer the size of an ordinary pin’s head was seen. The ulcer was deep and the base necrotic. There was no history of trauma.

Smears prepared from the conjunctiva and ulcer showed small Gram-negative bacilli in large numbers. Cultures from the conjunctiva and cornea gave growths of a small Gram-negative bacillus which gave a green color to the agar media and rapidly liquefied the blood serum. The bacillus was obtained in pure culture in all the tubes inoculated. It grew at room temperature and at 37 C., and in the gelatine and agar tubes, the green color imparted to the media was pronounced. The initial light-green color of the agar always became darker after the cultures had stood for a few days, also when the agar cultures were agitated with chloroform a blue coloring became evident. The culture obtained from the conjunctiva was inoculated into a guinea pig’s conjunctiva and the surface of the cornea slightly scarified. Forty-eight hours later, there was a large corneal ulceration, which progressed rapidly to panophthalmitis. From the corneal lesion in the guinea pig smears and cultures gave an organism similar in every respect to the one described above. We were dealing here with a strain of the bacillus pyocyaneus of considerable virulence. The ulceration of the cornea was thoroughly cauterized with the actual cautery and the conjunctivitis treated with twenty per cent. argyrol. No further treatment of the ulceration was necessary and the conjunctivitis cleared up satisfactorily.

Experiments have shown that the bacillus pyocyaneus is at times pathogenic for the conjunctiva, and that, secondly, the cornea becomes involved. This may have been what occurred in this case. The his-
tory of a conjunctivitis for three or four days, followed by great pain in the right eye, is suggestive. The virulence of the bacillus pyocyaneus varies greatly in the conjunctival sac.

Herbert's intra-epithelial capsulated bacilli. When the epithelium from punctate spots in cases of superficial keratitis was scraped, Herbert found in the epithelium large numbers of bacilli, which it was impossible to stain with the ordinary aniline dyes. With Gram's method they did not stain. They are thick, about 3 microns in length and 1.5 microns in width. In morphology they are not unlike the bacilli of the Friedlander's bacillus group.

"Amongst the infectious forms of keratitis, the infection with the mould fungi—keratomycosis—merits consideration. As a rule, the infection is due to earth or some vegetable substance. I have shown that there is a mild form of keratomycosis, which when only superficially observed, appears like a dense infiltrate, or a keratitis fasciculosa. Cases reported by Uthoff and Axenfeld, B. Kayser, and Johnson were considered as such a keratitis, but on closer examination I was able to demonstrate a peculiar, small, delimited nodule, in which the suspected mould was found. Cultures made with every precaution showed that these cases were due to the aspergillus fumi-gatus. It has the following characteristics. Besides growing on the ordinary media they will grow on acid substances (potatoes, bread infusion, yeast). The young colonies are soft, white; when the mycelium forms, the center becomes greenish, then greenish-gray, and finally the whole culture is smoky-gray, from the formation of the large number of spores."—(Axenfeld.)

The widening of bacteriological methods, and their application and value in ophthalmology is shown in no better way than by a study of ulcerative conditions of the cornea. It is of course essential to treat this condition energetically from the very beginning. The speed with which ulcers of the serpiginous type develop is well known. Whether the organisms present be pneumococcus, streptococcus, or diplobacillus, destruction of corneal tissue takes place all too soon. It is of inestimable value as regards treatment and prognosis to find out at the beginning what micro-organism, if any, is to be dealt with. Much stress is sometimes put on the clinical appearance of different ulcers. It seems to me of no great importance whether one side of an ulcer is progressing (pneumococcus) or whether the whole border of the ulcerated surface has a yellowish appearance (streptococcus), and certainly of less importance whether the ulcer is square or round, oblong or crescent-shaped. Ulcers of the cornea of the serpiginous type may be set up by the pneumococcus, streptococcus or
diplobacillus. Clinically the ulcers may present identically the same picture, but in the light of our present knowledge, in order to treat and prognose with some degree of intelligence, it is most important to find out with which of these, or with what other factor, we may have to deal.—(S. H. M.)

**Immunity.** The complementary science to the bacteriology of disease is that which deals with the means at the disposal of the body for protecting itself against the entrance into the tissues of harmful agencies and the means whereby such injurious substances, once they have become established, are destroyed or rendered impotent for harm. The science which attempts to discover and apply the principles underlying such processes is known as Immunology, or Immunity.

In a general way the factors, as the result of whose activity such offensive and defensive properties are conferred upon the body tissues, may be divided into two main groups consisting respectively of, (1) various tissue cells, and (2) soluble chemical substances, for the most part ferment-like in nature, which are present in the blood, lymph and other body fluids.

For many years a more or less acute polemic has been waged with reference to the relative importance of these two groups in the maintenance of the tissues in their normal state. Ehrlich and his followers have attempted to prove that it is the soluble (humoral) bodies which are of paramount, nay, even of almost exclusive importance; while Metchnikoff and his students have maintained that it is solely upon the activity of the migratory types of cells (polymorphonuclear leucocytes and other phagocytes) that the resisting properties of the body depend.

That neither of these opposing views is exclusively correct has been established; that, in order that the body may best protect itself against deleterious influences, a combined and mutually complementary activity of both soluble immune serum bodies and certain specially differentiated cells must be exhibited, is manifest.

Broadly speaking, it may be stated that cellular reactions are more efficient, and also, it would appear, more economical of tissue effort. Certain it is that in the presence of the more irritating forms of foreign material, whether bacterial or other (turpentine, croton oil, etc.), certain types of cells—more particularly the polymorphonuclear leucocytes—congregate, and that, furthermore, the period of time during which bacterial invaders are enabled to persist in the tissues is dependent to a very marked degree upon the presence or absence of such cells.

If, however, it is easy to show that the inflammatory types of cells

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are important factors in the protection of the tissues from the activity of certain bacterial species, it can likewise be proven that the bactericidal properties of such cells are exhibited chiefly when acting in conjunction with the soluble anti-bodies.

Serum anti-bodies may be placed in one or other of two large groups depending upon the simplicity or otherwise of the reactions in which they take part. The smaller and less important group consists of those anti-substances which are capable of direct action upon toxins. There they inactivate or detoxicate apparently by a process of synthesis. True toxins are responsible for the manifestations of disease produced as a result of infection by the diphtheria or tetanus bacilli, and it is in these diseases that passive immunization by means of anti-sera have proven most useful.

The majority of reactions taking place between antigen and antibody are more complex than that typified by the union of toxin and anti-toxin, nor does it seem that the process is one of synthesis of the various bodies taking part in the reaction, but rather a splitting or lysis of the antigen through the activity of the serum bodies. The complexity of this type of reaction arises from the fact that two serum bodies act in unison to produce their hydrolytic or digestive effect. One of these bodies—amboceptor—is specific and produced as the result of stimulation by means of antigen inoculation; the other—complement—is a normal constituent of the serum and is not affected by immunization.

As a detailed citation of experiments and a prolonged discussion of theoretic principles are out of place in this short contribution such as accompanies this article upon the bacteriology of the eye, the writer must refrain from entering deeply into the experimental aspect of his subject. I desire, however, to attempt to indicate what would appear to be the salient points proven or suggested by the more recent research in this field. I pass over at this time such well recognized and established phenomena as those dealing with the relative specificity of immunity reactions, the over-production of immune bodies under stimulation, and the persistence of anti-bodies in the body fluids for relatively long periods. Nor is it possible or necessary to discuss in detail the technique of the methods whereby the various immune bodies, to which the terms agglutinin, precipitin, amboceptor, complement, opsonin, etc., have been applied, may be recognized in the serum and thus made use of in the diagnosis and prognosis of disease conditions.

In a short note upon such a very intricate and large subject as immunity it is manifestly impossible to review, even ever so briefly,
the experiments of the host of investigators who have worked upon the subject of so-called anaphylactic phenomena, allergy or the epoch-making researches of Fischer and Alberhalden upon the chemistry of the proteins and the biologic reaction of the tissues to the parenteral introduction of foreign proteins. Suffice it to state that as the result of the investigations of a long series of talented and experienced minds commencing with Pasteur, Ehrlich, and Metchnikoff, we are at last in the position of being able to study, and we may hope profit by, the great mass of data which has been accumulated.

Of all single groups of experiments there is none which indicates so well certain of the more recently recognized principles of immunity as those described by v. Pirquet and Shieck in dealing with what they have termed allergy (q.v.). V. Pirquet noted that in the vaccination of individuals with vaccinia virus a very different reaction occurred in primary, as compared with secondary or subsequent inoculations. Thus, the vaccination of an infant or other person who has not previously been inoculated with cow-pox virus, is followed by the development after a latent period of between two and three days of a hyperemic papule with subsequent formation of vesicle, pustule and scar, the whole process requiring a period of over three weeks. Repeated inoculation of the virus into the same individual in a like manner is not followed by this typical "take," nor is the time of patency elapsing between the introduction of the virus and the onset of the reactionary stage so prolonged.

V. Pirquet explained this altered reaction by assuming that as the result of the interaction of the antigen (cow-pox virus) and the serum anti-bodies, elaborated at the time of the primary vaccination, a more highly irritant substance is produced which in turn stimulates the more efficient vascular and cellular reaction to take place. Furthermore, the earlier the morphologic reaction occurs the smaller the number of virus units which will have proliferated in the tissues and the smaller the subsequent reaction necessary for their destruction.

The view expressed by V. Pirquet relative to the increased toxicity of the products of antigen and anti-body interaction has subsequently received undoubted support by the work done upon the subject of anaphylaxis, in particular by the observations with relation to the split products of protein hydrolysis, of Vaughan.

V. Pirquet next directed his attention to the study of the allergic reaction in other diseases, more particularly tuberculosis, and has been successful in establishing it as a biologic law. He showed that not only does the body react in an altered manner to reinoculation by a viable micro-organism, but that the previously infected and hence
sensitized individual will react, morphologically (as shown by papule formation and other evidences of inflammation) within a very short period, one to thirty-six hours, after the introduction into the skin of non-viable bacterial protein, although the normal individual will not so react.

Experimental data, as at present interpreted, indicate that the principles underlying infection and immunity are briefly as follows: Most complex proteins, such as the albumins and globulins, among which are included the majority of bacterial cells, are possessed of but little essential toxicity, or tissue irritating property, for this reason, unless they be altered through the activity of some serum substance. Such bacterial cells would not stimulate vascular and cellular reactions and would, therefore, be permitted to proliferate without interference on the part of the inflammatory cells. Continued uncontrolled reproduction in this fashion must necessarily lead to the destruction of the host as the result of the metabolic activity of the bacterial units.

The body tissues are, however, endowed with the property of elaborating substances which are ferment-like in nature and which attempt to digest all heterologous proteins whether these be essentially toxic or not. Occasionally these proteolytic bodies are produced in sufficient concentration and of sufficient activity so that the foreign proteid is completely dissociated into polypeptids and amino-acids, in which event no morphologic reaction will occur nor is it necessary. It is to bodies such as these that the names, bacteriolysins, bactéricidal amboceptor, etc., are given.

More frequently, however, the serum proteolysins are not potent to completely destroy and hydrolize the heterologous protein but merely to partially digest the invader. Of the degradation products of partial protein digestion the peptones and primary proteoses are for the most part profound tissue irritants, and therefore call forth a vascular and cellular reaction which, as we have previously stated, is the most efficient means at the disposal of the body for destroying foreign elements, more particularly bacteria. The bacteria which are sufficiently digested by the activity of the proteolytic substances of the serum to be rendered more or less toxic are phagocytized by the inflammatory cells and undergo further and usually complete intracellular digestion. It is thus seen that it is by no means unlikely that no essential difference exists between the bacteriolysins and the so-called opsonins.

When invading bacteria enter the tissues, either parenterally as the result of traumatism, etc., or those areas such as the conjunctival
sac, which are but inadequately protected by their epithelial covering, one of several results may ensue. The micro-organisms may meet with no proteolytic bodies and hence they may be enabled to spread through the tissues and produce a generalized infection. This occurs if the trepanema pallidium be inoculated since so long a period elapses before a reaction is induced that they spread throughout the body. Again, if bacteria such as the staphylococcus aureus or albus, to which the body is so constantly exposed, gain entrance in but small numbers, the serum bodies alone may be capable of entirely destroying them and no morphologic reaction will be necessary. If, again, a larger number of staphylococci, or a less common or more virulent bacterium such as the gonococcus or the pneumococcus, be inoculated, complete degradation and destruction of the bacterial cells does not occur and the toxic split products will induce a morphologic reaction. This inflammatory reaction may be adequate to control the growth of the bacteria and ultimately to eradicate them altogether; or it may be insufficient and the invaders may spread throughout the body. In other instances the severity of the local hyperaemia and cellular infiltration may lead to such a marked interstitial œdema that the nutrition of the affected part is interfered with, with consequent necrosis and spread of infection.

No better example of the effect of a relatively high concentration of immune body content of the blood and body fluid could be cited than the comparison of the reaction and resulting injury to the eye which occurs in the presence of infection by the gonococcus by direct inoculation of the conjunctival sacs and by way of the blood stream during the height of an acute urethritis. In the former case the incubation period is prolonged sufficiently to allow the number of micro-organisms to obtain enormous proportions with the consequent necessity of a fulminating and oftentimes destructive lesion. In metastatic conjunctivitis of gonorrhœal origin the coccus is early brought in contact with the body fluids which latter are, moreover, laden with proteolytic bodies. As a result a much smaller number of bacteria develop and consequently a relatively mild reaction suffices for their eradication.

For the student of immunology no one part of the body offers such a splendid opportunity for the study of immunity reactions as does the eye.—(F. B. Gurd, Montreal.)

Bacterium. Plural, bacteriæ. A term used to designate simple forms of micro-organisms, especially microscopic fungi. The bacteriææ are schizomycetes or fission-fungi. The name is now rarely used in bacteriology of the eye.
Bacterium coli commune. See Bacillus coli communis.

Bacterium photometricum. This microorganism is found in water; its movements are dependent on light. It is, possibly, not a bacterium at all. See Bacteriology of the eye.

Bacterium pneumoniar. The pneumococcus. See Bacteriology of the eye.

Bacterium pneumonicum. Fraenkel’s pneumococcus.

Badal’s keratoconus operation. This is a modification of the method of Bader. In the latter operation the pupil is widely dilated with atropin, and the usual preliminary aseptic precautions are attended to. The eye is anesthetized with cocaine solution and the speculum is inserted. The eye is steadied with fixation forceps in the hand of an assistant. The point of a thin Graefe knife is entered at the transverse meridian of the base of the cone and carried through the anterior chamber to a point opposite that of entrance. The knife is then brought outwards on the side of the cone. The small flap is picked up with iris forceps, and a second incision from without inwards completes the separation. A small opening tapering from both ends is the result, and if the incisions have been true the edges of the gap will exactly approximate. The iris in most instances will prolapse into the wound, in which case the healing will be slow and severe inflammation is likely to result.

To avoid the latter contingency, Badal (Trois Cas de Kératocone. Résultats immédiats et éloignés des Interventions chirurgicales. Archives d’OphthalmoLOGIE, XXI., p. 433) proposed a modification of the above procedure. Three horse-hair sutures were introduced vertically across the base of the cone, the central one of which was placed a little farther back than the other two. The elliptical flap was then removed as related above; the edges of the opening were approximated and the sutures tied. The author considers the use of horse-hair sutures as positively essential to the success of the operation, being easily and effectually sterilized. Every other material, including silk, has the disadvantage of inducing slight suppuration at the points of puncture.

Bäderbehandlung. (G.) Treatment by means of baths.

Bader’s keratoconus operation. Bader (Treatment of Conical Cornea by Removal of the Top of the Cone. The Lancet, 1872, p. 73) reported a number of cases in which he performed excision of the apex of the cone. An elliptical piece was removed from the most prominent part of the cone with a linear knife in such a manner that the edges of the opening in the cornea approximate and completely close the artificial cleft. The chief and most serious compli-
cation of the operation was iris prolapse, with its attendant unfortunatesequeæ. Bader’s operation, even with its modified technic, was more or less hazardous on account of the violent reaction, probability of infection, and formation of anterior synechia, and at the present time has not been enthusiastically adopted.

The following is a description of Bader’s operation as given by Higgins.

The pupil is widely dilated with atropin, and the usual preliminary aseptic precautions are attended to. The eye is anesthetized with cocaine solution and the speculum is inserted. The eye is steadied with fixation forceps in the hand of an assistant. The point of a thin Graefe knife is entered at the transverse meridian of the base of the cone and carried through the anterior chamber to a point opposite that of entrance. The knife is then brought outwards on the side of the cone. The small flap is picked up with iris forceps, and a second incision from without inwards completes the separation. A small opening tapering from both ends is the result, and if the incisions have been true the edges of the gap will exactly approximate. The iris in most instances will prolapse into the wound, in which case the healing will be slow and severe inflammation is likely to result.—(W. O. N.)

**Bader’s method of anterior sclerotomy.** This is a modification of the de Wecker method, for relief of glaucoma. It aimed at making the corneal puncture and counter-puncture as near as possible to and in front of the insertion of the iris. He endeavored to leave a large bridge of conjunctiva, stretching across the sclerotic incision, and, with this in view, divided an extent of sclerotic equal to nearly a third of the circumference of the cornea.

**Badigeonnage.** (F.) Painting on the skin, as with tincture of iodine.

**Bague aimantée.** (F.), n. An amulet containing magnetized soft iron, formerly worn for the cure of migraine.

**Baguette de Maddox.** (F.) Maddox rod.

**Baignoire.** (F.) Bath; apparatus in which a bath is taken.

**Baignoire oculaire.** (F.) A basin for bathing the eyes.

**Baillon.** (F.) Gag.

**Baily’s beads.** This term is applied to a phenomenon accompanying eclipses of the sun, described by Francis Baily. Prior to the beginning and after the end of the obscuration by the moon’s shadow of the sun’s disc, the thin, crescent-shaped and unobscured portion of the sun seems all at once to become discontinuous, and looks like a belt of bright points of various sizes separated by dark spaces. The resulting appearance has been compared to a string of beads,
and is an effect of irradiation and the inequalities of the moon's edge.

**Bailey, Walter.** Physician-in-ordinary to Queen Elizabeth of England, and an ophthalmologist of mediocre ability. He was born at Portsham, Dorsetshire, England, in 1529, and died in 1592. In 1588 he published a work entitled "A Discourse of Three Kinds of Pepper in Common Use." His only really ophthalmologic volume was a popular handbook, entitled "A Brief Treatise of the Preservation of the Sight." The date of the first edition of this book is not known, the date of the second, however, is 1616. According to some authorities, this duodecimo volume constitutes the earliest English work on ophthalmology. (See Banister, Richard.)

In 1626 appeared a posthumous work by Bailey, entitled "Directions for Health, Natural and Artificial, with Medicines for all Diseases of the Eyes."—(T. H. S.)

**Bahn.** (G.), n. A path.

**Bain d'étuve.** (F.) Hot-air bath.

**Bain tiède.** (F.) Tepid bath.

**Bajardi's advancement suture.** It is of historical interest to note that Bajardi, among various modifications of the sutures, proposed one in which they are passed through the lids, and tied over a shot or bead upon the skin surface.

**Bajardi's peripheral iridotomy.** In extraction of cataract, Bajardi (Un Metodo per prevenire la Procidenza dell' iride Nell' estrazione Sem- plice della Cataratta. Turin, 1894) (as Chandler formerly did) perforates with the point of the cataract knife the periphery of the iris immediately after the corneal puncture, which he makes at the limbus. The point of the knife transfixes the iris and cuts its way through about one-fifth of the circumference of the iridic circle. The knife point is then withdrawn sufficiently to clear the iris, the counter-puncture is made in the usual way and the section is completed. The capsule is then incised with the cystotome (if it has not already been done by the knife) and the lens is delivered, if possible, through the button-hole opening in the iris. The iridic wound sometimes does and sometimes does not entirely heal, but in any event it affords an opening through which the aqueous, as well as lenticular debris may escape. Bajardi pictures many cases operated upon by him and feels much satisfied with the result of the operation.

**Bajardi's subconjunctival cataract extraction.** Bajardi (Sulla estrazione sottocongiuntivale della cataratta. Bollett. della R. Acad. Med. di Genova, Vol. XXV, N. 1-2, 1910) performs an extraction of cataract by a subconjunctival method that much resembles that of Czermak,
BAJONETMESSER

except that the incision is made entirely with a Graefe knife. He makes his sclero-corneal incision upwards to include from one-third to two-fifths of the circumference, the puncture and counter-puncture being ½ mm. within the conjunctival circle. The conjunctival flap above is cut from 12 to 15 mm. broad. He then makes an iridectomy, opens the capsule with a cystotome or with a cystotome forceps; then, with a Daviel spoon beneath the conjunctival flap (applied at the edge of the wound) he makes gentle pressure backwards and expresses the lens by means of another spoon bearing upon the ciliary region below. The subsequent acts are the same as in the ordinary operation.

Bajonetmesser. (G.), n. A bayonet-shaped knife, used in operations on the eye.

Baker, A. R. A well known ophthalmologist of Cleveland, O., whose life-dates are not procurable. He was, for many years, editor of a local medical paper, The Cleveland Medical Gazette, and, for a time, Professor of Ophthalmology in the old Wooster Medical College, later known as the Cleveland College of Physicians and Surgeons, which was afterwards absorbed by the medical department of the Western Reserve University. He was the representative, on numerous occasions, to the American Association of Medical Colleges, and, the year that the American Medical Association met in San Francisco, was chairman of the Ophthalmologic Section.

The Doctor was indeed an indefatigable worker, his only vacations for years occurring at the time of the meetings of the American Medical Association—all of which he attended most religiously. He was especially noted for his kindness to the younger members of the profession.—(T. H. S.)

Baker, William Henry. A general practitioner of Lynchburg, Va., whose practice was largely restricted to the eye, and who was widely known as an ophthalmologist. He was born at Winchester, Va., Sept. 14, 1857, received his general education at Roanoke College (which afterwards conferred upon him its highest honorary distinction) studied medicine at the University of Maryland and at the South Carolina College of Medicine, and settled for practice in Lynchburg, Va. Here he was soon besieged with patients, and, because of his special skill in ophthalmology, with patients in particular who suffered from diseases of the eyes. Never, though, would he wholly give up general practice. He wrote a few articles concerning diseases of the eye, but, for the most part, was known as an operator.

Dr. Baker was a man of imposing presence. He was six feet and one inch tall, broad shouldered, but weighed only 185 pounds. His
hair and mustache were a very dark brown, his eyes of a hazel color and remarkably clear. His expression was shrewdly observing, but kindly. He was quiet and well-poised, never gay, but constantly cheerful.

Baker was a truly good man. His purity and integrity were never called in question. He was also active, even from his boyhood days, in church work. While still very young he united with the Lutheran church at Winchester, of which his father was the pastor, and, while in Lynchburg (because in that place there was no Lutheran church) transferred his membership to the Presbyterian church, of which his wife was a member. However, he always remained loyal to the Lutheran denomination.

There is little to record, in a scientific way, about a man who was "merely" an excellent operator. Like a great singer, his memory can have no adequate perpetuation, saving and excepting in the hearts and souls of those who received some personal benefit from his skill, or, at all events, who came more or less directly within the circle of his professional influence. Suffice it to declare, then, that Dr. William Henry Baker was a man of first-class operative ability, and that, therefore, to many a darkened eye he must have said, in effect at least, those words divine with which even creation itself began, "Let there be light."

He was a type of the highly educated, very much handicapped, but forever striving, country ophthalmologist.

He died at Lynchburg, Va., Nov. 27, 1898, at the age of forty.—(T. H. S.)

Bakterien des Auges. (G.) Ocular bacteria.

Balancement. (F.) Compensation (such as between hypertrophy and atrophy).

Balance of the extra-ocular muscles. Stevens considers that "in the determination of the relative positions of objects in the field of regard by the sense of sight, the relation of the points of the retina on which the impression of the object is received to the macula lutea, or the sense of the muscular adjustment demanded in order to bring the impression to the macula, constitutes the basis on which is formed the judgment in regard to the positions and the expanse of the objects seen.

If the normal eye is so directed as to receive the most distinct perception of a given object or portion of an object, the eye must be so adjusted that a straight line drawn from the point of regard will pass through the nodal point of the eye to the macula or fovea centralis retina.
The extent of an object in the field of vision or the distance or direction of any other object with reference to the first in any other part of the plane of the field of vision is determined by reference to the relative distance and position of a second retinal impression from this given point or by the estimation of the muscular sensations which arise or which would arise from changing the adjustment from the first point of regard to the second." (Norris and Oliver, *System of Diseases of the Eye*, Vol. 2, p. 167.) See **Muscles, Ocular**.

The various extra-ocular muscles are delicately balanced under normal conditions. The tendency of the recti to draw the eyeball backward is opposed by the action of the obliqui. At rest, the anatomic position of the eyes is naturally divergent, owing to the direction of the orbits and the optic nerve and the natural length of the muscles. The deviation of sleep, however, is immediately succeeded on waking by the functional position of rest, in which the visual axes become parallel. To maintain this position is easy and natural for the individual when the muscles are properly balanced. If one muscle or set of muscles is weak, an increased innervation is required to maintain the normal balance. There are many tests of the muscle-balance, but only those most generally used will be described. First, however, it is necessary to mention definitely the terms which have been applied to the anomalies of the muscle-balance. These names were proposed by Stevens:

Orthophoria, normal adjustment of the ocular muscles.
Heterophoria, abnormal adjustment of the ocular muscles.
Hyperphoria, a tendency of one eye to rise above its fellow.
Hypophoria, a tendency of one eye to fall below its fellow.
Exophoria, a tendency of the visual axes outward.
Esophoria, a tendency of the visual axes inward.
Hyperexophoria, a tendency of the visual axis of one eye to deviate upward and outward.
Hypoxophoria, a tendency of the visual axis of one eye to deviate downward and outward.
Hyperesophoria, a tendency of the visual axis of one eye to deviate upward and inward.
Hypoesophoria, a tendency of the visual axis of one eye to deviate downward and inward.

Cyclophoria (Savage) is a want of equilibrium of the oblique muscles.—(J. M. B.)

**Balasius.** (L.), m. n. The balas-ruby; a purplish or reddish gem, anciently used as a charm and as a remedy for affections of the eye.

**Baldanza’s test for simulated blindness.** A. Baldanza in 1897 proposed this test for simulated blindness. It is a box like an ordinary stere-
scope, with a mirror hinged to the upper side, to illuminate the test-types placed at the end of the apparatus which is about thirty-three centimetres long, five by nineteen centimetres broad, and nine centimetres high. The two latter dimensions gradually diminish towards the front of the box, where they are not greater than twelve and five centimetres each. The oculars are provided with four 12° prisms. The two front ones are stationary, with their bases placed outward, while the two others, placed exactly behind, are movable in such a way as to double or neutralize the refracting power of the anterior ones. A vertical screen divides the box into two equal sections, in such a fashion that the types on the right half cannot be seen by the left and those on the left cannot be recognized by the right eye. If the patient read the types corresponding to the aperture on one side only he is probably blind on the other; if, however, he reads the types for both eyes he must see with both eyes.

Baldrian. Valerian.

Baley, Walter. Author of "A Brief Treatise of the Preservation of the Sight," called by some the earliest English work on ophthalmology. See Bailey, Walter.—(T. H. S.)

Balkenstaar. (G.) Barred cataract.

Ballenger's ethmoid cell operation. As a useful procedure to relieve eye symptoms due to certain ethmoidal diseases, Ballenger (Diseases of the Nose, Throat and Ear, 1909, p. 233) in 1905 devised a method for removing the ethmoidal cells and middle turbinal en masse. Owing to the fact that the ethmoidal cells have only three planes of attachment Ballenger found it possible to remove a large part of the posterior ethmoidal cells and some of the anterior cells with the middle turbinal in one piece. The chief instrument used consists of a long blade, curved slightly on the flat, and having a shorter blade attached at right angles to the end of the first blade. For a description of the operation, see Cavities, Neighboring.

Ballenger's maxillary, sinus operation. For the radical cure of eye symptoms due to chronic infection and other diseases of the antrum of Highmore, Ballenger, under local anesthesia, removes the anterior half of the inferior turbinal with his right-angle knife. The knife enters the turbinal at the middle point and cuts through it to its attachment to the nasal wall, and is then drawn forward following the line of attachment, removing the anterior half. The knife is next made to cut through the naso-antral wall at the posterior limit of the antrum and an upward incision is made as high as desired. The knife is then pulled forward, making an incision parallel to the nasal floor and then avoiding the lacrymo-nasal duct a downward
incision is made. The reverse knife is now entered at the posterior incision from which it is made to cut forward as close to the floor of the nose as the thickness of the antral wall will permit. The thickest portion of the wall at the nasal floor may be removed with bone forceps. Iodoform gauze is used to loosely pack the cavity for twenty-four or forty-eight hours and later exuberant granulations are controlled with caustics.—(F. B.)

**Ballet's sign.** This is an ophthalmoplegia externa, characterized by the loss of all voluntary movements of the eyeball. The automatic movements of the globe and of the pupil are, however, intact. It is seen in Graves' disease and in hysteria.

**Ballismus.** (L.), m. n. An old term for chorea.

**Ballonnement.** (F.) Distending a part with water, gas, etc.

**Ballottement, Ocular.** A term applied by Gould to the examination of the eye with the ophthalmoscope when, in the detection of moving or floating vitreous opacities through the dilated pupil, they can be proved stationary or "floating" by a change in position either of the physician or of the patient. If floating, we may, as it were, give them a fillip or "ocular ballottement," by asking the patient to look upward and again (suddenly) straight in front. In this case the dark particles, having been thrown upward by the motion, will be seen to float or settle downward to the lower parts of the posterior chamber.

**Ball's conjunctivoplasty.** This procedure Ball advises mostly in penetrating wounds of the cornea, and says that they should be covered with a conjunctival flap in order to prevent secondary infection. He tells us that "If the wound is situated at the periphery of the cornea, the simplest method of covering it will be to loosen the conjunctiva all around the cornea, and insert a purse-string suture. This is to be tied and is left in situ for several days. If the wound involves the center of the cornea, a loosening of the conjunctiva with the excision of a suitable area of this membrane, will be required. In simple, clean-cut corneal wounds, this method of treatment may not be necessary. In lacerated wounds it should be adopted."

**Ball's forceps for advancement operations.** Having found that the various types of advancement forceps now on the market are not satisfactory, James Moores Ball designed a new instrument. It is 3⅓ inches in length; the blades extend 7/16 inch from the handle; the male blade bears six teeth (arranged in three sets of two), each one being 1/20 inch in length.

It seems to the writer that the merits of this instrument, combining, as it does, the good points of several other advancement forceps, will be appreciated by ophthalmic surgeons without argument. With it,
an advancement operation, whether simple (muscle only), or total (muscle, capsule of Tenon, and conjunctiva), can be executed quickly and accurately. Its advantages are:

1. The placing of the blades at right angles to the handle makes for greater accuracy in the suturing of the muscle to the eyeball.

2. The absence of teeth in the female blade permits the passing of this part of the forceps beneath the tendon, without difficulty and without undue injury; while the rough surface of this blade, added to the presence of teeth in the male blade, prevents the slipping of the muscle and adjacent tissues.

3. The sliding lock can be closed or opened with less effort than obtains in case the spring catch is used, and it also prevents the accidental releasing of the muscle.

**Ball's Advancement Forceps.**

**Balléaire.** (Fr.) Pertaining to baths.

**Balsamo ottalmico di Saint Yves.** (It.) See *Balsamum ophthalmicum yveanum.*

**Balsamum cannabis indicæ.** (L.) The eye symptoms of poisoning from this preparation appeared in one recorded case, after taking one decigram. In half an hour both pupils were semi-dilated, and reacted very slowly to light. In a few hours the general symptoms became more pronounced, the pupils were dilated *ad maximum* and were not affected by light. The patient claimed that he could no longer see, and this loss of vision continued for some time.

**Balsamum Fioraventi.** This preparation, sometimes used as a local application—massage about the orbit—in pareses of the ocular muscles, is a spirituous mixture of various aromatic herbs, such as fenil, laurel, rosemary, mint, etc., with turpentine. When employed in the manner just mentioned care should be taken that it does not enter the conjunctival sac.

**Balsamum ophthalmicum.** (L.) A name applied to various preparations designed for application to the eyes.

**Balsamum ophthalmicum rubrum.** (L.) *Unguentum hydrargyri oxi di rubri.* Red oxide ointment.

**Balsamum ophthalmicum Sancti Yveii.** (L.) An ointment made of
BALSAMUM OPHTHALMICUM YVEANUM

5 parts of red oxide of mercury, 2 of flowers (oxide) of zinc, 20 of fresh butter, and 10 of yellow wax.

**Balsamum opthalmicum yveanum.** (L.) See *Balsamum opthalmicum Sancti Yveii.*

**Banc.** (F.) Bench; seat.

**Banc optique.** (F.) A lens tester for the exact measurement of eye glasses and other lenses.

**Bandage amidonné.** (F.) Starch bandage.

**Bandage à trois chefs.** (F.) Three-tailed bandage.

**Bandage de Galien, ou des pauvres.** (F.) Three or six tailed head bandage of Galen.

**Bandage en huit de chiffre.** (F.) Figure-of-8 bandage.

**Bandage renversé.** (F.) Bandage with turns.

**Bandages for the eye.** The characteristics of a good bandage, says Lamhofer, are that it covers the eye sufficiently on all sides, applies itself closely, does not press upon the eye ball, does not heat it; nor is it readily displaceable. It should be made of easily obtainable and not too expensive material that can be used in practically all cases.

The ordinary *adhesive plaster bandage,* which was formerly much used, offers the simplest protection against external irritants and friction of the lid-margins on the diseased globe. Five to six pieces of the finest adhesive plaster, each about 3 cm. long and 5 mm. broad, are placed vertically over the closed lids and across the lid aperture. Another piece is then pasted over these on the upper, and another on the lower lid. But even the best plaster will become too dry or too wet and will no longer adhere.

Until a short time ago practically every clinic had its especial bandage. In spite of their cost *flannel bandages* seemed to be the favorites, and it was not until the manufacture of mull bandages and bandaging cotton made it possible to use a cheap eye bandage that possesses all the good qualities of flannel.

The mull-cotton bandage is prepared as follows: First, cut a piece about 30 cm. in length from a five-metre long and five cm. broad roll of fine, white, unstarched mull. Broader bandages exert pressure on the ear and are uncomfortable. Make a pad of it by folding this piece so that it has eight layers. This pad, 5 cm. long and about 4 cm. broad, is laid somewhat obliquely upon the eye. As a rule the patient will, while applying the bandage, shut his eyes tight. Now, it is imperative that during the bandaging, both eyes shall be closed gently, as in sleep. The pad *may* be dry, but it is better to moisten it with some disinfecting solution. In cases of burns or after lid operations it should be thickly smeared with vaseline. Upon the pad is placed a wad of cotton
about the size of a small child’s fist, to fill up the cavity between the forehead and nose. Wherever especial care is necessary, as after cataract operations, or in severe wounds of the eye, there should first be placed upon each edge of the pad small wads of cotton and finally several small wads in the middle of the pad. Over all this is placed the mull bandage, which has previously been moistened by sprinkling with water (not dipped, for then it unwinds poorly), whereby the individual layers will apply themselves more closely to one another. The first turn begins at the lobe of the ear (the patient himself may hold the bandage there with his finger), passes over the middle of the wad of cotton, diagonally over the head and under the lobe of the ear (without forcing this upward) and again to the eye. The second turn must cover half of the first turn (otherwise the wad is easily displaced toward the top) and this turn may be somewhat more tightly applied. The second turn passes somewhat lower than the first, the fourth again directly over the first, and this one is carried over towards the temple and twice horizontally about the head. The end is fastened with a safety pin on the forehead. If the pin is fastened at the back of the head or at the side, it will exert painful pressure when the patient lies down. In case one wishes to bandage not only one eye (monoculus,) but also the other eye (binoculus), then the last horizontal turn on the temporal side is passed diagonally across the forehead and over the second eye, which has also been previously covered with pad and cotton. He then carries the turn from above down just as with the other eye; or, he can make an individual bandage with the turns running upward from below.

In order to apply a pressure bandage such as is sometimes recommended in cases of retinal separation, it is only necessary to apply the bandage more tightly. For a moist bandage, the pad is first dipped in liquid and upon the pad is laid a somewhat larger sheet of gutta-percha and upon this the cotton and the bandage.

Mull bandages may, if necessary, be washed and used again.

In cases of inflamed and uninjured eyes into which it is necessary to instil drops several times during the day, a simpler eye-bandage is sufficient for dispensary practice. It may be made of a strip of black silk or cotton goods 20 cm. long, cut spindle-shape, and 5 to 6 cm. wide at the broadest part, which is placed over the eye. Upon this is sewed a single or double layer of linen of equal size and to each end a narrow ribbon is attached which is tied on the top of the head and not at the back, lest it interfere with the wearing of a hat. At home a narrow band may be tied over this horizontally about the head. Such a bandage looks quite well, is black externally to keep out
the sunlight, and white on the inside, so that any soiling shows up readily. It may be constructed by unskilled hands at a cost of a few pennies out of almost any sterile stuff. Moreover, it may be readily replaced or washed.

Commercial eye-shades are made of pasteboard or covered wire screens. They are generally lined with green silk and are supplied with elastic ribbons. They are comparatively expensive and when flat and small not very practical. *(Encyklopädie der Augenheilkunde.)*

The triangular bandage is the one most frequently used by the Editor. It consists of two layers of sterilized gauze, between which is placed a layer of absorbent cotton. These are all together cut of the proper shape and size to cover the orbit, say about two inches in diameter. It is then laid smoothly upon the closed lids and held in place by three strips, each one inch wide, of zinc oxide adhesive plaster. Number one is placed horizontally over the supraorbital edge, the second from the nasal extremity of number one obliquely downward and outward along the side of the nose, while the third joins the temporal extremity to the lower end of the second strip on the cheek. These adhesive strips keep the dressings securely in place. Unlike other bandages, there is little or no danger of its slipping off during the night, or as a result of the patient’s efforts, as is apt to happen in the case of children, and some adults.

The lids may be prevented from adhering or the lashes from sticking to dressings by applying any simple, non-irritating ointment to the palpebral margins or to the dressing itself.

Roller bandages, of gauze or muslin, from 1½ to 2 inches wide and 5 or 6 yards long, are used in ophthalmic surgery, not only as a means of protection, but for applying pressure to the lids and eyeball. For
the latter purpose the depressions about the globe should be carefully
and evenly filled with absorbent cotton and the bandage applied firmly
about the head, and kept in place by safety-pins or adhesive strips.

The application of the bandage should begin on the forehead just
over the affected eye. It ought then to be carried around the forehead
across the opposite temple, obliquely down over the occiput under the
ear of the affected side and thence obliquely across the eye dressing. It

should again be passed around the head, but above the ear of the
affected side, then over the forehead to the opposite temple and
obliquely (down the occiput, under the ear on the affected side, and
obliquely) to the eye. This should be repeated, carrying the roller
alternately above and below the ear on the affected side, until the
bandage is firmly applied, fixing the dressing and keeping it from slipping.

The Moorfields' bandage consists of a piece of linen, 3 inches wide
by 7 inches long, with a notch of sufficient size in the center, into which
the nose fits. Four tapes, one at each corner, are so arranged that
loops are formed and surround the ears. The tape is then carried
singly around the occiput and forward on the forehead.

Bandages, Liebreich's. This ocular protection consists, according to
Soelberg Wells (Treatise on Diseases of the Eye, p. 30), of a knitted
BANDAGES, LIEBREICH'S

cotton band about 12 inches long and 2½ inches wide. At the one end are two tapes, the one going round the back of the head, the other forming a crossbar with the first, and passing over the top of the head. The other end of the bandage also carries a tape which is to be tied at the side of the head, opposite the affected eye, to the one coming round from the back. The principal advantages offered by this bandage are—that it perfectly retains its position without slipping, and that it can be undone and the dressings changed without the patient's head having to be raised from the pillow. If the thick, knitted band proves heavy and hot, I substitute for it a band of fine muslin or of elastic web. The bandage is to be applied over the following dressing: The patient being directed gently to close his eyes, a piece of soft linen is laid over the lids so as to soak up any discharge, small oval pledgets of charpie or carded cotton-wool are then placed over this, more especially in the hollows at the inside of the eyeball and beneath the upper edge of the orbit, so as to fill these out, and bring the padding nearly to the same level as in the centre. The pressure of this cushion should be quite uniform, and not greater upon one portion of the eye than another, more especially upon the centre of the eyeball, otherwise it will produce pain and discomfort. The succession of the pledgets of charpie should be applied in such man-
ner that the upper lid is gently stretched across the eyeball in a lateral
direction, and the lids thus kept immovable. The two principal points
of pressure should be at the inner and outer canthus, so that the eye-
ball is only pressed by the upper lid being stretched gently across it.

**Bandages, von Graefe's.** In his *Treatise on Diseases of the Eye*, p. 31,
J. Soelberg Wells tells us that von Graefe made use of three different
forms of compressive bandages—(1) the temporary; (2) the regular
compress; (3) the pressure compress.

The *temporary bandage* simply consists of a knitted cotton band
about 15 inches in length and 1¾ inch in width, which is to be placed
over the eye and fastened by a couple of tapes. For this purpose I
think Liebreich's bandage (q. v.) is to be greatly preferred, but with
the next two forms of bandage it is different, for here we can regulate
the degree and mode of pressure desired with a nicety and accuracy
not to be obtained with Liebreich's.

The *regular compress* is about 1¾ yards long and 1½ inch wide.
Its outer two-thirds consist of fine and very elastic flannel, its central
third of knitted cotton. The eye having been padded with charpie or
cotton-wool, as above directed, the bandage is to be thus adjusted:
One end is to be applied to the forehead just above the affected eye,
and is then to be passed to the opposite side of the forehead and above
the ear to the back of the head; the knitted portion is next carried on
below the ear and brought upwards over the compress, the bandage
being then again passed across the forehead and its end firmly pinned.
The opposite eye may be closed with a strip of plaster, or, should it
also require a compress, a separate bandage is to be applied.

The *pressure bandage* is made of fine and very elastic flannel, and
should be about 3½ yards long and 1½ inch wide. It is intended to
produce complete immobility of the eye, and to exert a considerable
degree of graduated pressure. The one end of the bandage is to be
placed upon the cheek, at a point about midway between the angle of
the jaw and the ear of the affected side, and the bandage brought up
over the compress (but not applied too tightly) and carried across
the forehead to the back of the head; and then, passing beneath the
ear, a second turn is to ascend (somewhat more vertically) over the
compress, pressing firmly upon the latter. The bandage is then again
carried across the forehead to the back of the head, and finally brought
once more over the compress, but this time it is not to be pulled tight.

**Bande.** (F.) (1) Band; (2) bandage.

**Bandeau.** (F.) Head-band or head-bandage.

**Bande d'Erlich.** (F.) A greenish-colored, perpendicular band which
appears in the anterior chamber after large injections of fluorescein.
Bandette.  (F.) Fascia.
Bandette des nerfs optiques.  (F.) The part of the optic nerves which is behind the chiasma.
Bandette gémée.  (F.) The fornix.
Bandette grise.  (F.) Band of gray matter in the corpus striatum.
Bandförmige Hornhautentzündung.  (G.) Band-like keratitis.
Bandkeratitis.  See Band-shaped keratitis.
Band-shaped affection of the cornea.  See Band-shaped keratitis.

Band-shaped keratitis.  Zonular opacity, Trophic keratitis, Symmetrical opacity, Band keratitis, Girdle-shaped opacity, Band or ribbon-shaped opacity, Transverse film.  This disease was described by von Graefe under the name of bandförmige keratitis, but Bowman and Dixon recognized it at a still earlier date.  The lesion is characterized by a grayish-yellow, non-vascularized deposit which extends directly across the cornea.  The opacity is generally about 4 mm. broad and corresponds rather closely to the interpalpebral aperture.  The disease generally shows itself at both extremities of the horizontal diameter, although it sometimes begins in the pupillary area.  The opacity, as a rule, slowly spreads towards the center of the cornea from each side; the older the opaque area the broader and less transparent it is.  When examined with the corneal microscope the surface is found to be uneven and to be made up of numerous grayish-white dots.

The eye is always more or less irritable; indeed, the disease generally happens in patients who have suffered for long periods from glaucoma or irido-cyclitis.  It sometimes attacks one eye, sometimes both.  When the eye or eyes appear otherwise healthy the disease is spoken of as primary—a rare form—but the secondary form, associated with other intraocular disease is much more common.  Parsons (Pathology of the Eye, p. 243) gives an interesting account of its histopathology.  "Dixon, in 1848, proved the presence of calcium carbonate and phosphate in particles removed from the film.  It is interesting to note that his case was one of the primary form.  The earliest microscopical examination is by Nettleship (1873): the cornea showed (1) puckering of Bowman's membrane; (2) perforations in this membrane, through which passed finely wavy fibrous tissue; (3) lifting up of the epithelium by this eruption of organized fibrous tissue.  Bock (1887) first investigated the subject exhaustively.  In one case he found calcareous particles on Bowman's membrane only, under which was a thin layer of spindle-cells and vessels.  In two other cases the substantia propria was replaced by new connective tissue, in which lay
calcareous granules and calcified vessels. Usher (1893) examined thirteen cases; he confirms the arrangement of the fibrous tissue and the presence of calcareous deposits. He points out that the cornea is usually thickest at the opacity, and that the new tissue is sometimes delimited from the substantia propria by granular bands. Leber (1897) came to the conclusion that the deposition of lime-salts always occurred first in Bowman’s membrane. In some cases the calcified membrane lay free and was covered with coral-like excrescences. He considered that it is caused by drying in the area exposed by the palpebral aperture, so that the little soluble lime-salts are precipitated; they are probably present in undue quantity, though the reason for this is not given. Leber regards the connective-tissue proliferation as secondary, and this is confirmed by a case of Schieck’s, in which Bowman’s membrane was calcified, but there was fibrous tissue present only in the most advanced parts. Not only are calcareous deposits present, but also hyaline ("colloid") globules. They have been observed by Bock, Goldzieher, Schrader, Kamoeki, Birch-Hirschfeld, myself, and many others. They are perhaps commoner in old leukomata, but they must be regarded as an integral part of the picture of band-shaped opacity, though this view is opposed by Greeff. Best distinguishes three types of the condition. In the commonest sclerosing fibrous tissue is insinuated between the epithelium and the superficial lamelle, so that Bowman’s membrane is much degenerated, and often destroyed in parts, elsewhere split and fibrillated and embedded in fibrous tissue and epithelium. This fragmentation of Bowman’s membrane was first described by Samter; it was found with different variations in all of Usher’s thirteen cases. The epithelium is often thickened, and elsewhere thinned or destroyed, as is so frequent in these degenerative conditions. The new connective tissue is poor in vessels, or non-vascular. Occasionally giant-cells are found near the calcareous masses, induced by the irritation set up. Best, comparing the earlier marginal with the later central parts, considers the new fibrous tissue to be formed earlier beneath Bowman’s membrane than between it and the epithelium. The second type corresponds with an earlier stage, in which the band is incomplete in the centre of the cornea. Sections through this part show already a very thin layer of connective-tissue nuclei beneath Bowman’s membrane, which is here very broad, as if ßedematous. The thickened epithelium is raised by an albuminous exudate, which is continuous peripherally with new fibrous tissue. The condition, with the subsequent isolation and destruction of Bowman’s membrane, may be compared with pannus. The third type corresponds with Leber’s description, and is not common. Bowman’s membrane is uncovered by epithelium and shows
Band-shaped opacity of the cornea.

Band-shaped opacity of the cornea. See Band-shaped keratitis.

Band spectrum. The discontinuous spectra of gaseous bodies, consisting of coloured bright bands.

Banister, Richard. An English ophthalmologist of the early 17th century, concerning whose personal qualities extremely little is known. Nor do we know the time or the place of his birth or his death. We do, however, know that he lived in Stamford, England, that he was highly gifted as an operator, and that he wrote the earliest work on ophthalmology to appear in the English language. This book, entitled A Treatise of 113 Diseases of the Eyes and Eyelids (London, 1622), was largely based on Guillemeau’s Des Maladies de l’Oeil, at that time very popular.

Banister’s work is greatly enriched by certain alleged poems, which, no doubt, are much more interesting historically and medico-economically than otherwise. Here, for example, is his versified opinion of some of his competitors:

"Yet they that hardly teeth can draw,
   Unless they spill much blood or break the jaw,
   Will deal with eyes and boast of famous facts
   They have performed in couching cataracts."

Referring to himself, he speaks with greater respect:

"Like cloudy vapors these [cataracts] the eyes o’re east;
   Yet vanished as the dew, by sunne at last:
   Long practise, careful skill, with observation,
   Will teach the mystery of the operation,
   To end this worke, that perfect it may stand,
   God guide with careful skill our Eye, our Heart, and hand."
The following verses should be found very helpful to one seeking "The fit time for Couch of Cataracts."

Couch cataracts upon
a day so faire,
That neither wind nor
clouds disturbe' the Ayre,
When spring with simples
fills the Earth's rich lap,
Or Autumnne makes
the tree put off his cap,
The Moone ith full,
or in conjunction sly,
Or tracing Aries,
or in Gemini.'"—(T. H. S.)

Bankart, James. A celebrated English ophthalmic surgeon. Born in 1834, he studied chiefly at Guy's Hospital, at which institution he was afterwards Anatomical Demonstrator. He was one of the surgeons at the West of England Eye Infirmary—in which capacity he was serving when he died. His writings were all of a general nature, and are chiefly to be found in the Guy's Hospital Reports, thus: "Dissection of Acephalous Monsters" (Guy's Hosp. Rep., 1868); "Abnormalities Observed in the Dissecting Room of Guy's Hospital" (Guy's Hosp. Rep., 1866-67 and 1867-68).

He died at Exeter, Oct. 31, 1902.—(T. H. S.)

Baquet. (F.) Tub.

Baraesthesiometer. n. An instrument devised by Eulenburg for testing the sense of pressure in different parts of the body. It consists

Eulenburg's Baraesthesiometer.
of a button at the end of a spiral spring which, when pressed upon, turns a registering needle on an index.


Barbe. (F.) Barb.

Barbel. *Mullus barbatu*us. An edible fish, greatly esteemed by the ancient Romans, but believed by them to produce serious diseases of the eyes. (Pliny, xxxii, 24, 17.)—(T. H. S.)

Barber's itch of the lids. This is a term sometimes, but erroneously, applied to sycosis of the lid margins. It is really an infection of the hair follicles by the staphylococcus.

Barbeyrac, Charles. Born in 1629 at St. Martin in the Alps, he received his medical degree in 1649. He married advantageously and became physician to the Cardinal de Bonellon (with a pension of 1,000 livres). In 1858 he wrote, by way of competition for a professoriate in Montpellier, a thesis entitled "Suffusio vomitu curatur."—(T. H. S.)

Barbier, Joseph Julius. This philanthropist was born in Valenciennes, France, in 1767. He had a thorough scientific training, and was an officer in a regiment from Besancon. He lived a retired life, left the army and coming to America joined the revolutionary army. During the revolution he served in the capacity of engineer. He was deeply interested in all philanthropic projects and his endeavors were particularly directed in behalf of the poor and the blind. After various experiments he found that the larger prints were very much more easily recognized (by the fingers) than lines, and after varied experiments with stenographic forms devised (A. D. 1820) a system in which the letters were represented by dots, variously grouped in a space two dots wide and six dots high. This was presented to the French Academy of Science, by which it was commended, and it was also employed experimentally in the National Institution for the Young Blind, and was known by the name "Ecriture nocturne" or "night writing," and served as the basis for the form later adopted by Braille, in which the dots were placed in spaces two dots wide and three dots high. This type is now used universally throughout the civilized world.

Bär, Brauner. (G.) *Arctia caja*. "Brown bear." One of the caterpillars whose hair, entering the structures of the external eye, produce *conjunctivitis nodosa* (q. v.) and other lesions.

Bareck's capsulotomy. In the extraction of cataract Bareck has abandoned Knapp's peripheric method of capsulotomy and gradually developed the following: The first incision is of a crescentic shape,
commencing laterally from the lower end of the vertical meridian; the second one, commencing just as far mesially from this, meets the first somewhat above the center of the capsule. (See the figure.) It is very important that the two incisions really intersect. If cor-

Barck's Fan-Shaped Capsulotomy.
rectly carried out, the lower triangular flap, as a rule, falls downward, and the upper portion retracting, leaves a clear, central pupillary area.

**Barck's corneal trephine.** In order to obtain the characteristic feature of a black central pupil, Barck has devised a double trephine (*vide* figure), which makes both the limits of the pupillary space, and the

Double Tattooing Trephine of Barck.

inner border of the iris-ring. After the obtainance of these boundaries by tattooing the central spot and leaving the surrounding area untouched, the tint of the periphery of the membrane is made to imitate the iris as much as possible wherever desirable.

**Barck's entropion forceps.** Carl Barck has devised an entropium forceps (*Am. Jour. of Oph.*, Dec., 1898, p. 366) with the blades placed T-shaped to the handles and curved to correspond to the lid margin. One branch of the forceps has a wide blade with three small holes, the other a narrow one with three teeth.

**Bard's sign.** Intended to differentiate between "organic" and congenital nystagmus. In the former case the oscillations of the eyeball increase when the patient follows the physician's finger moved before the affected eye from right to left, and then from left to right. In the congenital nystagmus the oscillations disappear under these tests.
Barenraupe, Verletzung durch die. (G.) Injury (to the eye) from caterpillars.

Bärenprung, Friedrich Wilhelm Felix. A celebrated German 19th century dermatologist and syphilographer, the first to indicate that herpes zoster ophthalmicus is confined to the distribution of the first and second branches of the trigeminus nerve, and that the disease is essentially an affection of the Gasserian ganglion. St. Yves—an ophthalmologist of the 18th century—was the first to describe the disease in question, but he deemed it only a variety of erysipelas.

Bärensprung was born at Berlin, March 30, 1822. He studied at Berlin and Halle, paying especial attention to entomology and to dermatology and genito-urinary diseases. In 1850 he settled as a practising physician in Halle, but, three years later, removed to Berlin in order to accept the appointment as Medical Director of the Department for Syphilis in the Berlin Charité. In 1856 he became professor extraordinary at Berlin of dermatology and genito-urinary diseases.

Bärensprung, being a man of strongly marked individuality, made numerous enemies and was frequently engaged in the most bitter literary warfare. As a consequence, he became somewhat unbalanced mentally, and, in 1863, receiving a digital infection, he became so decidedly insane that he had to be committed to an asylum. In one of his more or less lucid intervals, he was permitted to take a promenade alone, and, on this occasion, he leaped into the sea and was drowned. This occurred Aug. 26, 1864.

For the sake of completeness we may add that to Bärensprung is due, in part at least, the adoption and wide-spread use of the clinical thermometer.—(T. H. S.)

Baric. Same as barometric.

Barker’s solution. A mixture of beta-eucaine and adrenalin chloride used for subcutaneous injection, especially in lid operations. H. C. Wood believes that the efficacy of this solution, as a local anesthetic, may be much increased by the addition of cocain. The formula of the solution is as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure chloride of sodium</td>
<td>0.8 gm.</td>
</tr>
<tr>
<td>Beta-eucaine</td>
<td>0.2 gm.</td>
</tr>
<tr>
<td>Adrenalin chloride</td>
<td>0.001 gm.</td>
</tr>
<tr>
<td>Distilled water</td>
<td>100.00 gm.</td>
</tr>
</tbody>
</table>

Barley. Barley meal, boiled in sweet wine, was employed in antiquity as a poultice for the eye. Barley was also used as a menstruum for
various ophthalmic medicaments in a way no longer clearly understood.—(T. H. S.)


Barnabas de Regio. An oculist who, in 1340, wrote a book entitled, "Libellus de Conservanda Sanitate Oculorum." At the head of the work stands a letter from the author to Beltrandus de Sancto Genesio, Aquiligiensi patriarce, to whom Barnabas was body-physician. The first chapter of the work is devoted to ocular anatomy and physiology. Then follow two on those things which injure the eyes and on those which are helpful to them. The next four chapters consist of formulas only.—(T. H. S.)

Baroelectroesthesiometer. An apparatus to determine the amount of pressure when electric sensibility to pain is felt.

Baroffio’s test for simulated blindness. A modification of the well-known box or pseudoscopic apparatus of Fles, for the detection of pretended blindness. See Fles box.

Baroscope. A barometer not intended to give exact quantitative indications. Same as balance barometer.

Barraquer’s formation of a stump after Mules’ operation. The implantation of fat taken from the gluteal region and inserted into the capsule of Tenon after an enucleation had been performed, was recommended in 1901 and 1903 by Barraquer (Enucleacion ingerto de tejido adepa en la capsule de Tenón. Archiv. de Oftal. Hisp.-Amer., Vol. 1, 1901, p. 82). The fatty mass was held in position by suturing over it the musëles, capsule and conjunctiva. He reported some excellent results.

Bar-reading. When a pencil or similar object is held between the eyes and the print which the patient is fixing, uninterrupted reading can take place only when both eyes are employed. Priestley Smith uses for the purposes of this test of binocular vision for near, a thin strip of metal and advises that it be used in the following fashion: When the patient’s fixing eye reaches that portion of the line which is hidden from it by the bar, he must use his other eye. Then the fixing eye is covered for a moment with a screen. Next, the patient is taught to occlude it for himself by a momentary closure of the lids. Soon he will be able to travel along the line with only a slight hitch where he closes the better eye, and at last he will read smoothly, keeping both eyes open. This method, called by Javal controlled reading is always employed for exercising and improving the defective development of the fusion-faculty. It should be continued for months at a time and will be found most effective in squint and after operations for the various forms of strabismus.
Barred cataract. A form of cataract in which the pupil is irregular and small, and has behind it a capsulo-lenticular opacity, in front of which there is a thread or bar of lymph, running across the pupil.

Barrel-shaped distortion. Distortion caused by a concave lens.

Barrett’s suturing operation. In 1898 J. W. Barrett (Intercolonial Med. Journ. of Australia, 1898, III, p. 210) advised the following method of applying the sutures after introducing a glass globe into Tenon’s capsule:

“The operation of enucleation is proceeded with in the usual way. Then the needle is passed in through the conjunctiva about 10 mm. from the cut edge, in the position of the tendon of the inferior rectus. It is then passed from within outwards in the position of the external rectus, at the same distance from the cut edge, back from without inwards in almost the same position; it is then passed from within outwards and back again, in the position of the superior rectus and of the external rectus, and finally from within outwards, in the position of the inferior rectus, so the two ends of the suture are close together. The globe is inserted and the suture is tightly tied. The conjunctiva, capsule of Tenon and tendinous expansion of the muscles are therefore drawn firmly in front of the globe and about 10 mm. of conjunctiva and capsule are loose in front of the suture. The edges of the conjunctiva are now joined by a fine suture.”

After the modification of Bonnet’s operation which I employ, a ball may be dropped into the socket and the purse-string suture including muscles and conjunctiva closed over it, but it is better in this procedure to use a strong silk instead of a catgut suture. The after-treatment of a Mules’ operation should be employed.—(F. A.)

Barrier, Francois-Marguerite. A celebrated pediatrist, surgeon, and extractor of cataracts. Born at St. Etienne (Loire) France, in 1812, he received his medical degree at Paris, his thesis being “De la Tumeur Hydatique du Foie.” Settling at Lyons, he was promptly made professor of clinical surgery at the Preparatory School for Pharmacy and Medicine, and practiced chiefly pediatrics.

His writings are mainly of a pediatric character. Belonging to this group are: “Mém. sur le Diagnostic de la Ménингite chez les Enfants, ses Difficultés et son Importance dans la Pratique” (Lyons and Paris, 1842); “Considerations sur la Caractère de la Vie dans l’Enfance, Fondé sur de Nombreuses Observations Cliniques” (2 vols. 1842, 1845); “Traité Pratique des Maladies de l’Enfance” (2 vols. 1842; 2d ed. 1845; 3d ed. 1860); etc.

Barrier also wrote articles on Dislocation of the Lens (by a blow
from the horn of a cow); Transparent Staphyloma of the Cornea; a Bandage for Use After the Cataract-Operation, etc.

He was extensively known as an operator for cataract, his success in this important field being phenomenal. In the first six years of his work he performed about the same number of extractions and reclinations. In each of these kinds of operations, too, he attained to an equal number of successful results. However, by means of careful testing at various periods subsequent to operation, he became convinced that extraction gave by far the better visual results. After that he performed extractions almost exclusively. He was one of the first, if not the very first, to emphasize the importance of making most accurate visual tests after the cataract operation. This, perhaps, was his greatest contribution to ophthalmology.—(T. H. S.)

Barrow, Isaac (1630-1679). This distinguished professor of mathematics at Cambridge, and perhaps still more distinguished instructor of Isaac Newton, is especially to be remembered by ophthalmologists because, in his "Leciones Opticae" (London, 1669), he solved, for the first time in geometric fashion, the problem of finding the focus of all sorts of rays—divergent, convergent, and parallel—aftter these had traversed lenses of every description.—(T. H. S.)

Barthélémy's test for simulated blindness. This is one of the numerous tests for pretended blindness. According to Norris and Oliver (Vol. 4, p. 868) it has the advantage both of the stereoscope (q. v.) and the pseudoscope (q. v.). It consists of a large square ruler fifty centimetres long, graduated in centimetres, and supported at its middle by a pedestal or by a handle. At one of its extremities an iron plate pierced by two holes for the eyes, and furnished with hooks that permit the adjustment of prisms (stereoscope) or correcting glasses, is fixed. On the ruler, two travellers slide. One of these carries a wooden frame serving for a screen, and the other holds a test-card. A system of two mirrors that are movable around an axis that is fitted in one of the travellers can be adapted to the apparatus, allowing the physician to reproduce the tests of the Fles's box by fixing the cards or test-letters in a position that is external to the apertures of the screen which is intended for the eyes of the patient.

Barth, Joseph. Born in the island of Melita, or Malta, in 1745, he studied at Rome and Vienna. At the latter institution, he received, in 1773, the professorship-in-ordinary of ophthalmology and anatomy. In 1776 he became oculist to Emperor Joseph II. In 1791 he withdrew from his professorship (receiving a pension of 1,000 gulden yearly) and, in 1818, he died.

He wrote but little, being more inclined to teach and to operate

He was a very peculiar man, excitable, irritable—according to some, even quarrelsome. He was also conceited, and would talk for long hours about his own grand achievements. He was a very penurious man. Opinions differ greatly concerning his operative and didactic skill. His pupil, the much more celebrated Adam Schmidt, would, to the end of his own life, praise his former teacher in terms unstinted. Beer remarked concerning him, perhaps with justice, that he "is a man of remarkable talent, that he possesses mechanical skill to a very high degree; it is only a pity that he never received an orderly education—all, with him, is confusion, undevelopment."

Barth, though a scientific man, presented certain of the ear-marks of the quack. He had, for example, secret remedies. His eye-salve, in particular, was a very, very recondite affair. The formula for this salve he gave to Schmidt, exacting, however, Schmidt's word of honor that he would never divulge the secret so long as Barth himself remained alive.

Barth was very exacting of all his students and associates, and sometimes positively unkind. He has been accused of gross treachery toward the magnanimous Beer.

He was equally harsh with some of his patients. When one of these was especially timid, the shouting operator would stand the quivering wretch against the glass door of a great cupboard, and, dismissing his assistants, operate on the eye in solitary majesty. In 13 cases he is said to have operated with his patient leaning into an open window, the head bent back against the side-wall of the embrasure. The patient pulled down his lower lid himself, Barth, with the thumb of the unoccupied hand, drawing the upper lid upward. Both lids were pressed strongly against the orbital margins. Then the fierce-looking operator, shouting suddenly a threat of dire disaster in case the most absolutely perfect decorum were not observed, tapped the cornea lightly a time or two, as a feeler, with the flat of his blade, and then, suddenly, withdrawing, came again and performed a remarkably correct inthrust.

Besides Schmidt, Barth had still another extremely brilliant pupil—Ehrenritter. Of the two, perhaps the latter was even the greater man, but he died young, and we know but little about him. Both these pupils were selected by Barth at the command of the Emperor, who desired that the celebrated oculist should undertake the train-
Bartisch, Georg. The father of German (which is much like saying "modern") ophthalmology, the earliest person to write an ophthalmologic text-book in the German language, and the first in history to remove an eye in toto from the living human subject.

Bartisch was born at Königsbrück, a village near Dresden, Germany, in 1535. He was never a learned, but was always a practical man, to make a long story short, a genius. In the preface to his great "Augendienst," he remarks: "Because, on account of poverty, I have not been able to improve myself in the high school and before the 'Faculty,' I have been obliged to restrict myself to surgery. For this, however, I have always had both love and liking. I have learned that art of well-educated, well-experienced surgeons, oculists and cutting-doctors, with truly devoted industry—a fact which I can prove by three genuine indentures of apprenticeship. I have also now for almost thirty-six years practised this art con summa experientia." One of his three apprenticeships was taken with Meister Abraham Meyscheider.

At all stages of his professional career, Bartisch was a wandering (but never a vagabond) oculist, leisurely strolling about in search of a practice through Saxony, Bohemia, and possibly other lands. This, of course, was wholly in accordance with the custom of the time, for cities were small then and practice of a surgical character had simply to be gone after. In 1588 Bartisch became court-oculist to the Elector of Saxony. Then, it seems, he became as much of a fixture as was possible in the conditions then prevailing.

Bartisch wrote two books, one on cutting for stone (of very little value) the other, entitled "Ophthalmodouleia," or "Augendienst," priceless heritage of the human race. For this "Augendienst," although the composition of a very unscholarly man, was nevertheless, or perhaps on that very account, no omnium gatherum for all the ophthalmologic odds and ends inherited from the Arabs and from Greco-Roman antiquity (as were the works of Benevenutus Grapheus, and many another of the Christian Middle Ages); but it was, on the contrary, a volume of highly original character, comprising the results of the keenest powers of first-hand observation and, for the most part, of sound, uncompromising judgment. It was, moreover, no trifling matter historically—the earliest ophthalmologic text-book to appear in the German language.

The contents of this very appropriate herald of the long and stately
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Georg Bartisch.
procession of German ophthalmologic text-books, can probably be best exhibited by means of characteristic extracts:

On the title-page, then, we read: "Ophthalmodouleia, which is Augendienst. New and well-grounded account of causes and knowledge of all imperfections, diseases and infirmities of the eyes and of the sight, how one in the beginning meets, hinders and guards against all such with appropriate remedies. Also, how one should handle, cure, and drive away all such infirmities with medicines, instruments,

A Bartisch Patient, Prepared for a Pterygium Operation. Note the Look of Pleased Expectancy in Those Pre-Anesthetic Days.

and skill. With beautiful anatomical figures both of the head and of the eyes, as well as of the aforesaid diseases and infirmities, and also of all instruments and vessels belonging to and serviceable for the cure of such eyes. Also, of artificial preparations, purgations, calcinations, distillations of much applicable material, necessary and useful for the medication of the eyes. Together with a short extract from a few testimonials from persons to whom (through God's help) such treatments have assisted in the diseases of the eyes and the sight, which extract is to be found next after the introduction.....

"To all needful physicians, true-hearted fathers of families, and to the especial persons who are laden and afflicted with infirmities, diseases and defects of the eyes and of the sight, or who have to guard
against such things, for the comfort, the service and the welfare of such, composed and written by
Georg Bartisch of Königsbrück, Citizen, oculist,
Cutting and Surgical Doctor in the old electoral city of Dresden.
The like has never appeared before this year 1583.
Concerning the cause of blindness, the reason for eye-doctors, and various matters of ophthalmo-economics, he holds the following language in his "Introduction to the Elector of Saxony": "God

The First Eye Removed in toto from the Living Human Subject.

punishes, on account of sin, with blindness. He permits of healing, in order that we may praise Him and make known His works. Therefore has He furnished healing remedies, also the art of healing. Health is the highest good. A blind man, a poor man. The sound do not remember that, and so do not respect the eye-doctor. Lev. 19: To the blind shalt thou give no offense; that should be observed by them who understand the treatment of the eyes. Of such persons one finds at the present time very many, partly of high, partly of lower conditions, spiritual and worldly; in addition there are also fewer persons to be found who would busy themselves with
such things, mechanics, citizens, and peasants, who learned it behind the oven or with a tailor, shoemaker, furrier, baker, smith, in the workshop or in the shed, behind the plow or in the manure wagon. There are not lacking also old women, treacle-sellers, tooth-breakers, ruined shopkeepers, rat-catchers and mice-catchers, sharpers, tinkers, sow-gelders, sergeants and beadles, and other rash, wanton, inconsiderate, and unnecessary rabble, who wilfully usurp all this noble cure out of great presumptuousness and mischief. Of these not a few by means of stately costumes, lavish gold and silver, as well as many servants and horses, get themselves seen and heard, whereby many good people are not only shamefully betrayed, but also assessed out of all measure, and finally altogether ruined. The high authorities should make an active investigation. God will not let the blind come to be ruined, and sent His Son and the angel Raphael to their assistance. Therefore is ophthalmology a noble gift of God. I have held myself to this noble art from youth upward by the especial help of God. On account of poverty I have not been able to advance myself at the high school and before the Faculty, and so was obliged to hold myself to surgery, and have had for this both liking and love, like the approved authors: Hippocrates, Hammonius, Alexandrinus, Celsus; 36 years I practised and travelled, with great danger, in many and foreign lands.
Bartisch Couching a Cataract.
"Hominem experiri multa paupertas jubet. To medicines I have oftener turned than been served by them, also I have watched over my sick ones from the beginning to the end; not like the vagabond doctors, who thrust in [i.e., the cataract needle] and at once turn over their patients to a peasant or the servant of a shoemaker. Now I have acquired an excellent experience. That is evident, too, from the testimonials. Everything have I observed with exactness, and also explained by my own drawings and written down in ten books. The first of these concerns the infirmities of the eyes. Learned persons have suggested that I print it. This I will do without counting on thanks.

"Patients often demand too much, others would be healed without operation by the laying on of hands, others deny the improvement in order to keep from paying. Still, there comfort us the thanks of certain pious persons, and the eternal reward of God and the knowledge that a good name will be left behind.

Dresden, May 27, 1583.

George Bartisch, Oculist and Cutting and Surgical Doctor, Citizen and Inhabitant of that place."

All these passages from Bartisch I have given, in spite of the great detail, because (for one small thing) of the light they shed on the ophthalmo-economics of the day in general, as well as on Bartisch's own personality in particular. What a vivid illumination, for example, is spread over both these matters by that last seemingly insignificant phrase, "Inhabitant of that place." It was not an unimportant matter, in those days, that an ophthalmologist should be able actually to inhabit some place.

The various details of excellence exhibited by this first example of Teutonic ophthalmography, the "Augendienst," cannot here be gone into. We must, however, translate Bartisch's naïve narrative of one of his complete removals of the eye-ball—exenteratio oculi—an operation which this highly gifted (if almost illiterate) man was the first in history to perform: "In case, however, any person's eye project extremely far forward (egressio oculi) of which I have seen many and taken many out, and if it is large, hideous, and detestable, and cannot be covered up or hidden, as is to be seen by the following figure; and the person would be gladly loose and free from this, then I do to him as follows: Take, from the instruments here drawn, one which seems to thy hand best and most convenient whose figure is shown herein which must be prepared until it is as sharp as any razor can be; press it into a groove under the upper lid however very
close to the bone and on the skull-cap to the very backmost ground, turn then quickly and dextrously the entire eye, especially so that it may be emptied out and made loose on the hinder place in all parts, very fine and close around on the skull-cap and the bones in order that the corrupted material, the bad humors, veins and nerves may be brought out and away completely at all places. Yet everyone ought, who goes about this, to see to it industriously in advance that he does not injure the upper and the lower lid, so that it may not afterwards heal hideously and hatefully.

"When such a proceeding however, has been well performed, and the eye has been taken out; then let not the patient bleed long, but bind him up quickly, and use at the first dressing a powder of white vitreol, alum, etc."

As already hinted in one of the above-written passages, Bartisch himself drew many of the illustrations for his great "Augendienst"—a fact which makes these illustrations of especial value to the ophthalmologist who cares for the history of his subject. Some of the illustrations, it is well to add, were composed of layers placed one upon another, the object being, of course, to display the anatomic situation at different depths from the surface. This method was not original with Bartisch. Thurneisser, at all events, had employed it a little before him. But Bartisch was one of those who very early recognized the value of such illustrations.

With all his great genius, his keen observation and his well-balanced judgment, Bartisch, like every man that Providence has ever seen fit to create, was not wholly free from error or even from rank prejudice. Thus, he was grossly biased against the use of spectacles. Spectacles, he says, are exceedingly injurious. He has even known many eyes to be completely ruined by them. Moreover, one sees vastly better when one has nothing at all before one's eyes. A person ought rather to employ the right kind of powder or eyewater.

Bartisch was grossly superstitious, but the great man's many and often extremely humiliating mistakes that fall beneath this head, may best, at least in the matter of details, be relegated to oblivion.

Georg Bartisch died in 1607. He had a long, active, and extremely useful life, and, moreover, as already stated, he will ever be known as the herald of the long and glorious procession of German ophthalmographers.—(T. H. S.)

Bartisch's enucleation operation. About the first recorded method of enucleation, or "extirpation" as it was called, was described in 1583 by George Bartisch, (Ophthalmodouleia oder Augendienst, 1583),
of Königßbrück, in Saxony. Until about 1850 eyes were extirpated practically only in such cases as cancers, tumors, fungus hematodes, etc., and the method was rarely employed under any circumstances. Bartisch passed a strong needle and thread through the eyeball and then while making traction on the thread and eyeball, passed behind the eye a sharp knife, or spoon, and scooped and cut away the globe from all its attachments. Before permanently adopting the spoon knife, however, he first experimented with a small razor-shaped knife with which he severed the eye from its orbital attachments. The operation was so dreadful that Guthrie, in his work on the eye published in 1823, mentions the fact that Bartolini endeavored to mitigate its severity by pulling out a cancerous eye by hooks, a mild procedure, followed in three days by the death of the patient in convulsions.—(F. A.)

**Bartisch’s method for removal of cilia.** This mediæval procedure for the relief of entropion (q. v.) consisted in cutting away the lid margin with a knife. It was probably first described by Rhazes (q. v.), and at the beginning of the nineteenth century was to some extent revised by Saunders.

**Bartlett’s condenser.** A combination of a glass retort with a tube, water jacket, or canister employed as a condenser. It is really a Liebig’s condenser applied directly to the neck of a retort.

**Barton, Amy S.** A celebrated ophthalmologist and the first woman physician in Pennsylvania. She was born in Camden, N. J., Oct. 1, 1841, coming from a well-known family of orthodox Friends, who originally settled in Burlington County. In 1874 she graduated in medicine at the Woman’s Medical College. Then she devoted her life assiduously and untiringly to her chosen profession. Making a specialty of the eye, ear, nose and throat, she became actively identified with the work of the Woman’s College, particularly in the hospital attached to that institution, and was soon appointed Clinical Professor of Ophthalmology. She was probably the first woman in the entire country to be chosen to a professorship of diseases of the eye. She was for a time District Physician. For many years she was one of the consulting staff of the West Philadelphia Hospital for Women. For thirteen years she assisted Dr. Strawbridge in the Wills Eye Hospital. Under her influence, a large number of young women devoted themselves exclusively to diseases of the eye. A very large part of her professional services was always freely given to the poor "without money and without price."

Miss Barton was a tall, slender woman, and, like many another incessant worker, of rather delicate constitution. She had brown hair.
and light blue eyes, which displayed a wonderful depth of feeling. She was charming and gracious in manner—an excellent qualification either for him or for her who would be of assistance to the sick.

She worked so hard that her health began to suffer. Still, so wrapped up was she in the profession which she loved that she paid but little attention. Then came an admonition that simply could not be ignored—she received a stroke of apoplexy. This was in the late autumn of 1899. Rallying, she decided that her labors must, for the future, be somewhat less exacting. However, she returned to her

Amy S. Barton.

office before she was really able so to do, in order to attend to a number of patients who had long been waiting to see her. For about two months she labored with almost the old-time assiduity. Then came another stroke.

During the second illness, speaking of a young woman physician who was seeking practice, Dr. Barton remarked, ‘‘She is just climbing the ladder, and I am about stepping off,’’ and expressed her resignation that it was so. Much as she had loved her work, and deeply as
she had been interested in it, she was still ready to drop it when the 
Supreme Constructor of the Universe called. There was no repining. 
She was simply glad that she had been a scientist, a physician, and, 
most of all, that she had chosen the greatest of all the specialties for 
her life work. Then, too, was the thought of all she had done for the 
poor—a remembrance so dear to her that she knew not how to ex-
press it.

There came a third stroke, and all was over. "The little Quaker 
doctor," as some of the children called her, was gone. She died 
March 19, 1900.

After her death the Dispensary of the Alumnae of the Woman's 
Medical College, which she had been instrumental in founding, and 
for which she had worked very hard, was named, for her, "The Amy 
S. Barton Dispensary." This was very appropriate: an excellent 
opthalmologist and good and useful woman, she should not be for-
gotten.—(T. H. S.)

Bas. (F.) Stocking.

Basal cells of the retina. These stellate or horizontal cells are found 
in all the mammalian retina. They occur within the outer plexiform 
layer, and according to Piersol are of two kinds, the smaller outer and 
the large inner cells. The outer horizontal cells appear as stellate, flat-
tened elements, which occupy the outermost zone of the plexiform 
layer and possess a variable diameter, some being as small as .012 
millimetre, others as large as .040 millimetre. These elements must 
be regarded as nerve-cells which take part in the "indirect conduc-
tion," since they are provided with both branched protoplasmic and 
long axis-cylinder processes which extend for considerable distances 
within the plexiform layer and end in arborizations surrounding the 
terminations of the visual cells.

The inner horizontal cells, of much larger size than the correspond-
ing outer elements, have been especially studied by Tartuferi, Baquis, 
Dogiel, and Cajal. Following the description of Cajal, the inner hori-
zontal cells include two varieties of elements, those provided with 
descending processes and those without descending processes.

Basallinie. (G.) Base line.

Basal pareses (of eye-muscles). Pareses determined by some lesion of 
the nerves between their departure from the cerebrum and their entry 
into the orbit. According to Ball (Modern Ophthalmology, p. 667) 
these lesions are the most frequent causes of ocular palsies. They 
are usually of such a nature as to operate by direct pressure, as in 
meningitic exudate or tubercle, neoplasm and gumma either of the 
meninges or of the brain-substance, osteitis and periostitis, hemorrhage,
aneurism, or fracture. Any or all of the ocular muscle supply of one or of both eyes may be affected. Other cerebral nerves may at the same time be involved. When ocular pareses are accompanied by monocular blindness; bitemporal hemianopsia or homonymous hemianopsia, associated with the hemianoptic pupillary reaction sign, or where, in the oculomotor palsies, the internal muscles are not involved, they are usually of basal origin.

Bascule. (F.) Weighing-machine for heavy bodies.

**Base-apex line of a prism and its determination.** A line in the principal section of a prism that is drawn to connect its base with the apex-edge. Its location is practically determined when a straight line viewed through the prism appears to be a continuation of the same line seen by the naked eye close to the effective edges of the prism's nearer face. (See figure.) Rotation of the prism from this position correspondingly turns the line viewed through the prism, thereby breaking the line of continuity.—(C. F. P.)

**Basedow, Karl A. von.** A celebrated general physician, surgeon and ophthalmologist. Born at Dessau, Germany, March 28, 1799, he studied at Halle, there received his medical degree, and, in 1822, settled in the little town of Merseburg. He had at once an enormous practice, married early, and became district-physician. This appointment he held until the day of his death, many years later.

His demise took place somewhat suddenly, and precisely in the manner of that of Ludwig Böhm. At the autopsy of a person who had died of typhus fever, Basedow infected himself with a knife. At first, he seemed to be but slightly ill. Later, however, he became much worse, and died April 11, 1854.
Basedow was an exceedingly active man in almost every field of medicine and surgery. In ophthalmology, however, he performed his most remarkable services. His writings in our special branch are as follows:


5. Exophthalmos. (*Jour. Cit.*, 1848, No. 49, p. 769.)

In the article on which his immortality is founded—"Exophthalmos from Hypertrophy of the Orbital Cellular Tissue"—Basedow remarks: "I have often had occasion to observe an exophthalmos, which had been communicated to the orbit from disease of the cellular tissue in some other portion of the body, that is to say, through some special hypertrophy, which, in consequence of a disease of the heart or of the large vessel-trunks, appeared to arise in various glands and parts composed of cellular tissue." Reporting, then, in some detail, a number of cases of the peculiar disease in question, he continues:

"I regard this hypertrophy of the cellular tissue behind the eyeballs as a phenomenon secondary to a disordered circulation and an improper mixture of the blood, as a dyscrasia, which, turned in that direction by a latent scrofula, expresses itself in morbid glandular proliferations together with obstructions in the cellular tissue."

A great fight soon arose, after the publication of this remarkable article by Basedow, regarding the question of priority—a question which is still unsettled. Perhaps the history of the discovery of the three-fold disease so often called today by the name of Basedow, may be summarized as follows, without the excitation of any further animosity:

1. Under the name of "proptosis," Celsus and others of the ancient writers, seem to have huddled together confusedly every conceivable kind of exophthalmos, as well as panophthalmitis.

2. In 1722 St. Yves reported three cases of protrusion of the eyeballs, occasioned, as he said, by an accumulation of fluid in the deeper portions of the orbit. He did not mention, however, either tachycardia or enlargement of the thyroid gland.
3. Giuseppe Flajani, in 1802, reported in his "Collezione d'Osservazioni e Riflessioni di Chirurgia," three cases of cardiac palpitation with associated goitre.

4. Demours, in his work entitled "Maladies des Yeux" (1818) reported a case of one-sided exophthalmos. This, however, was manifestly not a case of morbus Basedowii.

5. Caleb Hillier Parry, a physician of London, in 1825 made a report of thirteen cases of associated goitre and tachycardia. In only a single case, however, had he observed a protrusion of the eyes. Nevertheless, this was getting pretty close to "Basedow's disease."

6. Robert James Graves, a physician of Dublin, in 1835, delivered a number of lectures on cardiac palpitation combined with enlargement of the thyroid gland. He reported a number of cases, and remarked that he had often observed in connection with the two chief symptoms a third—namely, protrusion of the eyeballs. These lectures, according to the partisans of Graves, entitle the distinguished Irishman to the honor of having the disease in question forever bear his name. The partisans of Basedow, on the other hand, rely upon two facts, which, as they contend, debar the Dublin physician from the honor which, as a rule, the medical profession of Ireland, of England, and, for the most part, of America, would be pleased to see accorded him. These facts are: (1) Graves did not regard the protrusion of the eyes as an essential element, or symptom, of the disease (and, in fact, it isn't.) (2) Graves' lectures did not appear in print until 1843—three years later than the article by Basedow.

Till definite rules have been agreed upon by representative national authorities for the settlement of questions of priority, such matters are absolutely doomed, of course, to be incapable of settlement. What is priority? The term has never been defined with any degree of precision.—(T. H. S.)

**Basedowii morbus.** (L.) Exophthalmic goitre.

**Basedow, Morbo di.** (It.) Exophthalmic goitre.

**Basedow'sche Krankheit.** (G.) Exophthalmic goitre.

**Basedow's disease.** Graves' disease. Parry's disease. Although this subject, especially in its important relations to ophthalmology, will be further discussed under the heading Exophthalmic goitre, yet it may be said, under this caption, that the eye symptoms are of great importance; indeed, they may be regarded as the most important evidences of the affection.

The three cardinal and characteristic symptoms of this disease are tachycardia, enlargement of the thyroid gland, and exophthalmos.
The secondary symptoms are tremor, excessive sweating, nervousness, mental depression, apprehension, emaciation, pain and weakness in the extremities, brittleness of the nails, loss of hair (including eyelashes and eyebrows), increased lacrimation, conjunctivitis, diminished power of convergence, and other less common symptoms. Tremor is a very constant symptom, although at times coming on only late in the disease, and has been classed by some writers as a cardinal symptom.

Of the three cardinal symptoms, tachycardia is almost constant, and is the first to appear. One or both of the other symptoms may be absent for a long time. According to Gowers, exophthalmos is absent in about one-tenth of the cases and the goitre in about one-twelfth. The heart's action always reaches 100 per minute, and has been frequently noted at 200. The goitre may be unilateral or bilateral; but if bilateral it is generally more marked on one side than on the other, and commences on that side. The exophthalmos may likewise be unilateral or bilateral, but is generally bilateral. It usually corresponds in side to that of the goitre, but several cases have been reported in which the goitre was on one side and the exophthalmos was on the opposite side. All degrees of exophthalmos are found, and very rarely actual dislocation of the eye ball has occurred. Many patients complain of an intolerable sensation of heat, which may lead them to cast aside their clothing and enables them to withstand low degrees of external temperature. The disease is one of early adult life, and principally affects females. Higgins places the percentage of cases occurring in women at 95 or 97. This is probably too high. Butler states the ratio to be 3 to 1. The same author calls attention to a family tendency.

The special eye symptoms of exophthalmic goitre are important and interesting. Three phenomena affecting the lids are classic, and should be carefully sought for, although they are not always to be found.—(J. M. B.)

Metz has published some contributions to the pathogeny of exophthalmic goitre. The main conclusion was that the disease is an intoxication of the blood by the products of the thyroid secretion—that the etiology should be sought for in a morbid process of the thyroid gland. He considered the other known etiologic theories and rejected them all. He does not now undertake to point out the exciting cause of the hyperthyrosis, but considers that the disease should be placed among the neuroses. Metz briefly reviews the clinical picture of the disease, which, as he states, occurs in the large majority of instances in females. He also details the difference between exophthalmic goitre and myxedema. The treatment which the author recommends is the use
of an antithyroid serum. He describes the method of obtaining it from the Jersey bull, from which the thyroid has been removed. The daily dose of the serum is 5 centigrams.

The history of exophthalmic goitre dates from the report of a case by Parry, in 1786. No complete study of it is found in the literature until Basedow, in 1840, presented a thesis upon the subject, in which he described its most characteristic symptoms. From this time the disease has been known in Germany by the name of Basedow's disease. Previous to Basedow's description of the cardinal symptoms, namely, exophthalmos, goitre and tachycardia, Graves, in 1835, in England, described what he termed "cardiothymoid exophthalmos," but did not depict a typical case of primary exophthalmic goitre. In England, up to the present time, the disease has been known as Graves' disease. Basedow's observations had led him to regard the disease as due to chlorosis. Later studies made by von Graefe, Köber and Charcot directed attention to the derangement of the sympathetic as the probable cause of the symptoms.

In the recognition of what we now consider the symptom-complex of this disease credit belongs to a number of clinicians. Charcot first observed the fine tremor so often seen; Tissier the elevation of temperature; Chvosteks the diminution of electrical resistance of the skin; von Graefe the failure of the upper lid to follow the eye ball in lowering of the plane of vision. Lastly, it was mentioned that Möbius, in 1883, first directed attention to the lessened power of convergence in persons suffering from this disease. He was also the first to advance the theory that the disease is due to an increased pathological activity of the thyroid gland.

In the study of the pathological anatomy, early observers, among whom we may mention Müller, White Copper and Martius, confined their studies chiefly to the condition of the nervous system and particularly to the medulla and the cervical sympathetic. In the medulla no changes of importance were found, although petechial hemorrhages were observed in the cord. These hemorrhages were recent and evidently occurred at the time of death, and therefore could bear no casual relation to the symptoms that were of long duration. The only observer who found positive evidence of disease in the medulla was Mendel. He found, in one case, the left restiform body atrophic, with degenerative changes in the solitary bundles of the opposite side. As no one else has since found anything abnormal in the restiform bodies in exophthalmic goitre, and as a similar atrophy has been found by Oppenheimer where no symptoms of exophthalmic goitre
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existed during life, it is probable that there exists no relation between the findings of Mendel and the disease under consideration.

The greatest effort has been made to establish a relation between the exophthalmic goitre and lesions of the sympathetic. Virchow, Trousseau, von Recklinghausen and others have found atrophy of the nerve elements with increase in connective tissue of the cervical sympathetic, particularly in those fibers that supply the heart. This sympathetic atrophy is frequently found post-mortem. Furthermore, the histologic structure of the sympathetic ganglia varies much, even in the same subject, one ganglion showing all the signs of atrophy with pigmentation which is considered pathologic, while others may be normal. These changes in the ganglion may be found in subjects that never presented any symptoms during life that would indicate disease of the ganglion. Similar degenerative changes in the pneumogastric nerves have been considered the cause of exophthalmic goitre. As in the sympathetic, it has been found that degenerative changes are common in the pneumogastric and bear no relation to this disease.

As first shown by Möbius, the essential cause of the disease known as exophthalmic goitre is a hypersecretion of the thyroid gland. The many symptoms presented are undoubtedly due to a toxemia. This condition is now generally termed hyperthyroidism. It is not unlikely, therefore, that definite and constant pathological changes are to be found in the thyroid gland. In nearly all the type of goitre corresponds to an hypertrophy of gland tissue, either circumscribed or diffuse. The gland may not be greatly enlarged. Microscopically, the alveoli are not found increased in size, but there is present a hyperplasia of the epithelial lining, either as one layer or in reduplication of layers of epithelial cells. There may also be found an infolding of the alveolar wall with the formation of papillae in the alveoli. In some cases in place of a hypertrophy an actual hyperplasia of gland tissue, with a numerical increase of the follicles, exists. This increase in the number of follicles is associated with hyperplasia of the lining epithelium of the alveoli. Degenerative changes with desquamation of alveolar epithelium are to be seen in more chronic cases. Degeneration of active functionating cells may with blocking of the lymphatics bring about a cessation of the symptoms due to hypersecretion of the gland. In this way a spontaneous cure takes place, providing the patient lives long enough.

Most observers are agreed upon the following gross characteristics of the thyroid gland in true exophthalmic goitre:

1. Generally diffuse enlargement of the gland, with a firm elastic
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consistency, the firm consistency being due to the lumen of the follicles being relatively free from colloid and filled with epithelial cells.

2. Expansile pulsation due to increased vascularity often approaching the type recognized as the struma vasculosa. This is due to an increase in the size and number of the vessels, both arteries and veins, of the gland. Albert Kocher is authority for the statement that in their clinic all cases of exophthalmic goitre examined presented indubitable evidence of an increased vascularity both of the capsule and substance of the gland.

Although the pathogenic changes just described, and which correspond closely in most respects with those found in simple diffuse hypertrophic goitre, are considered by von Eiselsberg and others as constant and pathognomonic of exophthalmic goitre, yet any anatomic form of goitre may be associated with symptoms of hyperthyroidism, viz., tachycardia, tremor, etc. The cases are best termed secondary exophthalmic goitre or simply as hyperthyroidism.

In other organs, changes of a secondary character are found. Frequently the heart is dilated; there may be hypertrophy of the left ventricle; in many, fatty degeneration of the muscle and myocarditis are present. A constant finding is the widespread changes in the voluntary muscles throughout the body. In old cases, intramuscular lipomatosi and degeneration of the muscle cells is a nearly constant finding.

The degeneration which takes place in the muscles throughout the body, and which is probably the direct result of the action of a toxic substance upon them, explains practically all the symptoms of the disease. To these changes we can trace the origin of the tremor, the general emaciation, and the loss of converging power. A weakening of the pharyngeal and tongue muscles from the same cause will give the so-called bulbar symptoms which were formerly regarded as evidence of disease of the medulla. The phenomenon of Bryson—loss of inspiratory expansion of the muscles of the thorax—depends upon a degeneration of the muscles of inspiration; namely, the thoracic muscles and the diaphragm. Lastly, the exophthalmos may be explained by the weakening of the ocular muscles, that permits of over-distension of the vessels of the eye and causes the bulging forward of the organ. This over-distension is the direct result of the loss of support furnished by the muscles that normally control the eye and retain it in place. Frequently enlargement of the lymphatic glands is found throughout the body. This is often associated with a persistent thymus gland giving the anatomical findings that have

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been termed the status thymicus, or status lymphaticus. In the absence of any other known cause, it would seem reasonable to suggest a possible relation between a diseased condition of the thyroid gland and this lymphatic hypertrophy.—(A. E. H.)

Treatment. The use of the serum and the milk of thyroidectomised animals that has been extensively advocated of recent years is based on a more rational foundation; unfortunately the clinical results so far are quite uncertain. Personally I have never seen any effects from this treatment that could not have been obtained as well and with less expense and annoyance to the patient from the ordinary means employed in the treatment of Graves' disease. In this disorder spontaneous remissions and intermissions are very apt to occur and one must be exceedingly conservative in attributing good effects to any one remedy. This applies, for instance, to thymus therapy. The results are ambiguous; the remedy is worthy of trial and has this advantage over thyroid that it has never been known to do any harm.

In far advanced cases that fail altogether to yield to the simple measures to be presently described surgical intervention must be thought of, partial or complete thyroidectomy being the remedy of choice in most cases. Provided the operation is performed by a very skillful and experienced surgeon, provided so much of the gland and capsule (accessory thyroids) are not removed as to produce tetany, the results are really astonishingly good. The operation should never be looked upon as a routine measure, however, to be resorted to promptly in every case of Graves' disease, but always as an emergency measure and a means of last resort.

One of the most important general measures to be employed in any case of exophthalmic goitre is the maintenance of complete rest, physical, mental and emotional, for a period of weeks, if possible. In most cases it becomes necessary, in order to accomplish this, to take the patients away from their home surroundings and to give them a change of scene. In aggravated cases a hospital or a sanitarium are the best place. If a resort is selected, the altitude should not be over 2,000 feet. The seashore is never good for these cases.

The question of diet is still a subject of controversy. Personally I have seen the best results from an abundant albuminuous diet combined with plenty of fresh fruit, cereals and vegetables. The proteid metabolism is usually very active in Graves' disease so that it becomes necessary to supply the deficit arising from the rapid dis-assimilation of body albumens; in other words, to put it crudely, it is necessary to "feed the goitre." There are some arguments against
this mode of therapy, but this is not the place to discuss them. The objection that a "meat toxemia" may develop from this diet is theoretically constructed.

Electricity has a decided place in the treatment of Graves' disease. The galvanic current with the anode applied below the angle of the jaw, the cathode, in the form of a flat plate electrode, applied to the left of the lower cervical spinal ganglia, is the best mode of applying the current. Weak currents, not to exceed one milliampere, and applied for not longer than three minutes, should be used in the beginning. The direction of the current may be changed to advantage during these three minutes, and both sides of the neck should be galvanized. Later the strength of the current may be increased. The high frequency current applied directly over the thyroid gland has recently been extensively used and seems to act beneficially in some cases. Hydrotherapeutic treatment should be carried out with great care and under careful control of the heart action and blood-pressure. It is directed against the neurotic phenomena more than the underlying disease and should be administered according to the common principles applicable to this class of disorders.

The medicamentous treatment of exophthalmic goitre is not very satisfactory. Iron and arsenic may be employed as in the general anemias. Here and there a little bromide and valerian may be indicated. Phosphate of soda in 30 to 60 grain doses two or three times a day seems to exercise a particularly beneficial effect upon the nervous mechanism governing the heart. The best remedy for the palpitation in tachycardia is aconite given in very small doses at intervals of from one to three hours. Digitalis has no place in the treatment of this disease unless there be evidence of cardiac insufficiency. Iodine is commonly used in Graves' disease, on what grounds has never become quite clear to me. Personally I have invariably found it to do more harm than good in this disorder.—(A. C. C.)

When these milder means fail surgical procedures are necessary. According to Halstead, they are as follows:

1. Operations on the gland itself. (a) Partial excision, generally unilateral thyroidectomy. (b) Enucleation of cysts, cystic tumors and encapsulated growths, as adenoma. (c) Incision and drainage of cysts. (d) Exothyropexy.

2. Ligation of thyroid vessels.

3. Operations on the cervical sympathetic nerves and ganglion. (a) Section of sympathetic cord, either unilateral, as practiced by Edmonds, or bilateral, after Jaboulay. (b) Partial resection, (Jaboulay, Vignard and Quenu). (c) Total bilateral resection by which the
three ganglia on each side, with their connecting cords, are completely removed, (Jaboulay).

At the present time the operation usually chosen in the treatment of exophthalmic goitre is unilateral or partial excision of the gland. The technic is practically the same as when a portion of the gland is removed in simple goitre.

For a description of the operative measures see Exophthalmic goitre.

Baseilhac, Jean. Born April 5, 1703, at Pouyastruc, near Tarbes, France (as the son, grandson, and nephew of physicians) he was for a time a student of surgery at the Hôtel Dieu, at Lyons, and, later, at the similarly entitled institution in Paris. In 1729 he entered the ecclesiastical order of Bernardines, at Paris, under the name of Frère (or brother) Jean de Saint Côme. As a member of this order he continued to practice surgery, and indeed performed all sorts of operations on great multitudes of the poor. He became especially celebrated as an oculist and as a cutter for stone. He is said to have invented more than 20 instruments, and to have improved a vast number of others. Among his most important works are: *Collection of Important Articles Concerning the Operation for Stone* (Paris, 1751) and *A New Method of Extracting Stone from the Urinary Bladder* (Paris, 1779).

He made a number of improvements in ocular instruments and operations, and, about 1750 (just a trifle later than Daviel) extracted a cataract by way of an incision in the cornea.

Baseilhac died July 8, 1781.—(T. H. S.)

Base line. According to Tscherning this is the distance between the centers of rotation of the two eyes; it varies between 66 mm. and 58 mm., or even less. "We can measure it by sighting a distant object, a lightning rod for example, along the surface of a planchette held horizontally. We close one eye and fix a needle in the planchette, so that it may appear to coincide with the lightning rod. The needle must not be placed too near the eye in order that its images may not be too diffuse. Then we repeat the experiment with the other eye without displacing the head; opening the two eyes, we should see the two needles blended into one, which coincides with the lightning rod. The distance between the needles is equal to the base line. We find also very great variations, especially if we examine children, whose base line is manifestly very short."

Base of a prism. The thickest part of the prism is called its base. Base of the orbit, Anatomy of the. Although this important subject will receive additional attention when describing the orbit as a whole,
yet it is proper to say here that the base of the orbital cavity is quite exposed in the skeleton, but, in the fresh state, is closed by the eyelids. They may, in this connection, be likened to an optic diaphragm, the opening being the interpalpebral slit. The orbital septum is attached to the margin of the orbit at the lower and outer sides and more or less within it or at the upper and inner of the external palpebral ligament. An imperfectly marked thickening of some fibers of the orbital septum is found at the outer canthal angle and extends to the malar bone. The inner palpebral ligament lies over the orbital septum and runs from the inner part of the tarsus of the superior maxillary bone, just in front of the nasal groove. It may be made out by drawing both lids outward when it shows quite clearly through the skin that is attached to it. Posteriorly, it has another attachment to the anterior surface of the lachrymal sac and acts as the tendon of the orbicularis palpebrarum. The reflected tendon of the orbicularis is really a membrane which passes behind the lachrymal sac to the crest of the lachrymal bone.

**Base, Variable.** In alphabets and print for the blind (q. v.), this term is used to designate the plan by which the horizontal space allotted to each character varies with the width of the character, as in the New York Point.

**Basham's mixture.** A mixture of iron and quinine, of considerable value in the general treatment of chronic or acute lachrymal abscess, and similar diseases of the ocular apparatus.

**Basic legal principles** of various countries (in their relations to ophthalmic expert testimony and similar matters). See *Legal relations of ophthalmology*, near the beginning of that section.

**Basilar layer of the iris.** An important (posterior) layer of the iris proper. See *Histology of the eye*.

**Basilicon, The, of Euelpides.** A collyrium much employed in Greco-Roman times for eyes that were "scabrous" in the angles, as well as "for all disorders of the eyes that are not treated by mild medicines." It consisted of poppy tears, ceruss, Asian-stone, gum, black pepper, saffron and psoricum. Concerning Euelpides, Celsus remarks, "Euelpides, who was the greatest oculist in our age," etc.—(T. H. S.)

**Basilisk.** Also called in modern times "Cockatrice," as a result of the vulgar confusion of this fabulous animal with the actually existent crocodile (crocodile in old French *cocatrice*). "Cockatrice" was also confounded with the French *coq*, English *cock*, and thus arose a modern addition to the ancient fable—namely, that the cockatrice, or basilisk, was produced from a cock's egg. The eye of this animal
was supposed to have the power of killing by a mere glance. All the ancient authors believed in the existence of the basilisk, and speak of its poison and its death-dealing look with the utmost horror. Nicander describes it as a lean little animal, three palms long and of a shining color. The great Arabian physician, Avicenna, speaks of a soldier who was killed by a basilisk, after he had succeeded in transfixing it with a spear. The basilisk, or cockatrice, plays a very conspicuous rôle in the earlier English literature, e.g., Shakespeare:

‘‘That bare vowel, I, shall poison more
Than the death-dealing eye of cockatrice.’’

We may add that one of the eyes of a real person, Vathek, the ninth caliph of the race of the Abassides and grandson of Haroun al-Raschid, was supposed to possess cockatricial power. ‘‘When he was angry, one of his eyes became so terrible that whoever looked at it either swooned or died.’’—(T. H. S.)

**Basil. Ocimum basilicum.** (L.) Basil, dissolved in wine, was much employed by the ancients in epiphora and ocular affections generally. Soaked in a cloth, it was bound about the head. Strangely enough, this very identical plant was supposed, if eaten to excess, to produce ocular disease.—(T. H. S.)

**Basiophthalmite.** In biology, the basal joint of the eyestalk in certain crustaceans.

**Basis orbitæ.** (L.) The anterior aperture of the orbit.

**Bassinage.** (F.) The cleansing and dressing of wounds.

**Bassin oculaire.** (F.) A small oval basin used in bathing the eye.

**Basso’s reclinateur.** For the removal of the lens in its unruptured capsule, D. Basso devised an instrument which he called a reclinateur

(see illustration) which fitted over the anterior surface of the lens under the iris. He states that slight pressure with it is usually sufficient to dislocate the cataract, which is then delivered in the usual way.

**Bates’ lachrymal syringe.** This surgeon has pictured a glass pipette for washing out the lachrymal sac. He believed it to be an improvement on the Anel syringe. (Archives of Ophthalm., 1901, p. 514.)

**Baths, Sweat.** Although this heading will be more fully considered elsewhere (See Sweat baths, and Hydrotherapy), it may suffice to say here that the baths should be given when the stomach is empty.
The patient should be in bed and wrapped up to the chin in a woolen blanket and again covered with at least four woolen blankets. Under the latter six quart bottles containing boiling hot water should be placed. If used at all, pilocarpine, or other adjuvant, should now be given hypodermically. The patient is also given to drink at least a pint of very hot water, very hot and weak lemonade, or very hot tea, to be administered through a bent glass tube, while the patient is lying down. In a few minutes he should begin to break out into a profuse perspiration, which should continue for at least two hours, only stopping short of that time if he shows any bad symptoms. At the end of two hours he should be thoroughly dried and the skin rubbed with alcohol and then allowed to rest for another two hours, when he may go out if he wishes.

Bâtonnet. (F.) (1) A rod-like body of Jacobson’s membrane of the retina; (2) Bacterium. A bacillus; also a rod of the retinal layer of rods and cones.

Bâtonnets, Cellules rétiniennes à. (F.) The retinal rods.

Batraciens, Aspect ophthalmoscopique du fond de l’œil des. (F.)
Fundus appearance of the eye in batrachians.

Batraciens, Paupières des. (F.) Eyelids of batrachians.

Batteries, Prism. The usual form of this means of lighting dark places is an arrangement of the so-called Luxfer prisms, although any others may answer equally well. It is of great value when, as in our crowded cities, the lower stories and rooms in buildings are rarely or never reached by direct daylight. These prisms are arranged as ornamental panes or as canopies in front of the dark windows. For basements or cellars they are inserted in the pavement, with secondary screens below the sidewalk to assist reflection into rooms beneath.

Batterio. (It.), n. n. Bacterium.

Baudon’s test for simulated blindness. This surgeon employed for the test two prisms, one red and the other blue, and each of about 15 degrees. These he placed in front of the eyes, bases out, and the patient was made to look at a candle-flame in a dark room two metres away. If the malingerer declares there is only one candle, it will be the one which he thinks he sees with the sound eye, while in reality it is the one that is seen with the eye which he pretends is blind.

Baudruche. (F.) Gold-beater’s skin.

Baudry’s test for simulated blindness. The purpose of this procedure for the detection of pretended blindness is to obtain a series of double images, so much alike that the malingerer is unable to distinguish the actual from the false, or to decide whether the diplopia pro-
duced by the method is referrable to one eye or to both. Marlow (Norris and Oliver, Vol. 4, p. 878) gives the following description of the apparatus: A dark red glass of even color is placed before the flame of a candle which is situated at a distance of two or three metres. Here the color of the false image, being produced by the decomposition of the white light in its passage through the prism (if, instead of white light, we use red light,—such as passes through a red glass colored by oxide of copper), cannot undergo any further decomposition, and, as a result, the real and the false images are identical in appearance. The interposition of this dark red glass renders the difference which still exists between the images, in binocular and in monocular diplopia, scarcely perceptible. The instrument which is used has the following arrangement: A triangular prism, on section a right-angled triangle, divided into two parts by a line of horizontal section, C'D, is united by its base, A'B, to a transparent medium, C, with parallel surfaces and of the same thickness. The whole glass represents a portion of a bevelled mirror without the mercury, divided into three distinct parts, A, B, C, which lie with their unpolished cut surfaces in apposition. (See the figure.) This glass is concealed in a circular metal box (oxidized brass) which is perforated on each surface by a central opening, one of which has a diameter of six and the other of three millimetres. A simple mechanism which allows sometimes one and at times the other of the two lines of separation (A'B' or C'D), and at the same time a small part (three millimetres) of the adjoining portions of the glass (or, in an optical sense, sometimes the base of the prism and sometimes the prism itself) to be brought before the pupil of the sound eye, is thus obtained. As the lines of division and the adjoining portions of the glass that are brought before the pupil are absolutely identical in appearance, sometimes monocular and sometimes binocular diplopia, unknown to the malingerer, even if he knows in advance the construction of the instrument, can be evoked with the greatest ease. It is almost superfluous to point out the different methods of applying this test. The person examined being permitted to believe that the
examiners are convinced of the reality of his disease, the eye that is supposed to be blind is, without exercising any pressure, covered by the examiner’s hand, and the patient is made to fix his gaze on the flame of the candle that is placed two or three metres away behind a sheet of dark red glass. The instrument is then arranged in front of the normal eye, the line of separation between the base of the prism and the medium with parallel surfaces, A'B', cutting horizontally the area of central aperture, which is placed in line with the pupil. Under penalty of showing evidence of bad faith, the patient will assert that there are two images of the candle-flame. On withdrawing the instrument, the line of separation of the two portions of the prism, C'D, is brought instantaneously, and without the knowledge of the patient, in place of the preceding, A'B', and the instrument is replaced before the healthy eye, though the eye that has been declared to be blind is purposely left uncovered. The patient declares that there are still two images. He is therefore completely deceived, since a monocular diplopia has been replaced by a binocular diplopia. It may be that the patient has taken the line of denying obstinately the existence of double vision. In this case the two parts of the test can be repeated several times, in order to catch the malingerer in a mistake. The writer maintains that these modifications of the prism-test are of a nature to baffle the most intelligent and the best-informed patient, since, on the one hand, owing to the interposition of a dark red glass, the two images resemble one another, in monocular as in binocular diplopia, and, on the other hand, with the instrument, the interested person cannot distinguish whether he has the base of the prism or the prism itself, in front of the eye that has been declared to be normal.

Baume du Canada. (F.) Canada balsam.

Baume ophthalmique. (F.) Ophthalmic balsam or liniment.

Baume ophthalmique jaune. (F.) That variety of red-precipitate ointment which is made with lard (or butter or olive-oil) and wax.

Baume ophthalmique rouge. (F.) Red-precipitate ointment.

Baumgarten, Friedrich Moritz Oswald. A celebrated plastic surgeon of Dresden, Germany. Born at Arnsdorf, Germany, in 1813, the date and place of his graduation seems both to be unknown. He collaborated a good deal with F. A. von Ammon in the field of plastic surgery, and became “Medizinalrath” at Dresden. Among his more important general writings are: Über Lippen und Mundbildung (von Ammon’s Monatschrift, 1838, Bd. I.); Blepharooplastik wegen Naevus Maternus (von Walther’s and von Ammon’s Journal, 1842, Bd. I). His only ophthalmic composition is a small but excel-
lent monograph entitled, Das Schielen und dessen Operative Wissenschaftlich Dargestellt (Leipzig, 1844).—(T. H. S.)

**Baum's electrical ophthalmoscope.** F. Baum (Klin. Monatbl. f. Augenheilk, May, 1913) has described a new electric ophthalmoscope in which the rays of light are deflected by a prism rather than reflected by a mirror. The apparatus is very small and compact and has been named by its inventor the "Pikkolo." The prism causes a bundle of parallel rays of light to be projected into the examined eye, thereby illuminating a larger part of the fundus than is illuminated by converging rays which must focus on a given point. This duct shaft of light also eliminates all disturbing corneal reflexes. (See the figure.) Baum makes the following claims of superior merits found in his instrument: First—The source of light is nearer the investigating eye than in any other electric ophthalmoscope. Second—The light rays being parallel, all enter the pupil of the examined eye and none are lost. Third—On account of the observers eye being so near the eye of the patient, the diameter of the field of vision is great. Fourth—The instrument is cheaper, lighter and more simple than any other similar apparatus. Fifth—The view seen by the observer is direct and not a reflected one as in some of the other electric ophthalmoscopes.—(A. S. R.)
Baumstaar. (G.) Pigmented cataract.
Baumwolle. (G.), n. Cotton.
Baumwollensamen. (G.) Cotton seed.
Baunscheidtism. n. A method of counter-irritation by means of an instrument invented by a person named Baunscheidt; formerly much in vogue in Germany. Over one end of a short tube was stretched a piece of chamois saturated with an irritant oil. This end of the tube was applied to the part of the body to be acted on, and a number of needles contained in the tube were forced through the chamois and into the skin by the action of a spring. (Foster.)

The employment of this curious panacea is embalmed in a considerable bibliography; in the literature are several monographs touching its use in ophthalmology.

Baxter’s cyclo-phorometer. This is a modification of the instrument first exhibited by Price, in 1893. Its purpose is to measure certain forms of heterophoria. According to Savage (Ophthalmic Myology, pp. 69-72) the original instrument consisted of a double prism (line of bases horizontal) and a rod at right-angles to this line of union, placed in a circular disc to fit the rim of a trial frame; and a Maddox rod (placed vertically) in the other side of the frame. Looking at a candle, the patient sees two horizontal and necessarily parallel lines of light with the one eye, as well as a single horizontal line of light with the other. The latter appears between the other two, and parallel with them in orthophoria of the obliques. This was for testing the obliques when the visual axes were approximately parallel. It was faulty in that there was no adjustment by means of which the frames holding the rods could be leveled. A little later, Baxter, of Boston, and Brewer, of Connecticut, each independently, invented a cyclo-phorometer, with the error in the Price instrument eliminated. Brewer named his instrument the torsiometer. Later, Stevens brought out his prism clinoscope (q. v.), the construction of which is not very different from the instruments of Baxter and Brewer. The Cyclo-phorometer (q. v.), made for use in connection with the monocular-phorometer stand, or the Wilson phorometer holder, consists of a base on which rest two graduated cells, in each of which is to be placed a triple Maddox rod with the axis vertical. Behind each of these circular cells is a rectangular cell for a displacing prism. There is an arrangement by means of which the pupillary distance can be easily regulated so that the one streak of light may be brought directly under the other. There is beneath the base of the instrument a spirit level
for regulating the adjustment of the instrument. On each disc contain- 
ing the rods is marked below a line continuous with the axis of the central rod. The rods placed vertically, with a prism of $5^\circ$ base up behind one of them, will show two horizontal lines of light, when a candle is looked at. The lower one will be seen by the eye before which is the combination rod-and-prism. The lines should be parallel, and their ends even. The latter can be regulated by turning the screw that controls the pupillary distance. The slightest movement of either disc will cause a loss of parallelism of the streaks of light. If not parallel, there is want of orthophoria of the obliques, the kind and quantity of the error being shown by the rotation of either disc. By removing the displacing prism, the intrinsic power—the cyclo-duction—of each oblique muscle can be taken alone, and then the combined cyclo-duction of either both superior or both inferior obliques. This is done, when only one muscle is being tested, by revolving the one rod in the temporal arc for a superior, and in the nasal arc for an inferior oblique. If both superior obliques are under the duction test, then both rods must be revolved in the temporal arc; if both inferior obliques, then both rods must be revolved in the nasal arc. The moment the two streaks separate, the rotations must stop. On the arc of the cells the extent of cyclo-duction can be read. The normal cyclo-
duction for a single oblique muscle is somewhere between $7^\circ$ and $14^\circ$. The combined cyclo-duction of either pair of obliques is somewhere between $12^\circ$ and $22^\circ$.

Bay, Lachrymal. A term often applied to the parts about the inner canthus. See Anatomy of the eye.

Bay rum. Although this form of perfume is supposed to be an innocent preparation, except in so far as it contains alcohol, yet it has come into notoriety of late years because of the substitution of methyl for ethyl grain alcohol. Those who are not particular as to the form of beverage indulge, among others, in this alcoholic mixture and should it happen to be mixed with Columbian spirits, for example, instead of pure alcohol, are exposed to all the dangers of wood alcohol poisoning (q. v.). This accident has happened many times.

From the reported cases the following has been abstracted: A 25-year old negro drank with two others half a litre of bay rum. The latter remained unaffected but the colored man, who had taken more than the others, noticed the next morning that he could not see well and soon became totally blind. As usual in cases of methyl alcohol amblyopia there was, in a day or two, a slight return of
vision, and, later, total and permanent blindness. After thirteen months the patient exhibited a slight, lateral nystagmus; the pupils were wide and motionless; the retinal vessels normal, but the papillæ were opaque and white. There was an atrophic excavation of the discs, and only on the nasal side was there an approach to the normal coloration.

**Bdella.** (L.), f. n. The leech.

**Bdellaire.** (F.) Pertaining to leeches.

**Bdelle.** (F.) Bdella; leech.

**Beale’s ophthalmoscope.** This instrument, invented about 1860 by Lionel Beale, was devised for the purpose of examining the ocular fundus without darkening the room. The inventor found it of considerable value in the dimly-lighted wards of the hospital. Soelberg Wells was able to see the fundus details perfectly in broad daylight, and thus describes the instrument: The reflector and lens are enclosed in a tube to the side of which is adapted a small paraffin lamp, with a large plano-convex lens. The illumination is so strong that it is not necessary for the tube to fit accurately to the margin of the orbit; indeed, the instrument can be used quite successfully even if two or three inches traversed by daylight intervene. The reflector is fixed in the tube at the proper angle, and the lens is made to incline a little, so as to remove the reflections upon the retina out of the field of vision. With this instrument the optic disk is at once brought into view without any difficulty, and as the lamp moves with the mirror and lens, inexperienced persons can use the apparatus successfully almost upon the first trial. The instrument weighs nearly a pound, but it can be made very much lighter. The lamp is the same as that which Beale has adapted to the hand microscopes he used for the demonstration of objects in his lectures. For making ophthalmoscopic drawings, the instrument can be fixed to a pillar and stand. The artist can work in daylight with very little effort, while the patient can retain the eye fixed in the proper position without exertion.

**Beam of light.** In *optics*, a narrow bundle of parallel rays of light; a fine cylindrical shaft of light.

**Béance.** (F.) The condition of being wide open or gaping.

**Bean tree.** See [Catalpa](#).

**Beard’s fixation forceps.** The fixation forceps now in general use are condemned by Beard as clumsy because of the strained position in which the operator’s hand is placed. The forceps designed by this operator are fashioned after the plan of a pair of de Wecker’s iris scissors. These forceps enables the operator to grasp the eye below
the cornea for a cataract operation without cramping of the hand. The blades of the forceps are set at an oblique angle to the handles and this permits of the handle being maintained in the vertical position with the hand of the operator out of the light. (See the figure.)

Beaver castoreum. Beaver-testicle, made into a salve with Attic honey, was employed by the ancient Greeks and Romans both to clarify the sight and to cure (as they supposed) paresis or paralysis of the ocular muscles. Mixed with the gall of a chameleon, it was used to prevent the return of eyelashes after epilation. See History of ophthalmology.—(T. H. S.)

Bebendes Auge. (G.) Nystagmus.
Bec. (F.) (1) Bill; beak; (2) Rostrum; tooth-forceps.
Bechterew's fibres. These are cerebral connections that run from the chiasma to the third ventricle.

Becker, Otto. One of the greatest ophthalmologic investigators and teachers of ophthalmology in any land or age. Born at Domhof, near Ratzeburg, a small town of Mecklenburg-Strelitz, Germany, May 3, 1828, he is said to have become a student under considerable disadvantages. Latin he learned from an old neighbor lady, for whom, in consequence, he cherished a grateful remembrance even to the end of
his days. At first he studied theology at Erlangen. Later, however, he turned to medicine. At Vienna the teacher by whom he seemed to profit most was Arlt, and, receiving his degree in 1859, Becker became, possibly because of Arlt’s influence, an ophthalmologist. In 1862 he became Arlt’s private assistant, and, Oct. 1, 1868, he was appointed professor-in-ordinary for ophthalmology at the University of Heidelberg—a position which he held till his death. At Heidelberg he succeeded the famous Herman Knapp, who had just migrated to America.

Becker’s most important writings are: “On the Anatomy of the Normal and the Diseased Lens” (Wiesbaden, 1883); and “Pathology and Therapy of the Lens” (in Graefe-Saemisch Handbuch, 1876). He wrote also numerous journal articles, and a biography of Arlt.

He was even better known, however, is a teacher and as an investigator than as a writer. Many of the most successful ophthalmologists in all the countries of the globe today owe their operative skill and their accurate knowledge of the eye to Otto Becker. As an investigator he was slow, painstaking, accurate and permanent. Time and toil were as dust and ashes to him when weighed in the balance against an unassailable result. Then, too, Becker was brilliant as an operator.

But this versatile man was not merely a great ophthalmologist, great as he was in all the branches of our specialty. He was also an all-round scholar, an accomplished linguist, a profound mathematician. There was, indeed, hardly a branch of human knowledge which did not immensely interest him.

He was a man of very imposing presence. Tall and well-proportioned—a typical blonde German of the kind which Tacitus describes—he was always well-nigh quivering with energy and earnestness. In very few men of commanding intellect do both mind and heart so fill, inform and animate its merely material envelope as was the case with Otto Becker. Becker’s body almost seemed, in fact, to be the natural output of his large, vigorous and indefatigable self.

He was also a man of warm heart, wholly free from envy and full of friendliness and gratitude. Thus, according to Hirschberg, who knew him well, he revered as a father the venerable Arlt, “and was continually studying how, even in small things, he could give him some pleasure, whether it was at the meeting of oculists at Heidelberg, or at Vienna at occasional visits, at the 70th birthday of the master, or during his severe illness.” The same great authority also tells us touchingly that when he (Hirschberg) had performed a cataract operation on the dear old lady who had taught the Latin lan-
guage to Becker in his boyhood, the former pupil, but now most cele-

Becker's Sign

Becker's Sign. Spontaneous pulsation of the retinal arteries in exophthalmic goitre (q.v).

Becker's test. A test for astigmatism, made by means of a set of parallel lines in triplets placed in various meridians. The differences in definition, clearness or blackness indicates the degree of the defect and the meridian of the ocular astigmatism.

Becquerel rays. In optics, invisible radiations emitted from the salts of uranium, which affect photographic plates and cause atmospheric
air to become a conductor of electricity. This property is not limited to the fluorescent uranic salts, but is shared by the nonfluorescent uranous salts. The emission of these radiations has been observed to continue, without any apparent diminution, during three years; in which time the active substance was preserved in a leaden box with double walls. A Polish lady, Madam Curie, has found that pitchblende, the mineral from which salts of uranium are extracted, contains a substance apparently allied to bismuth, which emits Becquerel rays with 4,000 times the activity of uranium. This substance, which has not been completely isolated, has been termed polonium, in honor of the native land of the discoverer. A second substance, allied to barium, has been found in pitchblende; this has been termed radium. A third substance, termed actinium, has been found; this latter substance appears to be allied to thorium. All of these substances continually emit radiations which affect photographic plates.

**Bed bug.** The *Cimex lectularis*, rubbed up with salt and woman’s milk, was highly esteemed in antiquity as a poultice for the eyes. The blood of this creature was also employed to prevent the return of eyelashes after epilation.—(T. H. S.)

**Bedeckt.** (G.), adj. Covered, concealed.

**Bed-perimeter, Wilbrand’s.** This is a well-known and useful instrument suitable for measuring the visual fields of bed-ridden patients. It is described in Norris and Oliver (Vol. II, p. 210). (See the figure.) A wooden board (a), the breadth of which is equal to the length of the perimeter, and the length of which equals the width of the bed, is

![Wilbrand’s Bed-perimeter.](image-url)
made so that it can be raised or lowered like a reading-desk. A second board (b), which can be placed at any degree of inclination upon two perforated irons (c), is supported by putting a little iron pin (d) into a series of holes. Upon the board (b) is placed the perimeter. The board (b) is connected with the board (a) on the side turned towards the patient, by means of two hinges, which are placed near the corners. Both boards between the hinges are hollowed out so as to fit the regions of the chest and abdomen. The perimeter itself is supported below by a clamp (f), which is fixed vertically to (b). The board (a) is supported by four wooden screws (g), which are fastened by pairs to a rather narrow board (h), resting horizontally on the lateral bed-boards. On the board (h), near the outer end, is placed a clamp (k), so as to prevent the whole apparatus from moving side-ways. A head-rest is so arranged that the chin of the patient can be brought into a comfortable position on the chin-rest of the instrument.

**Beech, Oil of.** OLEUM FAGI. A tar product, essentially the *pix liquida* of our pharmacopeia, official in the Austrian codex. It is a thick, viscid mass of a dark brown color, some of its many constituents slightly soluble in water; more soluble in oil and ether.

This remedy has been recommended undiluted as an application in blepharitis complicated by thickening or chronic infection of the conjunctiva. It is used as a more cleanly substitute for iodine and tar ointment, and as such should not be allowed to reach the conjunctiva but is to be painted on the dermal surface. The application had better be made at night and may be repeated at intervals, to irritate the skin without destroying its epithelium.

**Beef worm.** This is probably the larva of the Central American hypoderma hominis or hypoderma bovis, a parasite derived in both instances from cattle, which burrows under the skin and forms furuncular abscesses there. An account is given by Gann (*Wochenschr. f. d. Therap. d. Auges*, 1903, No. 21, p. 168) of one of these parasitic animals that had found its way into the lid near the outer canthus of the left eye. A small, raised papule at the border of the lid showed a small opening with a whitish spot in the center. This white spot proved to be the head of the worm, which drew back when touched. A decoction of tobacco was injected into the opening and the beef-worm was successfully extracted with forceps.

**Beerchen.** (G.), n.m. The cavity, or sacular recess, in the finest lobule of a racemose gland.

**Beer, Joseph.** (1763-1821.) Founder of the Vienna school of ophthalmology. See Appendix.
BEER, OCULOTOXIC SYMPTOMS FROM

Beer, Oculotoxic symptoms from. It is not only the alcohol in beer which, when taken to excess, produces toxic eye symptoms but it may be that the other ingredients of this beverage have some deleterious effect. The recorded instances during the last few centuries show particularly a transitory amaurosis or amblyopia and in some instances the picture of a typical alcoholic amblyopia. Adulterated beer affects the drinker according to the character of the adulteration. See Toxic amblyopia.

Beer's cataract knife. A knife with a triangular-shaped blade, generally used for making the corneal section in the removal of cataract.


Beer's method of amputation of staphyloma. This is the classical method of amputation of the staphyloma. The lower half of the protrusion is detached by means of a cataract-knife; the upper half is held with forceps and then cut off with scissors. The anterior capsule is now opened and the lens allowed to escape. The same precautions should be taken as in the extraction of cataract. Bands of connective tissue finally close the wound and there is left a white, broad and unyielding cicatrix.

Bee, The. Although the sting of this insect has been known for many ages to produce swelling and, often, local poisoning of the affected part yet it was not until lately understood that the active agent in producing the symptoms is an albuminoid secretion closely resembling the poison of the caterpillar—as seen in conjunctivitis nodosa (q. v.)—especially when there is added the presence, in either instance, of a foreign body remaining in the wound.

In addition to the toxic inflammation of the lid tissues there are reported serious results following sting of the eyeball. Among these are acute glaucoma, pannus-like opacity of the cornea (preceding removal of the sting), spreading ulcer of the cornea, cataract, iritis, and loss of useful vision. The treatment is, of course, the immediate removal of the sting with subsequent therapy as further indicated.

The products of the honey and wax—enjoyed great popularity as a part of the materia medica of ancient Greek and Roman ophthalmologists.

Beetle. Merely to look at a green beetle (scarabaeus viridis) was, in antiquity, to strengthen one's eyes. Even at the present day, in fact, all green substances are popularly supposed to be "good for the eyes." However, the green beetle was supposed, in olden times, to possess an especial efficacy. Hence the common practice of lapidaries, in ancient days, to keep a scarabaeus viridis on their tables. From time
to time, as the eyes of the cutter of gems grew weary, they were turned
for strength and comfort to the green beetle.

In this connection it is interesting to recall that Nero, whose eyes
were notoriously weak, either by nature or from alcoholic excesses,
was accustomed to behold the sports of the circus and amphitheater
in a green concave mirror—his back, presumably, being directed
toward the bright yellow sand.—(T. H. S.)

**Beevor, Charles Edward.** A well-known English neurologist, who
devoted considerable attention to ophthalmology. He was born in
1854. From 1891 to 1894 he acted as Secretary of the British Oph-
thalmological Society, and as vice-president from 1902 to 1904. In
fact, he was one of the original members of this association. He was
Croonian Lecturer of the Royal College of Surgeons in 1903, and
Lettsomian Lecturer of the Medical Society of London in 1902. In
the last-named year he was also president of the Neurological Society.
He was also Physician to the National Hospital for the Paralysed and
Epileptic.

His death occurred very unexpectedly in London, Dec. 5, 1908.—
(T. H. S.)

**Beginnender Staar.** (G.) Incipient cataract.

**Begleitung des Staars.** (G.) An obsolete term for a whitish, viscid
substance occupying the place of the crystalline lens after the extrac-
tion of a cataract.

**Begrenzungshaut.** (G.), n. The membrana limitans.

**Begrenzungsschicht, Hintere.** (G.) Posterior limiting membrane.

**Begrenzungsschicht, Vordere.** (G.) Anterior limiting membrane.

**Behandlung.** (G.), n. Treatment.

**Beinfäule.** (G.) Caries.

**Beinfrass.** (G.) Caries.

**Beisichtig.** (G.), adj. Near-sighted.

**Beleuchtung, Einfluss auf die Sehschärfe.** (G.) Influence of illumina-
tion on the visual acuity.

**Beleuchtung, Focale.** (G.) Focal illumination.

**Beleuchtung, Künstliche.** (G.) Artificial illumination.

**Beleuchtungs Apparat.** (G.) Instrument for illuminating (the eye).

**Beleuchtungsbild.** (G.) Illumination image.

**Beleuchtungsschirm.** (G.) Reflector.

**Belladonna.** *Atropa belladonna.* Although the many alkaloids derived
from *Atropa belladonna* are extensively employed in ophthalmology
the extract is the only preparation of the plant proper (leaves or root)
now used in the treatment of eye diseases. It is generally employed
alone or in conjunction with other remedies, as in Arlt’s ointment.
BELLADONNA, BLINDHEIT DURCH

(q. v.) as a salve to be rubbed into the temples and frontal region for the relief of pain due to eye-strain or inflammatory affections of the globe.

Belladonna, Blindheit durch. (G.) Blindness from the use of belladonna.

Belladonna, Ocular effects of poisoning by. These are, among the signs, swelling of the lids, excessive lustre of the corneæ, mydriasis, and paralysis of the accommodation. Exophthalmia has been observed, as a result, no doubt, of paresis or paralysis of the recti, together with a similar condition of the orbicularis, permitting the lids to be widely separated by the forward-pushing globe. See Legal relations of ophthalmology, in the middle third of the section.

Belladonna ointment. With the ophthalmologists living about the middle of the last century, various combinations of belladonna were popular. Among them was the following mixture: Extract of belladonna, 10 grains; ammonia-chloride of mercury 5 grains; lard 1 dram. a portion of this is to be rubbed over the forehead three or four times daily, and should be covered by a piece of thin tissue paper, so as to prevent its drying and becoming hard. It should not be washed off until it is time for its re-application. In the course of two or three days a slight papular eruption will appear, when the ointment is to be discontinued.

Belladonnin. This is a mydriatic extract from the mother-liquor in the preparation of atropa crystals. It is an amorphous, brown, varnish-like mass slightly soluble in water. It is not used to any extent in ophthalmic therapy.

Bell, Benjamin. (1747-1806.) Born at Edinburgh, Scotland, he studied medicine at first in the University of Edinburgh, later in nearly all the celebrated schools of Europe. Returning to his native town, he was appointed surgeon to the Royal Infirmary and was later made a fellow of the Royal College of Surgeons of Edinburgh. His Treatise on the Theory and Management of Ulcers went through numerous editions in Scotland, America, Germany, and France. A similar success attended his very remarkable System of Surgery (some editions of 6, and some of 7 vols.).

In this latter work from two to three hundred pages (according to the edition) are devoted to ophthalmic surgery. The presentation of this subject, however, is only fair, being at times somewhat obscure and at no time strikingly original.—(T. H. S.)

Bell-Bernhardt's phenomenon. This sign consists in the upward and outward rolling of the eyeball in peripheral facial paralysis in the attempt to close the eye of the affected side.

Belledame. (F.) Atropa belladonna.
Belloculus. (L.), m. n. A gem to which the ancient Assyrians attributed wonderful curative powers in diseases of the eye.

Bellon. (F.) Lead colic.

Bell's Phänomen. (G.) Bell's sign or phenomenon.

Bell's Phänomen bei peripherer Fazialislähmung. (G.) Bell's sign in peripheral facial paralysis.

Bell's paralysis, palsy or paresis. Seventh nerve paralysis. Facial paralysis. This is a lesion of the seventh or facial nerve, and it may be basal, fascicular or nuclear. When the orbiccularis is affected it may produce logophthalmos, i. e., the patient is unable to close the lids, that remain open even in sleep. Especially when the disease is unilateral—as in the majority of instances—all of the fibres of the muscle may be involved. Especially in nuclear cases, when the trigeminus is involved, ulceration of the cornea may set in. This eye coat, being deprived both of its trophic innervation and of its lid protection is easily injured by foreign bodies that readily lodge on its surface, producing small traumas, that are readily followed by infection and even destruction of the cornea itself.

The eye symptoms are usually among the first discovered in a beginning paresis of the facial nerve, and the usual methods of examination will generally show the condition quite early in its course.

Alexander Rochester points out a procedure which indicates the beginning paresis before any of the ordinary signs or symptoms are unmasked. The test is particularly of value after mastoid operations, where the surgeon is desirous of knowing if there is the least irritation present in the domain of the seventh nerve. The patient is told to close lightly both eyes and not allowing him to squeeze them tightly together as in the usual tests. The observer then grasps the patient's hand, holding it directly in front of his face and instructs the patient to look exactly in the direction of his hand, but constantly to keep his eyelids lightly closed. The hand is then gradually raised, until it is beyond the upper border of the field of fixation. At this time, if there is a paresis of the facial nerve, it will be observed that the lid on the affected side will be held closed with much more difficulty than is its fellow, and the upper lid margin will rise slightly away from the lower one, disclosing a narrow band of sclera. If the irritation of the nerve is of the very slightest degree, the eye may be kept closed, but the test is shown to be positive by the increased agitation and quivering undergone by the lid in its effort to retain its position.

A good description of this form of paralysis is given by Edward Jackson (The Eye and Nervous System, pp. 333-335), as follows:

The loss of function is shown by a general relaxation of all the mus-
cles of one side of the face. The "smoothing out" of the face produced by this relaxation varies with the amount of subcutaneous fat and the habitual wrinkling of the skin. It is less noticeable in women and children, more pronounced in the aged and those with deeply-furrowed faces. There is also inability to execute the usual movements of the face, as to elevate the brow or close the eye. It is generally advised to test the power of closing the eyes by having the patient attempt to close each eye separately. But this may prove misleading, for some persons cannot close either eye separately and others can close one eye alone but not the other. The latter is commonly the case where one eye has distinctly better vision than its fellow. It is better to have the patient try to close both eyes at once or to elevate both brows as nearly alike as possible. One may also detect the lessened power of the muscles by offering resistance to their action, as by resisting closure of the lids. This may be made a rough test of recovery. While in paralysis of central origin the oculofacial muscles are usually but slightly involved or may quite escape, it is possible to have a peripheral paralysis confined to these muscles. Thus Mills mentions a case in which from a stab in front of the ear the frontalis was paralyzed and the orbicularis palpebrarum was weakened, although the other facial muscles were unaffected. In another case, following a fall on the temple, the loss of power was confined to the frontalis. Paralysis of the frontalis destroys the power of elevating the eyebrow. This leaves the brow drooping on the affected side, narrowing somewhat the upper part of the field of vision. Paralysis of the orbicularis prevents closure of the lids. It also permits the lower lid to hang away from the eyeball, interfering with the lachrymal function. After three or four months secondary contractures may occur in the paralyzed muscles. These are less frequently exhibited in the oculofacial muscles than in those acting on the mouth. But they may obscure the diagnosis, and even give the impression that the paralysis affects the opposite side. The contracture of the orbicularis causes narrowing of the palpebral opening and wrinkling of the neighboring skin. The contracture of the frontalis causes an undue elevation of the eyebrow of the affected side. They are increased during voluntary action of the affected muscles, as in laughing. So far as the etiology is concerned, a large proportion of cases give a clear history of recent special exposure to cold, which seems to act by setting up a neuritis or pcrineuritis. Less frequently the neuritis seems to be of toxic origin. Syphilis, rheumatism, diabetes, gout, leukemia, diphtheria, and other specific infections are credited with causing it. It has also been ascribed to an acute specific infectious process. A considerable num-
ber of cases are secondary to aural disease, particularly suppuration of the middle ear, and local injury to the nerve, or its branches—after mastoid operation especially—may cause it. It may occur as a part of a polyneuritis. Shumway has collected eight cases in which it has been accompanied by optic neuritis and subsequent optic atrophy. In two cases he has seen it followed by marked flattening of the face on the affected side and ptosis.

The \textit{prognosis} depends upon the cause and, with neuritis due to cold, somewhat on the promptness with which effective treatment is begun. Probably half of all cases make a fair recovery, but a considerable proportion show permanent loss of power in the affected muscles, and in not a few the paralysis continues complete. The rapid and complete loss of faradic irritability is unfavorable, and complete recovery cannot be expected where secondary contractures have occurred. Long duration of the paralysis is also a ground for an unfavorable prognosis, although cases may recover after several months.

\textit{Treatment} must first combat the cause. In neuritis due to cold it is important that active treatment should begin promptly. A general purgative, leeches below the ear, salicylates and later iodides are to be tried. Counterirritation by a blister or by milder irritants may prove useful. At a later stage strychnia may be given. Electricity is to be used with caution, and its application immediately suspended if there arises evidence of secondary contracture.

\textbf{Bell's phenomenon.} The up-and-out excursion of the eyeball in attempting to close the eye of the affected side in peripheral facial paralysis, or paresis.

De Castro has found this sign constantly present in every case of peripheral facial paralysis. Negro called it the bulbo-palpebral hyperkinetic phenomenon, as it consists in the exaggerated position assumed by the eyeball when the patient is told to look up as high as he can. The eyeball on the side of the paralysis swings farther up than on the sound side, and in case both eyes are affected the phenomenon occurs on the side in which the paralysis is most severe.

\textbf{Bell's photophone.} Radiophone. An instrument that induces a remarkable transformation of sound waves into light undulations, and \textit{vice versa}. In this form of telephone, invented by A. G. Bell, a strong beam of light is reflected from the diaphragm of the telephone transmitter to a selenium cell which, in its turn, is connected with the receiver. Sound waves affecting the near-by transmitter set up corresponding variations in the light rays which, varying the electrical
resistance of the selenium cell, reproduce the original sounds in the distant receiver.

**Belmontin.** This preparation is practically identical with paraffin, the well-known white, greasy, tasteless, odorless, waxy product of the dry distillation of petroleum and other oils. It is of interest to us only as a base for the preparation of eye ointments.

**Bélonospase.** (F.) Acupuncture.

**Bélow's test for simulated blindness.** This test consists in showing test letters to the suspected malingerer of a size so small and at such a distance that the patient cannot read them. The types are then to be brought nearer the patient who, if innocent, should read them at the distance corresponding to his known vision.

**Belt, Edward Oliver.** Born May 19, 1861, at Rock Hall, near Dickerson, Frederick County, Maryland, as the son of John Lloyd and Sarah Elenora (McGill) Belt, he at first studied medicine with his brother, Dr. Alfred M. Belt, of Baltimore, then at the Medical Department of the University of Maryland. At this institution he received his degree in 1886. Practising general medicine for just a few months in Frederick County, he then became resident physician at the Presbyterian Eye, Ear and Throat Hospital, Baltimore—a position which he held for two years. Afterwards he studied ophthalmology and otology at London, Paris, Vienna and Berlin. Even after that he pursued a very thorough course in history and pathology at Johns Hopkins University, Baltimore.

On May 18, 1889, he married Miss Emily Walker Norvel, and by this union there were born two sons.

In 1889 he removed to Washington, D. C., where he devoted himself exclusively to ophthalmology and otology. He was one of the founders of the Episcopal Eye, Ear and Throat Hospital. He was also ophthalmologist and otologist to the Freedmen's Hospital, Surgeon to the Episcopal Eye, Ear and Throat Hospital, and consulting ophthalmologist to the City and Emergency Hospital at Frederick, Md. He was for a time professor of ophthalmology and otology at the Howard Medical School. He was extremely active in various medical societies, and was president of the Society of Ophthalmology and Otology at Washington.

In the midst of his prosperous and very useful career he and his two sons, aged six and seven years, were killed in the railroad wreck at Terra Cotta, District of Columbia, Dec. 30, 1906.—(T. H. S.)

**Bending the lens.** In optics, the term used to express the method of varying the curvatures of the surfaces of a lens without altering its focal length. For instance, it is “bending the lens” to determine
the curvature that should be given to one side of a lens whose focal length and curvature of the other surface are prescribed. See Aberration.

**Benedetti, Alessandro.** He was also called Alexander Benedictus. He was born at Legnano, 1460, and died 1525. An excellent plastic surgeon who practised in Crete and the Morea, and who, from 1493-1495, was professor at Padua. To him we are indebted for the observation that, though there were in his day numerous skilful oculists in Asia, there were none at all in Italy or anywhere else in Europe.—(T. H. S.)

**Benedict, Traugott Wilhelm Gustav.** Born at Torgau, Germany, as the son of a rector at that place, he studied medicine at Leipsie and practised for a time in the Saxon Erzgebirge. In 1812 he was appointed professor of surgery and ophthalmology in the newly reorganized Leopold University at Breslau. In this position he labored for nearly 50 years—until, in fact, his death, which occurred at Breslau, May 11, 1862.

Benedict seems to have been an exceedingly eccentric man. A contemporary, indeed, flatly calls him "A wonderful original." To the day of his death he would not use either chloroform or ether. He has been immensely ridiculed for his habit of praying just prior to an operation—a habit which will not seem ridiculous to the many physicians who, though they do not offer prayer before an operation, are yet sufficiently serious to operate in no unpious frame of mind.

To the serious-minded Benedict the world of ophthalmology is deeply indebted for the first clear, unmistakable declaration of the etiologic relationship between cataract and diabetes. His views upon this matter were long contested bitterly—even by so great a man as V. von Graefe himself—but, little by little, these views won their way to acceptance by the sheer force of their absolute and undeniable truth.

Benedict's writings are distinguished throughout by a very uninteresting style, but by much learning, careful observation and conscientious judgment. His ophthalmologic compositions are as follows:

1. —Dissert. de Morbis Humoris Vitrei in Oculo Humano (Lips., 1809).
2. —De Pupillae Artificialis Conformatione Libellus (Lips., 1810).
3. —De Morbis Oculi Inflammatoris Libri XXIII (Lips., 1811).
4. —Handbuch über die Erkenntniss und Heilung der Augen-Entzündungen (Leipzig, 1814).
5. —Beiträge für Prakt. Heilkunde und Ophthalmiatrik (Leipzig, 1812).
6. —Monogr. des Grauen Stares. (Breslau, 1814).
BENEDICTUS, ALEXANDER


Benedictus, Alexander. An excellent plastic surgeon, ophthalmic and general, who flourished in the latter half of the 15th century. See Benedetti.—(T. H. S.)

Benedikt’s theory of optic neuritis. This observer believed that the papillitis in this condition results from reflex vasomotor action; but it has long been doubted whether purely vasomotor changes are capable of bringing about inflammatory alterations.

Benedikt, Syndrome of. Paralysis of the muscles supplied by the oculo-motor or third nerve of one side, associated with paresis and tremor of the upper extremity of the opposite side.

Benevenutus. See Appendix.

Benham’s spectrum top. This scientific toy is intended to be used in experiments by flashing light. It consists, according to Burch, of a disk half black and half white, and on the white part a series of concentric arcs each occupying about 30, there being from 18 to 24 of them, according to the size of the disk. The outermost arc begins against the black on one side and the innermost ends against the black on the other side, the rest forming a regular series between, each one beginning a little later and ending a little sooner. When such a disk is rotated it appears colored with a passable imitation of the spectrum, being red at the periphery, green midway, and blue at the centre, or red at the centre and blue at the periphery according to which way it revolves. For a given thickness of line there is a certain distance at which the colours look brightest. Seen from a greater distance they appear pale, and if the observer is too close each line will seem to have a black centre and to be colored only on the edges, thus showing conclusively that the effect is one of aereal induction.

Benign follicles. The enlarged lymphatic follicles found in simple folliculitis may easily be mistaken for trachoma bodies; indeed, the genuine trachomatous follicle and the simple follicle may exist side by side, so that it is impossible to distinguish them clinically, especially in the early stages of the disease. The microscope, and the incidents of the attack, will be needed, in many instances, to insure an exact diagnosis. See Trachoma.

Benin, —igne. (F.) Benign; benignant.
Benson's operation for entropion. This procedure is a modification of van Millingen's operation, in which a flap of mucous membrane is taken from the lower lip and implanted on the defective palpebral conjunctiva.

Bent lance-shaped knife. This is another name for the ordinary keratome.

Benvenuto. Benevenutus. The most important ophthalmologist of the Christian middle ages. See Appendix.—(T. H. S.)

Ben Vengut de Salerno. Benevenutus. See Appendix.

Benvenuto, Collyre de. (F.) Benvenuto's eye water (q. v.).

Benvenuto's collyrium. Benvenuto's eye-water (q. v.).

Benvenuto's eye-water. This mixture is described by Guy de Chanlia in his Chirurgia magna. The formula and method of preparation are as follows: Take an ounce of powdered sugar, an ounce of dried petals of red roses and two pints of ordinary white wine. These should be boiled to one-half and filtered. The resultant liquid is a clear, syrupy fluid, rose-color by reflected light and orange-yellow by direct illumination. The collyrium is mostly used in trachoma with abundant secretion, in sub-acute conjunctivitis and phlyetenular conjunctivitis. The secretion and hyperemia in this disease are said to be greatly reduced by this application until a cure is brought about.

Benzaldehyde. This is one of the products of the distillation of alcoholic beverages which has some unknown effect upon the eye in alcoholic amblyopia. It is found with other aldehyds, nitrobenzol, etc. It is proper to mention here that toxic amblyopia is not entirely due to pure ethyl alcohol or nicotine or both, as is claimed by some writers, but by such by-products as those mentioned.

Benzine. This petroleum ether, soluble in oils and carbon disulphide, very volatile and very inflammable, is of some use in ophthalmology, but is now rarely prescribed. It has been employed instead of oil of turpentine for the same purposes for which that irritant is generally instilled into the conjunctival sac—attempted absorption of corneal opacities.

Benzine is also employed to remove adhesive plaster bandages from the ocular neighborhood.

Benzine poisoning occasionally causes disturbances of vision if the fumes of the drug are breathed repeatedly, or if the poison be taken internally. Miosis, with lessened or absent pupillary reaction or (in severe poisoning) even dilation of the pupil and nystagmus have been reported. Peters observed a case of amblyopia with scotoma for red and green in a girl who for years had been in the habit of smelling a bottle of benzine or a cloth moistened with the drug. The scotoma
found in this intoxication gradually disappeared, but without marked improvement of central vision. See Toxic amblyopia.

Benzoate d'ammoniaque. (F.) Ammonic benzoate.

Benzoated lard. ADEPS BENZOATUS. OINTMENT OF BENZOIN. AXUNGIA BALSAMICA. Hog's lard impregnated with benzoic acid and the odorous principle of gum benzoin.

That the benzoin in this preparation has any curative effect when applied alone or in conjunction with other remedies we are not prepared to say but, in common with several ophthalmologists, the Editor has found it a trusty application in the simple forms of blepharitis and as an ointment to prevent adherence of the lids in conjunctival discharge.

Benzol. Also known as phenyl hydride, benzine and coal naphtha. C₆H₆. It is a coal tar product, a colorless, mobile and highly refractive liquid. Below 6° C. it crystalizes into colorless, pyramidal crystals. It dissolves in ether, alcohol, acetone and oils. It boils at 80° C. Its use in medicine is largely limited to inhalation for lung diseases.

The ocular symptoms from poisoning are visual disturbances due to retinal hemorrhages.

Benzolism. Benzol-poisoning, from inhaling the vapor of benzol or from swallowing it. The symptoms are dizziness, loss of consciousness and anesthesia; in severe cases hallucination, epileptic convulsions and coma. See Benzol.

Benzonaphthol. (G.) BETANAPHTHOL BENZOATE. BENZOGENAPHTHOL. C₁₇H₁₂O₂. A whitish powder, which darkens with age, insoluble in water, soluble in alcohol. It has been used in typhoid fever, dysentery, etc., and in dentistry. Dose, 2 to 5 grams during the twenty-four hours.

After taking 4 grams daily for sixteen weeks (for bladder trouble) one of van der Hoeve's patients had a central amblyopia in the right eye (RV = 6/8). The papillae were hyperemic, both retinae became pale and studded with yellowish-white dots mixed with dark striations.

Benzophenol. See Phenol.

Benzophenoneid. See Pyoktanin.

Benzosone. See Acetozone.

Benzoynaphthol. See Benzonaphthol.

Benzoyl-pseudotropine. See Tropacocaine.

Benzoyltropin. This is an atropine derivative about whose action on the human eye we know little. However, when a solution containing 0.001 gram was instilled into the eye of a cat the pupil became widely dilated after half an hour.
Benzyolvinyldiacetonealkalmine lactate. See Eucaine, (Beta) lactate.

Béranger. The first man in history to show that Galen's description of the conjunctiva, as a mere prolongation of the orbital periosteum, is false. See Berengario da Carpi.—(T. H. S.)

Bérard, Auguste, junior. Brother of the celebrated Professor of Hygiene at Montpellier, Frederic-Joseph Bérard, and himself a distinguished Professor of Surgery at Paris. Born Aug. 2, 1802, at Varrins, near Saumur, France, his earliest education was obtained at Angiers, under the excellent supervision of his brother. Going to Paris, he became, successively, Interne, Assistant in Anatomy, and Prosector of the Faculty. In 1829 he received the degree of Doctor in Medicine, presenting a thesis entitled, De la Luxation Spontanée de l'Occipital sur l'Atlas et de l'Atlas sur l'Axis.

Bérard became a celebrated surgeon and wrote numerous books and articles. For a time he lectured on ophthalmology at l'Hôtel St. Antoine, and he also composed a number of articles on ophthalmologic subjects, of which the more important are the following:

7. Cataract. (Diet de Méd.—Nouv. E'd.)

As a man, Béard was almost always courteous and obliging. He was very much liked by all—patients, students, and even the menials about the hospital.

He died very suddenly, Oct. 14, 1846, of gastric cancer.—(T. H. S.)

Béraud, Valve of. A valve sometimes present at the inferior termination of the lachrymal sac, partially covering the entrance to the nasal duct.

Berberine sulphate. The salt of an alkaloid obtained from berberis vulgaris (barberry, jaundice berry, sowberry), (Hydrastis canadensis) and many other plants. It is found in the market (Merck & Co.) as yellow, acicular crystals and, when pure, is soluble in water and alcohol. This alkaloid and its salts have been confused with hydrastine (q. v.), yellow hydrastine sulphate and yellow hydrastine muriate. In
some parts of this country these names still indicate the corresponding berberine salts.

S. R. Weaver employs this remedy in most forms of conjunctivitis associated with discharge, from gonorrheal ophthalmia to simple conjunctivitis.

\[\begin{align*}
\text{R} \\
\text{Berberin. sulph.} & \quad \text{gr. iiss} \\
\text{Acidi boric.} & \quad \text{gr. x} \\
\text{Sodii. bibor.} & \quad \text{gr. v} \\
\text{Morph. sulph.} & \quad \text{gr. ss} \\
\text{Aqua dest.} & \quad \text{fl. 5i.}
\end{align*}\]

Put four or five drops into the eyes every two hours.

**Berberis aristata.** \(L.\) An Indian species distinguished by its slender (pendulous or erect) racemes of flowers which are longer than the leaves. The bark of the root contains a large percentage of berberine (q. v.). It is employed in ophthalmic practice like *berberis lycium* and some other species.

**Berberis chinensis.** \(L.\) A species of berberry found in China and northern India. The juice of the fresh fruit is there applied to weak eyes.

**Berberis lycium.** The well-known ophthalmic berberry, a species growing in India. According to Royle, an extract from the wood or roots of this and other Indian species of berberry is the medicine *rusot*, or *ruswut*, employed in India as a local remedy in ophthalmic affections. It is the *lycium indicum* of Dioscorides, which was employed in the same way.

**Berceau.** (F.) Cradle.

**Berengario da Carpi, Giacomo.** He was also called, Béranger and Berengarius. Professor of Surgery at Bologna, born 1470, died 1550. He was the first to show that Galen's description of the conjunctiva as a mere prolongation of the orbital periosteum, is false.—(T. H. S.)

**Berengarius.** A celebrated anatomist and ophthalmologist, better known in medical literature as Béranger. See **Berengario da Carpi.** —(T. H. S.)

**Berenstein.** A well-known Russian ophthalmologist. Born in Lithuania in 1865, he received his medical degree at Dorpat. He studied ophthalmology with Hirschberg in Berlin and Leber in Heidelberg. He settled at first in Lodz, but soon removed to St. Petersburg, where he had a large practice. He was a very amiable man, and was widely known, admired and loved, both in Germany and Russia. He died of pneumonia, Jan. 5, 1901.—(T. H. S.)
Berger’s corneal loupe. This is practically a corneal microscope, and permits of minute study of the anterior portions of the globe—of the cornea especially. It is self-illuminated and is a most useful instru-

![Berger's Binocular Loupe](Image)

ment. The Hess loupe and the Jackson binocular magnifying lens are among the magnifyers constructed on about the same principle.

**Bergleute.** (G.) Mountaineers or inhabitants of hill countries, who are especially subject to trachoma and other ophthalmic diseases.

**Beri-beri.** A dropsical ailment, occurring in both acute and chronic forms and characterized by the appearance of pleuritic or pericardial effusions, with general anasarca, anemia, extreme weakness, and paralysis. The acute form is generally fatal; recovery frequently takes place in the chronic form. It is prevalent in India, Japan and Ceylon and is most common among men. Its cause is not known, but it is possibly of microbial origin. Improper diet also has some influence upon the production of the disease. This disease is held responsible for toxic neuritis and a number of other eye diseases.

**Berkeley, George,** Bishop of Cloyne, was born near Thomastown, in County Kilkenny, on the 12th of March, 1685. He entered Trinity College, Dublin, at the age of fifteen, and was elected to a Fellowship there in 1707. Trinity at the time was feeling the influence of the discoveries of Newton and Boyle, and Locke’s *Essay on the Human Understanding*, the philosophical exposition of the new empiricism, was already well known. In 1705 Berkeley had formed a society to discuss the New Philosophy, as it was called. The Essay had more influence upon his thought than any other philosophical writing. Berkeley is Locke’s direct successor, and his main philosophical doctrines are suggested by problems which Locke had left unsolved or had solved unsatisfactorily. His one great philosophical principle—
the impossibility of anything existing independently of perception—occurred to his mind during this early study of Locke. We know from his Commonplace Book that already in 1706 he was convinced that he had found here the key to the difficulties and inconsistencies which he found in the Essay. However much in later works he enlarges his exposition of this principle and defends it against new objections, there are certain assumptions of Locke's philosophy which he never questions, and which essentially determine his statement of philosophical problems.

Berkeley's first publications were two small treatises, entitled Arithmetica and Miscellanea Mathematica, published in 1707. His first important work, the Essay towards a New Theory of Vision, appeared in 1709. In the next year, when he was only twenty-five, he published his Treatise concerning the Principles of Human Knowledge. In 1713 appeared the Dialogues between Hylas and Philonous. Berkeley spent the years between 1713-1721 in England or abroad. Shortly after his return he was made Dean of Dromore, which office, along with his position at Trinity College, he resigned on being made Dean of Derry in 1724. The next years of his life were devoted to the furtherance of a proposal for establishing a great missionary college in Bermuda, from which America was to be evangelised. Berkeley was ready to give up his Deanery to become Principal of the new college. His extraordinary powers of persuasion were applied with such effect to the House of Commons that Walpole promised a Government grant of £20,000. In 1728, having made all preparations, he sailed for America, going first to Rhode Island to interest New England in his scheme. But when the persuasive author of the scheme was no longer there to trouble them the Government cooled, and Berkeley, after waiting in vain for promised support, was forced to give up his scheme and return home disappointed. During his stay at Rhode Island he composed Alciphron, or the Minute Philosopher—the largest of his works. It was published shortly after his return to England in 1732. In it Berkeley applies his philosophical doctrines to Christian apologetics. In 1734 he was made Bishop of Cloyne. In the same year appeared his Analyst, a treatise in which he applies his principles, not very successfully, to Newtonian mathematics. Ten years afterwards he published his last work, Siris, or A Chain of Philosophical Reflexions and Enquiries concerning the Virtues of Tar- Water and divers other subjects connected together and arising one from another, an extraordinary miscellany of reflections on medicine, vital spirits and metaphysical principles. Siris is striking as showing the influence of Plato in Berkeley's thought. It is far removed from

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the empiricism of Locke. At the same time it lacks the vigour and consistency of his earlier writings, and is more noteworthy for occasional interesting suggestions and admissions than as a serious philosophical treatise.

A. D. Lindsay, who wrote the introduction to Berkeley's Essay towards a New Theory of Vision, in Everyman's Library, says that the Essay is remarkable in not asserting all that Berkeley held. While insisting that visible qualities are in the mind and dependent on their being perceived, he retains the ordinary view in regard to tangible qualities, taking for granted that we do perceive distance by touch, and even allowing that we can have different tangible ideas of the same object. The result of this method is unfortunate. For Berkeley first reduces all visual space to visual signs of tangible space, on the ground that visual ideas are within the mind, and assuming that tangible space needs no explanation. Then in his other writings he asserts that tangible ideas also are within the mind, but does not re-examine the account of the perception of tangible space which this new position involves. If Berkeley had stated his ideal theory in the Essay in the thoroughgoing fashion of the Principles, he would have seen the difficulty of explaining any perception of space on his theory. For the objections which he brings forward to visual apply equally to tangible space. The main argument of the Essay that visual ideas and tangible ideas are different would remain the same, but it would be seen that in Berkeley’s principles the perception of space must be different from either, and yet it must be perceived through both.

Berkeley’s argument rests on the particularity of ideas or on the impossibility of ideas which are different being also in any way the same. § 103, "That which I see is only variety of light and colours. That which I feel is hard or soft, hot or cold, rough or smooth. What similitude, what connection have those ideas with these? Or how is it possible that any one should see reason to give one and the same name to combinations of ideas so very different, before he had experienced their co-existence?" Hence, Berkeley argues, "If we take a close and accurate view of the matter, it must be acknowledged that we never see and feel one and the same object. That which is seen is one thing, and that which is felt is another." We infer from visible ideas to tangible through association. The reference therefore requires practice and experience. Visible ideas are arbitrary signs of tangible ideas. When we think we see distance, we are really arguing from visual ideas to tangible ideas of distance which we have previously found to be associated with them. The association comes from the
ideas being found together, not from any inherent connection. Just because the objects of sight and of touch are different, there can be no inherent connection, unless we are to believe in an abstract idea of extension, abstracted alike from sight and touch, and that Berkeley has shown to be impossible. Since, therefore, sounds, colours, and touch sensations are absolutely different, the long and short system is not given by abstracting from them, but is somehow given in and through them. The difference of colour and hardness is no reason for concluding a difference in the extension which may be perceived through them. The shape of an object is no more constituted by tangible ideas than by visual. Its shape is not hard any more than it is, say, yellow. But from the tangible ideas, e. g., from passing our fingers over the object, or from visual ideas, we conclude what its shape must be if it feels or looks in that way, and if we know its real shape we can on reflection say what tangible and visual ideas we shall get from it in different conditions. Hence, there is a perfectly real meaning in saying that we have visual and tangible ideas of the same object. That does not mean that the object is a mysterious unknown something. It is perceived or understood through the visual or tangible ideas, but does not simply consist of them. Berkeley's position which insists that what may be called bare sensibilia are the only objects of perception, and that difference in sensibilia means difference in objects, makes our perception of space inexplicable, and that inexplicability marks the breakdown of "the doctrine of ideas."

In 1752, Berkeley left Cloyne for Oxford, where he died the next year. See the Introduction to the Essay Towards a New Theory of Vision, Everyman's Library.

**Berlin blue.** Indigo. This agent, mostly of vegetable origin (from various species of Indigofera) is a dark-blue, tasteless, odorless powder, now used as a dye or chemical test, although it was formerly given internally in hysteria, epilepsy, etc. The effects upon the eye are known to us mostly through animal experimentation. The sterile powder—which is insoluble in water— injected into the anterior chamber of the rabbit, has been followed by a sterile exudate and sclerocorneal perforation. Lewin (Die Nebenwirkung der Arzneimittel, 175, 1899) reports in the case of a number of patients treated with this remedy not only stomach, bladder and kidney irritation but pressure in the head and *phosphenes* before the eyes.

**Berlinerblau.** (G.) Indigo. Berlin blue (q. v.)

**Berlin, Rudolf.** A celebrated German-Swiss neurologist and comparative ophthalmologist. Born May 2, 1833, at Friedland, in Mecklenburg-Strelitz, Germany, he studied at Göttingen, Würzburg,
Berlin, and Erlangen. At the latter institution he received his medical degree. He was for a time assistant to Pagenstecher at the latter's Private Ophthalmic Institute in Wiesbaden, and later to Bruns in the Surgical Clinic of the University at Tübingen. In 1861 he became the Resident Physician to the Ophthalmic Institute in Stuttgart, and in 1875 he began to teach comparative ophthalmology at the Royal Veterinary College in Stuttgart.

Rudolph Berlin.

His more important compositions are: "On the Path of Foreign Bodies in the Vitreous Chamber" (Archiv. für Oph. XIII); "On Section of the Optic Nerve" (Monatsblatt für Augenheilkunde, IX); "On the So-Called Commotio Retinae," "On Extirpation of the Lachrymal Sac" and "Orbital Diseases" (all in Greafe-Saemisch's "Handbuch der Augenheilkunde").

He also wrote a number of articles on comparative ophthalmology, and, together with Eversbusch, founded, and for some years edited, the well known "Zeitschrift für Vergleichende Augenheilkunde."

He died at Stachelberg, Switzerland, Sept. 12, 1897.—(T. H. S.)

**Berlin's opacity.** In 1873 Berlin first described an arc of opacity that not infrequently surrounds, or almost surrounds, the fovea after confusion of the macula or commotio retinae. It is milk-white in its denser portions, which slowly fades into the color of the normal fundus. See *Commotio retinae.*
BERLIN'S THEORY OF SYMPATHETIC OPHTHALMIA

Berlin's theory of sympathetic ophthalmia. In 1881 Berlin drew attention to the hypothesis that the transferred inflammation is practically a specific metastasis transmitted by way of the blood vessels, and that the products of inflammation producing the disease may remain within the organism without ocular development until the conditions are favorable for their morbific influence. When they reach the capillary vessels of the uveal tract of the opposite eye and there find conditions favoring their development, they give rise to the sympathetic inflammation. This theory has lately been received into favor and, under other names, has met confirmation.

Berlue. (F.), n. An aberration of vision (generally hallucinations) in which objects appear to be seen which cannot be demonstrated in the field of vision. Musca volitantes belong to this category.

Bernard de Gordon. A 14th century French physician, of some importance ophthalmologically. See Gordon, Bernard de.—(T. H. S.)

Bernard, P. A Parisian oculist who flourished about the middle of the 19th century. His writings are as follows:

1. Subconjunctival Operation for Cataract. (Annal. d'Ocul., vii, i, 208, anno 1842.)

Bernard the Provençal, of Arles. A wandering oculist of the 12th century, probably born at Arles, who studied at Montpellier, and who had for his chief teacher the great Salernus. He wrote about 1155 a "Commentary" on this master's "Tabulae"—which were simply synoptical tables on the subject of materia medica, giving the mode of preparation and the therapeutic action of the various drugs of the day. Bernard's comments on these "Tabulae" are extremely interesting. Thus, he speaks of the various drug-adulterations customary in his time, and other trade tricks. The oculistic portion of this "Commentary" is very scanty.—(T. H. S.)

Bernardus Provinzalis Arelatensis. A peripatetic French oculist of the 12th century, of no very great importance. See Bernard the Provençal, of Arles.—(T. H. S.)

Bernheimer's fibres. These are fibres that run from the optic tract to Luys's body and take part in the visual act. They really form a portion of the occipital optic or visual radiations.

Bernstein, Johann Gottlob. A celebrated 19th century professor of
surgery at Berlin, who paid considerable attention to ophthalmology. He was born at Saalborn, near Berka, in Weimar, June 28, 1747. For a time he wandered as a barber’s assistant through Austria and Germany. Then he sailed as a ship-surgeon on a 4½ months cruise to Greenland. Returning to Germany, he practised at Ilmen-au for a considerable number of years. In 1806 he removed to Jena, and in 1810 to Berlin, where he taught and practised surgery for many years. In 1835 he died.

In 1793 he published a "Surgical Lexicon,"—a work which contained nearly ninety articles on ophthalmologic subjects. The book as a whole comprised but little of a highly original character, but it formed an excellent summing up of the surgery (including the surgical ophthalmology) of the day. It went through many editions. In the fifth, however, the ophthalmological part was contributed by Dr. Busse, a privat-docent at Berlin.

In 1822 Bernstein published a "History of Surgery," in which ophthalmic surgery received an appropriate share of attention.—(T. H. S.)

Berry’s operation for staphyloma. This is among the most useful of the procedures for reducing a partial staphyloma. Berry recommends that a cataract needle be introduced through the base of the staphyloma and held in one hand. An elliptic piece of the cicatricial tissue of which the staphyloma is composed is then cut out by making one incision at one side of the needle with a cataract knife, and another from the other side, converging toward the first, and in such a manner that the portion held by the needle, and consequently the needle itself, is cut out. The dressing consists of a firmly applied antiseptic bandage and usually it is necessary to continue the bandage for some time until flattening of the mass has been secured.

Berry’s test for scotomas. This observer suggests that by making a perimetric examination of a particular area of the visual field the ordinary test for scotomas may be more definitely carried out by observing them at a distance of two or more metres. In this way a larger projection of the blind area is obtained and the observer is able to use smaller retinal images, so that very small objects are unnecessary.

Bersanus, Sebastiano. A native of Cremona, president of the "Academie de Animati," and author of a work entitled "De Morbo Oculorum," which seems to have been a work of little value. He flourished in the latter portion of the 16th century.—(T. H. S.)

Bertelé’s test for simulated blindness. This method is quite similar to
that of the box of Fles (q. v.), but differs from it in the substitution of a screen for the mirror of the Fles box.

Berthold, Arnold Adolf. A Göttingen professor of physiology and medicine, who was born Feb. 26, 1803, at Soest, in Westphalia, Germany, studied at Göttingen, and received therefrom his medical degree in 1823. After further study in Berlin and Paris, he qualified himself in 1825 as a privat-docent and practising physician at Göttingen. He published at Göttingen, in 1829, his "Textbook of Human and Comparative Physiology," which appeared in a number of later editions. Together with Bunsen, he published at Göttingen in 1834 "The Oxyhydrate of Iron as an Antidote to Arsenous Acid," in which was announced the important toxicological discovery which the title implies. In 1835 he became special, in 1836, ordinary, professor at the Göttingen University. In the field of our specialty he was also very active. In 1830 he published at Göttingen "The Upright Appearance of the Visual Object in Spite of the Inverted Image Thereof on the Retina of the Eye." This work appeared in a second edition four years later. In 1839, however, appeared at Göttingen that particular composition of his which caused the greatest stir in the ophthalmologie world—a volume entitled, "The Myopodiorthoticon, or the Apparatus for Healing Short-Sightedness." The "apparatus" consisted of a frame which prevented the person using it from reading at less than a given distance from his page. The instrument was, from time to time, adjusted in such a way as to compel the reader to do his reading at greater and greater distances. By this process of gradually increasing the distance between the eyes and the object looked at, shortsightedness, he asserted, could be entirely cured. Many noted ophthalmologists fell in with the new idea, recommended the instrument, and gave it a great vogue. Then, in a short time, it was heard of no more.—(T. H. S.)

Berthold's myopodiorthoticon. A high-sounding name given by the inventor (Das Myopodiorthoticon, 1840) to a certain form of desk by means of which the myope was compelled to hold his book at the greatest possible distance from his head that would permit of reading. This distance was gradually increased. Donders agrees with Burow that "no diminution of the myopia is to be expected from this plan, as the accommodation for the farthest point is only a passive, and not an active, operation, and he supplies the proof from the experience of his own eyes. Berthold's desk was also tried in vain at Königsberg; and, according to von Hasner, the attempt at Prague was attended with no better result. However, the last-named writer expressly states that myopia depending upon slight degrees of staphyloma scleroticæ.
may, particularly in the commencement, be diminished by restraining the eye from looking at near objects. See **Myopia**.

**Berthold's test.** See also **Blindness, Simulation of**.

**Bertin-Sans, Optoscope of.** This device for the subjective examination of simulated blindness in one eye, is described by Baudry (*System of Diseases of the Eye*, Vol. IV, p. 870), as follows: It is a box sixteen centimetres long, eighteen centimetres broad, and four centimetres deep. All the sides are opaque except the anterior wall, which presents two openings fitted with transparent glass forming eye-pieces. At the side of these are two other round openings furnished with ground glass. Unknown to the malingerer, the finger can easily cover the latter, by means of a projection of wood which conceals them. In the interior of the box, on the opposite posterior wall, are two plane mirrors, the junction of which forms a projecting angle, and whose vertical planes cut at a right angle through its middle makes a horizontal line drawn from the centre of the ground glasses to an imaginary point situated twenty-five centimetres from the two eye-pieces—that is to say, at the distance of distinct vision. As a result of this arrangement, the image of each of the ground and transparent glasses is seen by each of the eyes in the shape of a small luminous circle. When the images become superposed, the luminous circle becomes single. If one of the ground glasses be blocked from use, the circle will remain single but less brilliant, and it becomes impossible to distinguish whether it is the image of the right or of the left aperture which has disappeared. The remainder of the test is easily understood.

**Bertrandi, Giovanni Ambrogio.** A famous professor of anatomy, surgery and ophthalmology at Turin, Italy. Born Oct. 17, 1723, at Turin, where his father was an extremely indigent and, apparently, an unskillful surgeon, he received his general as well as his medical training in the schools of his native town. In 1745 he composed a dissertation entitled, "**Ophthalmographia,**" which, together with a similar work on the anatomy of the liver, were published together in 1748. The "**Ophthalmographia**" seems to have been an excellent work for its day. In 1747 he received the degree of Master of Surgery.

His masterpiece appeared in 1763, in two volumes, entitled "**Trattato delle Operazioni di Chirurgia.**" An excellent work in general, it is almost wholly devoid of ophthalmologic matter.

After Bertrandi's death—which occurred Dec. 6, 1765—a collected edition of his works was published at Turin under the title, "**Opere Anatomiche e Cerusiche di Ambrogio Bertrandi.**" This monumental
affair consists of 14 volumes. The work is distributed under the following separate titles: Opuscoli (2 vols.); Trattato delle Ferite (1 vol.); Trattato delle Ulcere (1 vol.); Malattie delle Ossa (1 vol.); Malattie Venere (2 vols.); Arte Ostetrica (2 vols.); Trattato delle Malattie degli Occhi (2 vols.); Trattato delle Operazioni di Chirurgia (3 vols.).

The "Trattato delle Malattie degli Occhi," though composed from memory by former pupils of Bertrandi, instead of by the master himself, is nevertheless expressed in clear and interesting language, and it was, for its time, a work of great value. Especially excellent is the division devoted to cataract. The book was much in favor both in and out of Italy for very many years.—(T. H. S.)

Berufserkrankungen der Augen. (G.) Occupational diseases of the eyes.

Beruhigungsmittel. (G.) A sedative.
Beschleuniger. (G.) Accelerator.
Besiclometer. An instrument for measuring the forehead to determine the proper width of spectacles frames.

Besicles, Oeil muni de. (F.) The eye fitted with glasses.
Besonnung gegen tuberkulöse Hornhautleiden. (G.) Precaution against tubercular diseases of the cornea.

Beta-monohydroxy-naphthalene See Betanaphthol.

Betanaphthol. NAPHTHOL. B-NAPHTHOL. BETA-MONOHYDROXY-NAPHTHALEN. C_{16}H_{7}OH. This is a phenol occurring in coal-tar and found in the market as a colorless or pale-yellow, crystalline, scaly powder with a faint phenol odor and a sharp taste. It dissolves slightly in water; soluble in alcohol and oils.

This agent is generally used as an antiseptic and parasiticide, especially in the form of ointment. It is incompatible with antipyrene, camphor, phenol, potassium permanganate and menthol.

Panas advised the employment of naphthol as a lotion in the second stage of simple acute conjunctivitis:

Betanaphthol 1.00 (gr.xv); Alcohol q. s.; Aqua dest. 1000.00 (Oij.). To be freely applied with a pipette.

Betanaphthol benzoate. See Benzonaphthol.

Betony. BETONICA ALOPECURIS. Mixed with wine and honey, betony was employed by the ancients in diseases of the eyes generally, more particularly, however, in lippitudo.—(T. H. S.)

Bettman, Boerne. A celebrated ophthalmologist of Chicago, known especially as an operator. He was born at Cincinnati, O., Sept. 6, 1856, of Bavarian parents. His father, a general practitioner, was a graduate from the University of Munich, in 1836. Dr. Boerne
Bettman, after a three-year course of study, under the preceptorship of his father, in the Miami Medical College, received his medical degree in 1877. He was then assistant, for a short time, to Dr. Elkanah Williams, the first professor of ophthalmology in the United States. Proceeding to New York, he studied for a time in the laboratory of Dr. Heitzman, and then for a year and a half was assistant to Dr. Herman Knapp. For three years, then, he studied in Europe. In

Vienna, his teachers were Arlt, Stellwag, Jaeger, Mauthner, Fuchs, Politzer, Gruber and Storch. At Heidelberg, in 1879, he became the second assistant to Dr. Otto Becker. Later, he was made Becker's first assistant.

In 1880 he returned to America, and, settling in Chicago, was well-nigh immediately successful. He was the first lecturer in ophthalmology and otology in the College of Physicians and Surgeons of Chicago. This position he resigned, however, in 1883. He founded the Chicago Society of Ophthalmology and Otology and assisted at the organization of the Chicago Medico-Legal Society. In 1892 he was made Professor of Ophthalmology and Otology in the Chicago College of Physicians and Surgeons—a position which he held till
nearly the time of his death. He was also, for a while, Professor of Ophthalmology and Otology in the Chicago Post-Graduate Medical School. He served, moreover, as oculist and aurist to many of the Chicago hospitals.

Among his publications are the following:

“The Operative Treatment of Episcleritis” (Weekly Medical Review, Mar. 17, 1883).


Translation of Dr. Carl Koller’s article on Cocain (Chicago Medical Journal and Examiner, February, 1885).


“Mastoid Periostitis” (read before the Chicago Medical Society, Nov. 4, 1889).

“Traumatic Iridodyalyses” (North American Practitioner, December, 1890).

“Dislocation of the Lens into Anterior Chamber” (Chicago Medical Recorder, June, 1891).

Dr. Bettman was a brilliant operator, and many are the stories of his skill and dexterity. Thus, having introduced his cataract knife with the edge turned downward, instead of up, he quickly “flopped” his blade, without withdrawing (as Knapp himself once did) nor lost a drop of aqueous. He was quick and active in his manner, sometimes abrupt, but really kind at heart. Like all true Jews, he was a patriot, and he loved to talk about the history of his country. He served as assistant surgeon, with the rank of captain, in the second regiment of the Illinois National Guard. He died the lingering death of one afflicted with disease of the spinal cord, but bore his sufferings bravely, indeed with absolute resignation.

He passed away, May 25, 1906, at Chicago, aged only 50 years. Into that brief period, however, he had crowded the work of a century.

—(T. H. S.)

**Bettman’s method.** See Artificial ripening of immature cataract.

**Bettman’s operation for pterygium.** This method the author called subvolution. It resembles the Galezowski procedure in which the pterygium is detached from the cornea, after which a suture is passed through this apex. The growth is then doubled up and the head stitched to its base, under the caruncle. The operative defect is then covered by conjunctival stitches. The pterygium finally shrivels and the healing is fairly smooth.
Betula, Oil of. See Birch oil.
Beugungserscheinungen. (G.) Symptoms of luxation or curvatures.
Beurre. (F.) Butter.
Beutelaugig. (G.) Bottle-eyed.
Bévue. (F.) Binocular diplopia.
Bewegungsnachbild. (G.) After-image following the ocular excursions.
Bianco dell’ occhio. (It.) An obsolete term for the sclerotic or “white of the eye.”
Bi-astigmatism. A condition in which lenticular and corneal astigmatism co-exist in the same eye in different axes. It is therefore a variety of complex astigmatism. Double toric lenses—i.e., lenses toric on both the front and the rear surface—are now and then prescribed for bi-astigmatism. See Complex astigmatism.—(T. H. S.)
Biaxial. Having two axes: as, a biaxial crystal (q. v.).
Biaxial crystal. A crystal having two axes of refraction in which there are two distinct directions of single wave velocity; whereas, in uniaxial crystals, such as calcite, quartz and similar crystals, there is only one direction, termed the optic axis, in which all waves are transmitted with one uniform velocity. In any other direction there are two distinct velocities of wave transmission, and the resulting rays are polarized perpendicularly to each other, as, for instance, in tourmaline (which see). Biaxial crystals, such as mica, are of another class whose distinctive refractive properties were discovered by Brewster and Biot.
Biberon. (F.) Sucking-bottle for infants.
Bibitorius. (L.), adj. (From bibitor, a toper.) A synonym of the internal rectus muscle, so-called from the habit acquired by drinkers of converging the eyes to look into the glass.
Bible. Ophthalmology of. See Appendix.
Bibliography of ophthalmology. See Literature, Ophthalmic; Periodical ophthalmic literature; History of ophthalmology.
Biborate of sodium. This useful and well-known salt of sodium, better known as borax or sodium borate, is found in large, colorless, inodorous prisms that have a mild, sweetish, cooling and alkaline taste. It readily effloresces and becomes opaque.
Borax is often combined in collyria with boric acid and other agents, but it may, in 1 to 5 per cent. solutions, be used alone as a mild and soothing detergent in almost every form of conjunctival disease. As a general statement it can be said that borax is indicated in about the
same dosage and for the same purposes as boracic acid (q. v.), although its antiseptic value is less. It makes a good collyrium and detergent wash in conjunctival catarrh and hyperemia. A favorite formula is:

\[
\begin{align*}
\text{Sodii boratis} & \quad 1.0 \text{ gm. (gr. xv)} \\
\text{Aquae laurocerasi} & \quad 5.0 \text{ c.c.} \\
\text{Aquae rose} & \\
\text{Aquæ dest.} & \quad \text{āā 100.0 c.c. (f\text{\textcopyright}iii f\text{\textcopyright}iii)}
\end{align*}
\]

**Bichlorid-vaselin.** This is a name for White's ointment (q. v.), consisting of mercuric chloride in vaseline, 1:3000. It is a very useful non-irritating antiseptic.

**Biconcave lens.** A lens whose opposite surfaces are concave. See **Lens**.

**Biconcavilens.** (G.) Biconcave lenses.

**Biconvex lens.** A lens whose opposite surfaces are convex. See **Lens**.

**Biconvex lens, Refraction by a.** The first proposition made by Donders in speaking of refraction through a biconvex lens is that with the exception of the axis-ray, all rays are refracted in a lens. He goes on to show how, by the determination of four cardinal points, the position,

![Refraction by a Biconvex Lens](image)

as well as the magnitude of the dioptric images, formed by a single refracting surface, may be constructed and calculated. The question he raises is, "whether we can also, for a system composed of various refracting surfaces, find such points, and whether we can likewise make use of the same in the determination of the size and position of the dioptric images. In the eye there is a biconvex lens, which, just as every lens, has two refracting surfaces. We shall therefore examine the question specially with respect to a biconvex lens. Does a lens possess a nodal point in this sense, that all rays directed thereto pass through unrefracted? A lens possesses such a point only when the nodal points (the central points of curvature) of both surfaces coincide. This takes place only in a lens having the form of the first figure; the two surfaces of curvature are at \( h_1 \) and \( h_2 \), described for this lens from the point \( k \), and every ray directed to this point, as \( a \ b \) and \( a' \ b' \), therefore coincides on both the anterior and the posterior sur-
face with the radius. Such a lens is not biconvex, but convex-concave, (English writers would say concavo-convex, with a positive focal length.—S. H.) and with a negative focal distance. In every other form of lens every ray is refracted, except that which coincides with the axis. This is easily demonstrated. In the second figure $k_1$, is the centre of curvature of the anterior surface $h_1$, and $k_2$, that of the posterior surface $h_2$. Now if the ray $a\ b$ be directed to $k_1$, it is not refracted on the surface $h_1$; but arrived at $c$, it is bent from the normal $c\ v$, and proceeds in the direction $c\ d$. The same is true of the ray $a'\ b'$, which, directed to $k_2$, and $b'$ passes through unrefracted, but at $c'$ is bent from the normal $c'\ v'$, and proceeds as $c'\ d'$. Every ray, therefore, which is not refracted at the one surface, deviates at least at the other from its direction; and all rays which, while they are in the lens, are not directed to $k_1$ or $k_2$, are refracted at both surfaces. In a lens, therefore, no nodal point exists, to be classed with the nodal point of a simple refracting surface, of such a nature that all rays directed there-to should pass through unrefracted."

Refraction by a Biconvex Lens.

Biconvexlinsen. (G.) Biconvex lenses.

Bicorne. (F.) Bicornute.

Bicylindrische Gläser. (G.) Bicylindrical glasses or lenses.

Bident, Agnew’s. See Agnew’s bident.

Biene. (G.) A bee.

Biene, Augenverletzung durch. (G.) Ocular injuries by bees.

Bienengift. (G.) Poison from bees.

Bier’s artificial congestion treatment, as applied to eye diseases is still of interest to ophthalmic surgeons. The main difficulty in applying this form of therapy in ocular affections is a mechanical one. This obstacle is largely overcome in the procedure advised by Hoppe. To master the technic without harm to the patient he first studied the method on himself. A mask of plaster of Paris, fitting closely to his face, had a small preorbital air space which, through tubes of lead and rubber, was connected with a very sensitive capillary ether manometer. The
congestion of the eyes was produced by tying a rubber band, 2 cm. wide, around the neck below the larynx. This enabled the author to ascertain the normal blood circulation of the orbit and its variations under physiologic conditions. While inspirations caused a decrease of pressure, the latter rose in expiration, deglutition and with movements of the lids. The veins of the orbit were found to be less influenced by the congestion than the veins of the face and lids.

The following cases were treated in this fashion, without using other remedies; hay-fever conjunctivitis 1, phlyctenular conjunctivitis 3, ulcerated phlyctena 1, superficial vascular keratitis 3, herpetiform keratitis 1, deep infiltration and ulcer of the cornea 1, hereditary syphilitic parenchymatous keratitis 1, traumatic iridocyclitis 1, vaccine conjunctivitis and blepharitis 1. In one case the bandage was worn for two months, in another for three.

The treatment requires precautions, since individual reactions differ. No bad influences were observed. The most striking result was the alleviation of inflammatory pain, especially in a case of cyclitis. There was a much more effective action from atropin, which very likely was longer retained in the conjunctival sac, the swelling of the mucous membrane of the lachrymal passages hindering its outflow. In more than half of the cases the recovery could be attributed to the congestion, which was the only treatment employed.

Slight affections, says Hoppe, are better treated without congestion. In more severe diseases, not yielding to other therapeutic measures, congestion ought to be tried. It is propagated to the tunics and slightly to the interior of the eyeball. In some morbid processes it promotes absorption, in others not.

Hoppe concludes as follows: Artificial passive congestion of the head is not an indifferent procedure; it requires perfect knowledge of technic and the observation of precautionary measures. The method has no effect on the diseased eye. It should not be used in slight affections of the eye. In severe cases where other modes of treatment give no results, this method might be tried. Moderate stasis of several hours' duration extends to the coats of the eyeball and may affect to a slight degree the interior of the eye. The procedure causes in some cases a diminution of the inflammatory pain. The stasis acts favorably in the resorption process in some cases; in others the effect is doubtful, and in still others there is no apparent effect. The stasis increases the effect of atropin.

Renner first tried the process on himself, and, after describing the symptoms states that he employed this mode of treatment, with good results, in 5 cases of keratitis parenchymatosa, where the affection had
lasted from several months to a year. After two to four weeks of treatment, lasting six to twelve hours daily, there was decided improvement. In other cases the results were less satisfactory, but in no case was there any bad effect noticeable.

Wessely has also studied the effect of passive congestion on rabbits, cats and dogs by applying a rubber band around the neck and by suction by means of a glass globe hermetically sealed on the bones of the orbit. The results were that, even if the hyperemia of the head was increased to such an extent that an enormous transudation occurred on the head, the orbit and the exterior parts of the eye, the interior of the eye showed very little hyperemia.

The intraocular pressure rose after application of the rubber band to an average of 5 or 6 mm., i.e., to no alarming degree, while the manometer registered 80 mm. when the suction method was employed, showing that suction is not without danger. The pressure on the eye produced by the hyperemia in the surrounding parts after suction, and the counteraction of the intraocular pressure from constrictions most likely prevent, according to the author, hyperemia of the interior of the eye.

Wessely's experiments, planned and carried out with admirable exactness, demonstrate that the interior of the eye is but slightly influenced by passive congestion. He emphasizes the fact that suction produces such a hyperemia of the exterior parts as could not be brought about by any other method, but whether it is preferable to other modes of treatment, e.g., the application of heat, must be decided by further clinical experiences. See Hyperemia treatment.

**Bifilar micrometer.** An optical micrometer having two threads.

**Biflexe.** (F.) Twice flexed.

**Bifocal lens.** In optics, a lens having two adjoining fields of view, differing in refractive power, each field being used separately in spectacles to correct optically imperfect vision for near or distant objects. Conception of this principle is ascribed to Benjamin Franklin, whose spectacles contained two lenses before each eye, one being effective above, the other below their centrally located and abutting straight-lined edges within the frame. The so-called solid bifocal lens is a subsequent improvement in which the adjoining fields are integral parts of a single lens, and one of whose surfaces is prescribed by two intersecting spherical curvatures of different radii to produce the required difference in power. In the higher powers the lens is inefficient on account of its prismatic action and the limited area of its upper field, wherefore it has been supplanted by the so-called cemented bifocal lens, in which the amplified power of its lower field is secured through
attachment, by balsam, of a small lens or segment of any desirable size or form. By this means it is possible to place the optical center of the upper or lower lens in line with the visual axis of the eye when either field is used. In Borsch's fused bifocal lens the lower field is obtained through fusing a small lens of flint glass into a corresponding cavity placed eccentrically in the major lens of crown glass, and the lens is subsequently finished so that the surfaces of both the upper and lower fields constitute a uniformly curved continuous surface, thereby obviating the projecting edge of the segment common to cemented bifocal lenses, while also making the integral segment almost invisible. Flint glass, on account of its higher refractive index, is here used to produce increased power, and not to effect achromatism, which, in fact, is hardly a possibility under the prescribed conditions.—(C. F. P.)

Even when carefully adjusted and properly worked out in all their various relations, bifocal lenses can be worn with comfort by not more than fifty per cent. of ametropes and presbyopes. The reason for this difficulty cannot be discussed here, but the fact remains. A formula for bifocal glasses, accordingly, is one that should never be given except with the understanding that it is not certain that the patient will be able to make use of it, even after considerable trial. When, however, bifocals can be worn they are of the greatest value and satisfaction to the wearer. He is not obliged to put off one pair of glasses to hunt about for a second pair, nor are his time and attention occupied by a mere exchange of distance glasses for near, and vice versa. Looking at the problem in its different aspects the most important rule to observe is that the patient should always look directly at the object he wishes to fix, whether that be in the distance or near at hand. Patience, perseverance and practice will enable him to overcome most of the difficulties inherent in bifocals. In any event, it is generally desirable to have a separate pair of distance glasses—when these are needed—as well as a one-lens reading glass to be used on special occasions instead of bifocal lenses. When the patient is engaged in looking for some time in the distance only, or for protracted periods in doing near work only, he may with greater comfort and less strain upon the eye use single lenses rather than the combination. The difficulties in connection with bifocal lenses will be considered under various other headings. See for example, Lens; Eye glasses, Adjustment of.

Bifokallinsen. (G.) Bifocal lenses or glasses.

Bigle. (F.), adj. Affected with strabismus.

Bilateral miosis. This symptom often accompanies hemorrhage into the pons Varolii and is probably the most important ocular symptom of that lesion. It must be remembered, however, that it may be entirely
absent in pontine lesions; or it may result from bleeding into the corpus striatum as well in meningeal hemorrhages.

**Bild.** (G.) Picture; finding; symptom-complex.

**Bild, Optisches.** (G.) Optical appearance.

**Bildungsfehler.** (G.) Anomaly or defect of development.

**Bile, Uses of, in ophthalmology.** The application of human bile and biliary salts to the purposes of the ophthalmic surgeon are restricted enough, although Neufeld observed a bacteriolytic action of bile on Fraenkel’s diplococcus, while other microorganisms were not influenced by it, and Schultz and Levy ascertained the bacteriolytic action of taurocholate of sodium on pneumococci. Verderame and Weekers also report a specific action of taurocholate of sodium on pneumococci from various ocular affections, while solutions with other microbes, diplobacilli, xerosis bacilli, etc., remained opaque. If, however, exudations and pus, which contained pneumococci, were treated with taurocholate or glycocholate of sodium, no certain bacteriolytic action could be observed. Their action on pneumococci in the living, where they are lodged between the corneal lamellee and are less accessible, will be much less, as was shown in several cases of serpent ulcer. In advanced or serious cases of serpent ulcer, the cholates are not able to stem the progress of the corneal infection and cannot be recommended.

**Bilifulvique.** (F.) Having the greenish-yellow colour of bile.

**Billi, Domenico.** An 18th century Italian ophthalmologist, concerning whom almost nothing of a personal nature is known. The only work of his which has been preserved to us (and this is very rare withal*) is entitled “Breve Trattato delle Malatie degli Occhi di Domenico Billi, Cerusico d’Ancona, Dedicato a Sua Emin. Il Sign. Cardinale Allessandro Albani” (Ancona, 1749, pp. 224, with a plate).

In the preface to his work, this early Italian ophthalmologist sets forth the reasons which he had for the composition of the book. The Italian surgeons, he says, understand no English, French, or German; hence, they are far behind the world beyond the Alps in all that pertains to the theory and practice of ophthalmology. Hence, too, the poor of Italy who suffer from diseases of the eyes, must submit themselves to the blind leading of peripatetic quacks.

Though the work professes to be but the merest compilation from German, French and English ophthalmologists, it is nevertheless well written, and, in the words of Hirschberg, “For the development of Italian ophthalmology it has certainly been of value.”—(T. H. S.)

**Billot and Baudon’s test.** This is an apparatus constructed on the prin-

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*The ophthalmologic world is wholly indebted for its knowledge of Billi (as of so many other men and matters) to the great Hirschberg.
Bimaculares Sehen. (G.) Simultaneous vision with both maculae.

Bimaculaire vision. According to Heine this is the highest grade of binocular vision. It consists of the ability to distinguish between the finest differences of distance; to be realized it is necessary that both maculae functionate perfectly. In Hering's experiment (q. v.) (with small rods) Heine was able to perceive the pictures on the retina when they were separated a distance that corresponds to a visual angle five-sixths of a second.

Since the points in these images lying in the binocular line of vision in one case rise to consciousness in the case within the left occipital lobe and in the other in the right occipital lobe, it is certain that the macular centres must be bound together in a high functional unity, whether it be through commissural or collateral fibers. It would be important in cases of hemianopsia of various kinds to measure the exactness of central and peripheral perception of depth, since from this we might expect to get important information about the anatomical-physiological union of the visual centers.

Bimane. (F.) Ambidextrous.

Bimane. (F.) Ambidextrous.

Bimanauls. (F.) Ambidextrous.

Bimane. (F.) Ambidextrous.

Bimanual ophthalmoscope. The instrument introduced by Tanner, has two handles, one above and one below. The upper handle, with the instrument in position before the patient's right eye, terminates in a hook, which is placed over the ring finger of the left hand of the operator, whose little finger rests upon the patient's forehead. The right hand of the operator grasps the lower handle. The lenses are turned by the thumb of the left hand. When the left eye is under examination the position of the operator's hands on the instrument is reversed.

Binary lens. A double lens.

Binasal hemiopia. This unusual sign will be further considered under the caption Hemiopia and Hemianopia, as well as in the section Field of vision. It will suffice to say here that it is almost invariably associated with tumor at the chiasma and sometimes with acromegaly (q. v.). The following case briefly illustrates one phase of the condition: A woman of 39 years, in apparent good health, complained to Casey Wood first of dimness of vision at the near point with a sense of strain. Later she noticed that she could see better by turning her
head to one side. She wore her hyperopic correction of 1.25 with some relief. Her vision is 1/x in O. D. and 1/v in O. S. Pupillary reaction and tension normal; shows a diffuse grey-white decoloration of both optic nerves. The fields of vision for white and colors show heteronymous hemiopia.

A skiagram showed an enlargement of the sella tursica, with a faint shadow that represents an enlarged hypophysis. Her blood count shows red corpuscles 4,250,000; white corpuscles 9,600. She has no symptoms of acromegaly or myxedema. A month after the first examination she was examined again, when it was found that the visual fields and vision had slightly improved.

**Bindegewebe.** (G) n. Connective tissue.

**Bindegewebs balken.** (G.), n.pl. Connective-tissue trabeculae.

**Bindegewebskör perchen.** (G.), n. Connective-tissue corpusele.

**Bindegewebsring.** (G.) Areola or ring of connective tissue.

**Bindegewebswucherung der Papille.** (G.) Connective tissue growth at the papilla.

**Bindehaut.** (G.) Conjunctiva.

**Bindehaut, Amyloide Entartung der.** (G.) Amyloid degeneration of the conjunctiva.

**Bindehaut-Arterien.** (G.) Arteries of the conjunctiva.

**Bindehaut-Bildungsfehler.** (G.) Developmental anomalies of the conjunctiva.

**Bindehautcatarrh.** (G.) Catarrhal conjunctivitis.

**Bindehautcyste.** (G.) Conjunctival cyst.

**Bindehaut des Augapfels.** (G.) Bulbar or ocular conjunctiva.

**Bindehaut-Drüsen.** (G.) Glands of the conjunctiva.

**Bindehautentzündung.** (G.) Conjunctivitis.

**Bindehaut-Epithel.** (G.) Epithelum of the conjunctiva.

**Bindehauterkrankungen.** (G.) Diseases of the conjunctiva.

**Bindehaust gefässe.** (G.) Blood vessels of the conjunctiva.

**Bindehaut, Infectiöse Erkrankungen der.** (G.) Infectious diseases of the conjunctiva.

**Bindehautkatarrh.** (G.) Catarrhal conjunctivitis.

**Bindehautsack.** (G.) Conjunctival sac.

**Bindehautschwellung.** (G.) Chemosis of the conjunctiva.

**Binnendijk’s test for simulated blindness.** This device closely resembles the Armaignac (q. v.) test. It is a modification of the ingenious instrument of Fles (q. v.), who made a box intended to prove that the malingerer’s alleged defective eye sees an image which he imagines he is seeing with his good eye. Binnendijk made the mirrors movable on a hinge so as to vary the angle which they form, and thus obtain
such relations to the images that, unless the malingerer closes one of his eyes it is impossible for him to know which is the image perceived by the right eye and which seen by the left.

Binnenmuskel. (G.) Intracocular muscle.

Binocle. (F.) A double eyeglass.

Binocular, adj. Fitted for use with both eyes.

Binocular. 1. Having two eyes. 2. Referring to both eyes; suited for the simultaneous use of both eyes; as, a binocular telescope or microscope.

Binocular accommodation. The power of the two eyes, when used together, of focusing, for all distances, the images of objects on the two retinae.

Binocular asthenopia. Extensive oculomuscular asthenopia, i.e. the fatigue and other symptoms that arise while both eyes are being used. A defect of binocular vision.

Binocular contrast, Hering's. According to Burch, (Practical Exercises in Physiological Optics, p. 86) "an ordinary stereoscope is very convenient for this purpose, a square of red glass being inserted on one side of the central partition, and a square of blue glass on the other—or a plain box divided down the middle with a pair of eye-holes at one end and the colored glasses at the other will do equally well, no lenses being required. A small black wafer is fixed at the centre of each glass, with a white wafer close to the left side of the one on the right-hand glass, and another close to the right side of that on the left-hand glass. The two black wafers, being fixed binocularly, combine to form a single image, with the white wafers, each seen with a different eye against a different colour, one on each side of it. If preferred, the white wafers may be one above and one below the black spot. The instrument may be directed to a sheet of white paper, or to a mirror reflecting the light of the sky. To bring out the full effect the light upon the white wafers must not be too bright. It should be reduced until the contract colours show up strongly, orange against the blue glass and blue-green against the red. The point brought out by Hering is this: Helmholtz had said that contrast effects were judgments of the mind. Hering shows that if you look with both eyes at once, though the colours of the two fields may combine, as they do with many people, to produce the impression of purple, the two contrast colours will not combine to produce the complementary yellow-green unless they too are superposed, but will retain each its own hue. It is difficult to imagine the mind combining two impressions, and at the same time keeping separate the judgments they give rise to. Hering argues very properly that contrast phenomena are functions of the retina rather than of the brain."
Binocular corneal loupe. Both Wecker and Gayet constructed instruments of this kind but they were never used to any extent on account of the great difficulties encountered when examining the living eye. Liebreich was among the first to use binocular lenses of about 5 D, with an aperture large enough to admit of the use of both eyes together, although true stereoptic vision was probably rarely obtained. The latter purpose was accomplished, however, by Schulze and was afterward known as the binocular corneal loupe. This instrument, also, known by the name of Westien, an optician in Rostock, who manufactured it, is thus described (System of Diseases of the Eye, Norris and Oliver, Vol. 2, p. 58), by Laquer: It is composed of two horizontal Bruecke’s loupes which converge towards the objectives. The inner thirds of the objectives are, as it were, blended. Two separate images are secured for the two eyes, and they are fused stereoscopically. The oculars are placed in tubes which can be drawn out and in, and they can thus be suited to any pupillary distance. The apparatus is fixed upon a solid stand, and may be raised and lowered or turned sidewise. The large screw under the objectives brings the instrument into focus. The head of the patient is fixed by a chin-rest which admits of being raised or lowered. The illumination is obtained in a manner as follows: A lamp is placed upon a table three or four metres distant, and in front of it, at a distance of twenty-five centimetres, a convex lens of 4 D. and ten and a half centimetres’ aperture is mounted upon a strong stand. There is a second convex lens of 6.5 D. and eight and a half centimetres’ aperture about sixteen centimetres from the patient’s head, the latter lens receives the parallel rays sent from the former and collects them in a small and very bright circle about one centimetre in diameter,—thus large enough to illuminate at once the whole cornea. The part illuminated is altered by moving the second lens. The preference of this method of illuminating over
the lens supported by a jointed rod and attached to the instrument, such as Zehender at first used, lies in the fact that the illumination is larger and is fixed as long as the patient keeps his eye quiet, these being dependent upon the fact that movements of the instrument, such as focusing, do not disturb it. The advantages of this instrument depend upon the magnifying power (which reaches a linear enlargement of ten diameters) and the beautiful stereoscopic effect, which enables one to recognize at a glance the relative topographical relations of the various parts. Thus one can see how deeply a foreign body is embedded in the cornea, the depth at which blood vessels lie in the corneal parenchyma, and the extent to which a tubercle or a gumma encroaches upon the anterior chamber; and yet the eye is nine to ten centimetres from the objective of the instrument.

The more modern instruments of Aubert, Zeiss, Jackson, Koller and others are elsewhere described.

**Binocular diplopia.** That form of double vision which occurs when both eyes take part in the visual act. It disappears when one eye is covered or excluded, and generally results from divergence of the optic axes caused by a paresis or paralysis of one or more external ocular muscles.

**Binoculare Accommodationsbreite.** (G.) Binocular range of accommodation.

**Binocular field of fixation.** This topic is of especial importance in cases of squint. It is defined by Londolt (Norris & Oliver’s *System

Vol. IV, p. 53) to be the extent of the space over which "the lines of sight of the two eyes can meet in the same point of fixation. This experiment should be made at such a distance that the convergence may be disregarded. We use for this the mural division which we have
described in the discussion of subjective stabometry. We have marked for this purpose upon the wall the tangents of the multiples of 5 in nine meridians, separated by 20 from each other, also the meridians inclined at 45. (See the figure.) The person to be examined is placed before this division in such a way that his eyes correspond to the centre of the imaginary hemisphere whose projection is inscribed on the wall and floor. The head is fixed by means of a dental strip supported by a solid pedestal. Then one moves, along the principal meridians of the chart, a lighted candle, which the patient follows with his eyes until he commences to see it double. The point at which this diplopia appears constitutes the limit of the field of binocular fixation in each given direction. This is recorded on a scheme like that used for the record of the monocular field. The perception of the diplopia is favored by a colored glass, which is best held by the patient himself before one of his eyes. The full line in the figure corresponds to the normal field of binocular fixation of the author. The pointed curves at the left and right of the lower part of the figure are nothing else than the infero-external limits of the monocular fields of fixation. The nose prevents this space from being dominated simultaneously by both eyes."

Binocular field of vision. Although the field of vision (q. v.) is usually determined one eye at a time, yet it must be remembered that patients always speak of their visual defects from the binocular standpoint, that is to say, they always, when possible, use both eyes together. When the indirect or peripheral vision of a patient is tested by the perimeter (q. v.), when using both eyes simultaneously, the field thus obtained is different from either monocular field and may be pictured as in the accompanying figure. The relation of this form of the visual field to the various kinds of strabismus and other ocular defects will be considered under the caption Field of vision.
Binocular fixation. As is well known, normal eyes bring about stereoscopic vision when used together to the fullest extent, and binocular single vision is obtained, (q. v.). There are many tests for the fact and the degree of binocular fixation. The amblyoscope (q. v.) is one of the most important of these means but there are many other similar devices, for example Duane's screen, cover or parallax test is one of these. That author describes it as follows: "If there is any noticeable deflection behind the screen, the screen-test is applied in a second way or by binocular uncovering. This procedure consists in covering the left eye and then uncovering both eyes and noticing the movements that take place. If, on this uncovering the left eye, the right eye remains steady and the left moves into position, the patient has binocular fixation, and the deflection was a heterophoria and not a squint. If, however, the right eye should move out of its position and the left eye should move into place, there is a squint and the left is the fixing eye. If neither eye moves, there is a squint and the right is the fixing eye. By repeating this experiment with each eye alternately the examiner can tell whether there is a habitual binocular fixation, an alternating fixation, or a uniocular squint."

Binocular fusion field. According to Savage this is related to the field of rotation but can be determined only by the use of prisms. He does not believe that it is important to measure the extent of the field except in the four cardinal directions, and pictures approximately the shape and size of the fusion field—as shown in the accompanying cuts. When an image is displaced by a prism to any point within the field, while the image in the other eye is on the macula, an effort at fusion will be made, and if the muscle that must respond is sufficiently strong, fusion will at once take place, caused by such rotation as will bring the macula under the displaced image. When the image is thrown, by
a stronger prism, entirely outside of the field of fusion, the guiding
sensation, which seems to reside in this area only, will not call on any
muscle to move the eye for the purpose of fusion. The nasal limit of
this retinal area, as measured by a prism in front of the eye, is 8°; the
temporal limit, 25°; the upper limit, 3°; and the lower limit, 3°. The
line drawn through these four points marks the entire boundary of
the field. This may be considered the normal size of the fusion area.
In some cases it may appear to be smaller, while in still other cases
it may be larger. (*Ophthalmic Myology*, p. 83.)

**Binocularer Augenspiegel.** (G.) Binocular ophthalmoscope.
**Binoculares Doppeltsehen.** (G.) Binocular diplopia.
**Binoculare, Visone.** (It.). Binocular vision.
**Binocularlupen.** (G.) Binocular magnifiers or (loups) loupes.

**Binocular magnifying lenses of small power** include the Jackson, Zeiss,
and similar instruments, all of which will be described under their
separate headings. Some of them are adapted to natural light only;
others are self-illuminated or are dependent on outside sources of
artificial illumination. The Zeiss catalogue refers to their own instru-
ments of this class as follows: These binocular magnifiers have been
devised to enable medical men, zoologists, botanists, watchmakers and
others called upon to examine small solid objects under a low magni-
fying power to do so with both eyes and thereby to secure an easier
and better appreciation of details and of the solid structure of the object
than is possible with the unaided eye.

The magnifiers are supplied either fitted with a head band for con-
tinued wearing or with a socket pin for attachment to a lens holder.
The apparatus can also be supplied with an illuminating device con-
sisting of a metal filament lamp and a condensing lens for lightning up
the object.

The available magnifiers are adjusted for eyes with points of rota-
tion separated by the following distances: 59, 62, 65 and 68 mm.

<table>
<thead>
<tr>
<th>Magnification</th>
<th>3</th>
<th>2.5</th>
<th>2</th>
<th>1</th>
<th>0.75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free working distance in cm.</td>
<td>5</td>
<td>7</td>
<td>9</td>
<td>22</td>
<td>30</td>
</tr>
</tbody>
</table>

**Binocular field of view**

| in cm. | 2.5:3.5 | 3:4.5 | 4:6 | 7:11 | 10:14 |

**Binocular movements of the eyeballs.** It is quite probable that in
any excursion of the eyeballs all of the ocular muscles take some part,
if not in direct movements then in steadying the globe and in prevent-
ing too pronounced nystagmic motions. However, most of the turning
of the eyeballs to the right is, according to Ball, (*Modern Ophthal-
mology*, p. 656) "accomplished by the associated action of the external
rectus and the obliques of the right eye with the internal rectus and
the superior and inferior recti of the left eye; to the left, by the asso-
ciated action of the external rectus and the superior and inferior
obliques of the left eye with the internal rectus and the superior and
inferior recti of the right eye. The muscles associated in oblique con-
jugate deviations are:

| Up and to the right | R. E. Superior rectus, inferior oblique and external rectus. |
|                     | L. E. Superior rectus, inferior oblique, and internal rectus. |
| Up and to the left   | R. E. Superior rectus, inferior oblique, and internal rectus. |
|                     | L. E. Superior rectus, inferior oblique, and external rectus. |
| Down and to the right| R. E. Inferior rectus, superior oblique, and external rectus. |
|                     | L. E. Inferior rectus, superior oblique, and internal rectus. |
| Down and to the left | R. E. Inferior rectus, superior oblique and external rectus |
|                     | L. E. Inferior rectus, superior oblique and external rectus |

Convergence of the visual lines results from the associated action
of the internal recti of both eyes.

This important subject is carefully and exhaustively treated by
Savage in his Ophthalmic Myology. He believes that rotation to the
right or left in the horizontal plane is brought about by all the twelve
muscles acting under a stimulus of seven of the nine conjugate innerva-
tions, the subverting stimulus perfectly neutralizing the superver-
ting stimulus, and the intorting stimulus just as completely neutraliz-
ing the extorting stimulus. The axis of rotation is the vertical axis
of the eye, and there can be neither elevation, depression, nor torsion
while this rotation is being effected. It can hardly be claimed that the
conjugate stimulus, which would move the eyes in the opposite direc-
tion, plays no part; for, if both eyes are to be rotated directly to
the right, the internus of the right and the externus of the left must
have a control current of nerve impulse sent to them, but a current
much less powerful than is sent to the right externus and left internus.
This is as necessary as that the conjugate innervation of the subvertors
should be neutralized by the conjugate innervation of the supervertors.
Thus it would seem clear that, in every rotation of the eyes, all twelve
of the muscles are called into harmonious action under the influence of seven of the nine conjugate innervations, and all in obedience to the law of corresponding retinal points. With mathematical precision all ocular motions must be accomplished. The rotation of the eyes directly up is in the vertical planes of the eyes, and the transverse diameters are the axes of rotation. In this rotation the conjugate innervation for supervision is greater than the conjugate innervation for subversion; the intorting stimulus, which is less, neutralizes the extorting stimulus, which is greater, and the three conjugate innervations intended for the lateral recti hold them in perfect harmony. The same is true of rotation directly down, except that the conjugate innervation for sub-version is greater than that for supervision, and that the intorting stimulus is greater than the extorting stimulus. That the obliques have something to do with movements directly up and down is evident from the fact that, in the upward movement, the superior recti, there would be intorting of both eyes, if the inferior obliques did not counteract this. Besides this, the inferior obliques also help to supervert the eyes. If in the simple rotation of the eyes all the muscles are called into action to fix the planes of rotation, it can hardly be denied that they all will be concerned in the more complicated rotations. Changing the point of view from the primary position to any secondary position not in either of the four cardinal directions, can be accomplished in either one of two ways: Let the secondary point of view be 45° up and to the right. This may be reached by rotating the eyes directly to the right to a cardinal point immediately beneath the point sought, thence directly up to the point aimed at. The first of the double movements will be a rotation on the vertical axis; the second will be a rotation on the transverse axis. As already shown, these two revolutions will be accomplished without the slightest torsioning of the eyes, for no torsioning is possible in rotations around either the vertical or transverse axes. In the one rotation, the visual axes have been carried along the horizontal plane; in the other, along the vertical plane. In the other method of reaching the oblique secondary position, the visual axis of either eye is made to sweep along the plane common to its center of rotation, the primary point of view and the oblique secondary point of view, which will include the visual axis in the first and second positions. The axis of this rotation must be at right-angles to this plane, which has an inclination of 45°; therefore, the axis must be at an angle of 45° also, and of necessity it must be in the equatorial plane. If action of the right superior oblique and left inferior oblique, under the stimulus of the eighth conjugate innervation, does not accompany
this rotation, the oblique position cannot be reached without a great outward torsioning of the right eye and an inward torsioning of the left eye. This torsioning must be prevented, if the eyes are to have the same position—vertical axes of the eyes still parallel with the median plane of the head and horizontal axes still in the fixed horizontal plane—which they would have had if the same point of view had been reached by, first a rotation directly out, and, secondly, a rotation directly up. This can be accomplished only through the eighth conjugate innervation, which is divided equally between the superior oblique of the right eye and the inferior oblique of the left, the action under this stimulus being just enough to neutralize the torsioning

that otherwise would result. In going in this most oblique direction the torsioning, if not prevented, would be the maximum. If the angle formed by the visual axis in its first and second positions should be 45°, the outward torsion of the right and the inward torsion of the left eye would be 9° 44'. The experiment showing this can be easily accomplished by means of the rubber ball and the three knitting needles. On carrying this rotation through 90°, the meridian that was vertical in the beginning becomes inclined 45° at the end of the revolution. Rotation in a less oblique direction would be attended by a slighter torsioning, until it is reduced to zero on reaching the horizontal or vertical plane.

The accompanying cut was designed by Maddox, (The Ocular Muscles) for solving "false torsion." The following is the solution in his own words:
"Taking VC as unity—
Since $OV = \sin I$
and $\frac{OM}{OV} = \cos R$,
\[\therefore OM = \sin I \cos R.\]
Moreover $OC = \cos I$;
\[\therefore \frac{OM}{OC} = \frac{\sin I \cos R}{\cos I} = \tan I \cos R.\]
But $\frac{OM}{OC} = \tan (I-X)$;
\[\therefore \tan (I-X) = \tan I \cos R.\]
Or $X = I - \tan^{-1} (\tan I \cos R)$

Torsion in Oblique Rotation (Savage-Daniel).

"Putting this into language: The false torsion is equal to the angle from the vertical, or from the horizontal, of the axis about which the eye rotates, less the angle whose tangent is the multiple of the tangent of the inclination of the axis of motion with the cosine of the angle traversed by the line of fixation. The short table above will give an idea of the amount of false torsion which takes place on looking in any diagonal direction midway between any two of the cardinal directions. Since the greatest false torsion of
which the eye is capable occurs at the extremity of these diagonals, we may see at once that it does not ever much exceed 10°.

**Rotation about an axis 45° from the horizontal.**

Degrees  5°  10°  15°  20°  25°  30°  35°  40°  45°
Torsion  6°12′  26′  1°  1°47′  2°49′  4°6′  5°40′  7°33′  9°44′

At the author's request, Prof. John Daniel, of Vanderbilt University, designed the illustration, with the view of determining the amount of torsion that would occur as the result of oblique rotation of the eyes, if it were not prevented by oblique muscles. The following is the solution by Daniel:

"Make \( v_0 = \text{unity.} \)

\[
\begin{align*}
I &= \text{angle between the vertical and the axis of rotation,} \\
   &= \cos \alpha. \\
R &= \text{angle through which the eye is turned on said axis,} \\
   &= \alpha. \\
\end{align*}
\]

Then \( X \) = angle of torsion, \( \alpha \).

\[
X = \sin^{-1} \left( \frac{\cos I \ \text{vers } R}{\sqrt{\cos^2 R + \cot^2 I}} \right) \quad (\text{for, in the triangle } \alpha m, \ \sin X = \frac{\alpha m}{\cos \alpha})
\]

\[
\sin X = \sin \alpha \frac{\alpha m}{mc} = \sin (90° - I) \cdot \frac{\alpha m}{mc}
\]

\[
\frac{\cos I \ \text{vers } R}{\sqrt{mc^2 + oc^2}} = \frac{\cos I \ \text{vers } R}{\sqrt{\cos^2 R + \cot^2 I}}
\]

\[
X = \sin^{-1} \left( \frac{\cos I \ \text{vers } R}{\sqrt{\cos^2 R + \cot^2 I}} \right)
\]

"That is, starting from a primary position, when the eye is rotated \( R \) degrees on axis inclined \( I \) degrees to the vertical (or horizontal) the resulting torsion \( X \), is an angle whose sine is equal to \( \cos I \) times the vers \( R \), divided by the square root of the sum of the squares of \( \cos R \) and \( \cos I \). The numerical value of the torsion, \( X \), when the inclination of the axis is 45°, is as follows for angles of rotation, \( R \), as follows:

**Angle of rotation**

<table>
<thead>
<tr>
<th>( R )</th>
<th>5°</th>
<th>10°</th>
<th>15°</th>
<th>20°</th>
<th>25°</th>
<th>30°</th>
<th>35°</th>
<th>40°</th>
<th>45°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torsion</td>
<td>6°12′</td>
<td>26′</td>
<td>1°</td>
<td>1°47′</td>
<td>2°49′</td>
<td>4°6′</td>
<td>5°40′</td>
<td>7°33′</td>
<td>9°44′</td>
</tr>
</tbody>
</table>

"This was worked out independently of the simpler formula given in Maddox, but the two are equivalent."
The mistake made by Maddox was in supposing that no effort was made by the obliques to correct the torsioning that otherwise would occur. Other evidence than that given may be deduced to show that the torsioning threatened by rotations in oblique directions is not allowed to occur. An astigmatic, with his correcting cylinders (say of 2.00 or 3.00 D) placed in their proper positions and held as close to the eyes as possible, may be asked to look at an object up and to the right at the maximum obliquity. If torsioning has occurred, revolving the axes of the cylinders in the direction taken by the best meridians ought to be necessary for the improvement of vision. In fact, any such revolution of the cylinders makes vision worse. Again, there are patients who have congenital marks on the eyeball in or near the horizontal meridian, and there are others who have corneal scars, who may be made subjects of experimentation. If such a person should be asked to look up and to the right in the direction of maximum obliquity, and torsioning, if it takes place, should be easily detected. In fact, these marks, if in the horizontal meridian at the beginning, are still in the same horizontal plane at the end of rotation. After all, the chief argument against the statement that torsioning actually occurs when the eyes are rotated in an oblique direction, is that, under such a condition, we would be wholly deprived of our power to judge of verticality and horizontality. If the obliques did not prevent the torsioning, the eyes, on looking up and to the right, or down and to the left 45°, would see a vertical line inclining to the left 9° 44′. An oblique rotation of the eyes does not deprive us of our idea of verticality. As already shown, our judgment of verticality depends on the fact that the vertical axes of the eye are parallel with the vertical plane of the head. In oblique rotations up and to the right and down and to the left, the eighth conjugate innervation prevents torsion by calling into action the right superior oblique and the left inferior oblique. In oblique rotations up and to the left or down and to the right, the ninth conjugate innervation prevents torsioning of the eyes by calling into action the left superior oblique and the right inferior oblique. Thus it is clear that the obliques have four conjugate innervations: the first, for both superior obliques, in cardinal sub-version, to prevent divergence of the vertical axes; the second, for the two inferior obliques, in cardinal supervision, to prevent convergence of the vertical axes; the third, for the superior oblique of the right eye and the inferior oblique of the left eye, when the rotations are up and to the right, or down and to the left, to keep the vertical axes parallel with each other and parallel with the median plane of the head; and the fourth, for the superior oblique of the left eye and the inferior
oblique of the right, when the rotations are up and to the left or down
and to the right, not only to keep the vertical axes parallel with each
other, but also parallel with the median plane of the head.

If what is taught in the foregoing paragraph be true, then it follows
that Listing’s law must be false. While most readers may be familiar
with the wording of this law, it is, nevertheless, reproduced here:

“When the line of fixation passes from its primary to any other posi-
tion, the angle of torsion of the eye in this second position is the same
as if the eye had arrived at this second position by turning about a
fixed axis, perpendicular to the first and second positions of the line
of fixation.” Certainly it is around such an axis that the eye rotates
from the primary point of view to the obliquely-placed secondary
point of view. It is equally certain that there would be a torsioning
unless a preventive force were called into action. If the obliquity
of the plane of rotation be at the maximum (45°), and the rotation
45° in that plane, the torsion effected by the rotation from the one
point to the other, as already shown, would be 9° 44′. Since no such
great torsioning takes place, even when determined by after-images,
it would appear that some effort is made by the eye to prevent it, at
least in part; and if in part, why not wholly? The chief evidence in
favor of Listing’s law is the study of the after-image. After looking
intently at a bright vertical line, with the eyes in the primary position,
there can be no doubt but that the after-image will incline when the
closed eyes are quickly rotated up and to the right; but no one has
ever claimed that the leaning was so much as it would have to be if
there were no effort at all made for the preventing of the torsioning
of the eyes. The leaning of the after-image would be expected, for the
stimulus of the after-image is not great enough to call into full action
the eighth conjugate innervation, and without this, the vertical axes
cannot remain parallel with the median plane of the head, although
they may be—must be if there is orthophoria of the obliques—parallel
with each other.

The idea of uncounteracted torsion would have no place if Listing’s
law had been framed as follows: “When the line of fixation passes
from its primary to any other position, the angle of torsion of the eye
in this second position is the same as if the eye had arrived at this
second position by turning” first about the vertical axis, and then
about the horizontal axis. This would mean, of course, that the eye in
its second position would have its vertical axis still vertical and its
horizontal axis still horizontal.—(G. C. S.)

Binocular ophthalmoscope. In looking through the monocular ophthal-
moscope, there is lacking a direct determination of depth; and other
defects of perspective. This imperfection, of which even the skilled ophthalmoscopist is hardly conscious, is said to be covered by binocular observation of the fundus. Girard-Teulon long ago constructed (after the plan of Nachet’s binocular microscope) a binocular ophthalmoscope. According to Schweigger, however, both in this instrument, as well as in its modifications, perception of depth is not particularly satisfactory. It is much improved, however, in Schweigger’s binocular electrical ophthalmoscope. The demonstration ophthalmoscope (q. v.) of Thorner is also arranged as a binocular ophthalmoscope. Binocular ophthalmoscopes are not generally used, and it is a question whether on the whole they really possess any advantage over the ordinary instrument.

**Binocular range of accommodation.** See Accommodation, Binocular range of.

**Binocularsehen.** (G.) Binocular vision.

**Binocular single vision.** This form of vision arises when the images of an object formed upon the retina of each eye are so blended that the observer is conscious of but one object. Two chief theories have been proposed to explain this phenomenon: (1) The theory of identical points, and (2) the theory of projection. The latter theory assumes that the retino-cerebral apparatus, by a process of mental projection of the image into space, has the power of appreciating the shape and size of an image, as well as the direction of the rays of light which form it. While the limits of this treatise will not permit an extended discussion of the subject of binocular single vision, it will be necessary to consider the first theory more extensively. The theory of identical points assumes a correspondence of each point of one retina to a similarly situated point on the retina of the other eye. When the eyes are directed toward a far-distant object, the visual axes being then parallel, a correspondence actually exists; but when the visual axes converge the points do not converge. Furthermore, a part of each retina has no corresponding points in the other. This is due to the fact that the actual centre of the retina is not at the fovea centralis, but lies nearer the nasal side. So long as the images of a point are within the horopteric circle they fall on corresponding parts of the retinæ. Images of a point outside this circle do not fall on corresponding points. This circle, the horopter of Joannes Müller, may be described as being, in the simplest form, a circle which embraces the centre of rotation of each eye and the apex of the point of fixation of the visual lines. Thus, in the figure, it is a simple problem in geometry to demonstrate that images of any point lying within the horopteric circle fall on corresponding retinal points. Thus, the images
of $B$ will fall on such points. For, if $C$ and $D$ are nodal points of the two eyes, and $F$ and $H$ are the centres of the foveae; the angles $D-A-C$ and $D-B-C$—being angles in the same segment of a circle—are equal. In the triangles $A-I-C$ and $B-I-D$, the angles $A-I-C$ and $B-I-D$—being opposite angles are also equal. Therefore, the angles $A-I-C$ and $B-I-D$ are equal; and the angles $E-C-F$ and $G-D-H$ are equal. Now, if the left eye be placed on the right, so that $C-F$ corresponds with $D-H$, $G$ must correspond with $E$. Since the doctrine of identical points is true for only some visual acts, an attempt must be made to explain binocular single vision without the horopter. Such objects as are situ-

![The Horopteric Circle of Joannes Müller.](image)

ated outside the horopter are seen double, but it is possible to obtain only a single cerebral impression of them. Thus, the expert ophthalmoscopist keeps both eyes open while examining the fundus. The image seen by one eye in this case is ignored. Under some circumstances a new mental picture of two combined dissimilar retinal impressions is made. Thus, ideas of solidity and depth are obtained in binocular vision by the mental combination of dissimilar retinal impressions, as in using the stereoscope. This is an instrument by means of which two somewhat similar pictures, drawn in perspective, are superimposed so that they appear single. One reason why non-identical points yield good vision is that vision becomes less distinct as we pass from the centre of the retina, and the observer learns to neglect the blurred peripheric images while giving attention to those formed on the fovea.

—(J. M. B.)
Savage, in his Ophthalmic Myology, gives an ingenious illustration of the single character of binocular vision. He believes that it depends "on the predetermined relationship of the vertical and transverse axes of the eyes to the median and horizontal planes of the head. Suppose the head erect, the two eyes looking at a line lying in the median plane, and bisected by the horizontal plane of the head. The extended vertical plane of the right eye has been rotated around the vertical axis to include the line in the median plane; likewise the vertical plane of the left eye has been rotated around the vertical axis until it intersects the median plane so as to contain the line looked at. The line now lies in three extended vertical planes, the median plane of the head, the vertical plane of the right eye, and the vertical plane of the left eye. In each eye the image of the line is on the vertical retinal meridian, half below and half above the transverse plane of the eye. In obedience to the law of projection the one eye sees the line located in space as the other eye sees it; that is, definitely related to the median plane of the head, and there is but one object. Suppose another line looked at to lie in the horizontal plane, and that it is bisected by the median plane. Let the point of fixation be the point of bisection by the median plane. Not only does the median plane bisect this line, but the extended vertical plane of each eye bisects it also, at the same point. The image in each eye, of necessity, must coincide with the transverse plane of the eye, thus falling on the horizontal retinal meridian half the image on one side of the vertical plane and half on the other side, both the image and the line throwing the image being bisected by the vertical plane of the eye. Each eye would see this line in space precisely where the other eye sees it, hence only one line, though two images. This would be true of both images, whether they extended one degree or many degrees, on the vertical and horizontal retinal meridians, respectively. What is true of the vertical and horizontal meridians of the two eyes must be true of every other meridian, so that meridian 45° in one eye must everywhere correspond with meridian 45° in the other eye, point for point, degree for degree, beginning with the macula. To see singly when there are two images, one in each eye, is a law of the mind, but it is based on the predetermined physical relationship (parallelism) that exists between the vertical axes and of the two eyes and the median plane of the head, and the including of the transverse axes within the horizontal plane of the head. The law of corresponding retinal points is unchangeable."

**Binocular single vision, Antipathy to.** See Antipathy to binocular single vision.
Binocular single vision, Line (curve) of. See Circle, Isogonal.

Binocular stereoscopic ocular. An ocular composed of two eyepieces about as far apart as the eyes, and connected with a tube acting as the eyepiece of a uniocular microscope.

Binocular triplopia. This is a term made use of by Javal to describe the condition that obtains in certain cases of squint. The patient may reach a period, after operation, when he fixes or localizes with reference to both the old and the new fovea.

Binocular vision. This is the faculty of using both eyes so that they see together without diplopia. Although the foregoing is the ordinary definition of binocular vision yet it is well known that there are many varieties and degrees of sight with both eyes. The desire in practically every individual is to obtain binocular single vision, or single vision with the two eyes together. This act depends upon the blending of two sets of sensation, called fusion—a function that probably originates the impulse that directs the movements of the eyeballs in various directions. Moreover, along with this desire to fuse the retinal images of the two eyes into one sensation is the association convergence and accommodation (q. v.). If, for any reason, the movements of the eyes are abnormal so that the light rays do not fall simultaneously upon corresponding points in the two retinae, diplopia follows. Hill, in his chapter on the Anatomy of the Intra-Cranial Portion of the Visual Apparatus (System of Diseases of the Eye, Vol. I, p. 390), is a strong supporter of the theory of corresponding retinal points with a single cortical area. He says that it is almost impossible to conceive of a cerebral mechanism of binocular vision arranged upon any other plan.

"In man, therefore, and in certain monkeys which agree with him in having the eyes directed forward, each retina is divided by a vertical line into a lateral or temporal portion (about three-fourths of the whole), which is concerned with binocular vision, and a mesial or nasal portion (about one-fourth), which can be used only for monoc-ular vision. According to Newton's theory of the construction of the chiasm, all the fibres from the nasal sides of the retinae cross to the opposite side of the brain, whereas some of the fibres from the temporal sides are connected with the brain on their own side of the body. The crossed is the primitive connection, the diversion of certain fibres to the brain on the same side being a secondary adaptation which keeps pace exactly with the overlapping of the fields of vision, or development of stereoscopy. The size of the uncrossed tract, as traced by observing cases of natural or surgically induced degeneration (and we may say at once that it is impossible to follow the tract by any anatomical method, whether of maceration, teasing, or sections
in the coronal or horizontal planes), should, according to this theory, vary directly as the development of binocular vision in the animal, and this we find to be the case. In the rabbit it is so small that it was for a long time overlooked; in dogs it is much larger; in monkeys it is larger still.

In order, however, that the anatomical facts which have been ascertained from a study of the degeneration of fibres through the chiasm should enable us to picture to ourselves the mechanism of binocular vision—to understand what we may term the mental superposition of the images focused on corresponding points of the two retinae—the division of the retina must not simply coincide with its division into a part concerned with binocular and a part concerned with monocular vision, but the part concerned with binocular vision must be further divided into two. It can be proved that the connection of eye and brain is primitively contra-lateral; it is assumed that the connection with the same side is adapted to binocular vision. It is supposed that, whereas all that part of the nasal side of the retina which can be used only in monocular vision retains its primitive crossed connection, the superposition of corresponding images is effected by the division of the binocular portion of the retina into two halves about a vertical line. Impulses generated by the impact of light upon the temporal side of this portion of the retina of the right eye are carried by uncrossed fibres to the right side of the brain, to which side of the brain the impulses simultaneously generated in the nasal side of the left eye are also carried by crossed fibres. The images are therefore superposed, as it were, in the brain. According to this view of the cerebral mechanism of vision, the chiasm contains three sets of fibres, namely, (a) the crossed fibres concerned with monocular vision, (b) the crossed fibres concerned with binocular vision, and (b₂) the uncrossed fibres concerned with binocular vision. It is, we believe, impossible to recognize these three sets of fibres in the optic nerve by any anatomical difference of size or grouping. The observation of the degeneration which results in various animals from enucleation of the eyeball does, however, confirm the physiological hypothesis, for the size of the uncrossed tract keeps pace with the development of stereoscopic vision. In the rabbit the bundle of fibres which degenerates in the optic tract of the same side is so small as to be easily overlooked, and its supposed absence is cited, by those who believe in the total decussation of the optic nerves in the chiasm, as a proof of their theory; but it must be remembered that in the rabbit binocular vision is limited to very small portions of the retinae on their temporal sides, and therefore the uncrossed fibres which belong to half
only of the stereoscopic portion of each retina are but a small frac-
tion of the total number of optic fibres. Stereoscopy varies greatly in
development in different breeds of dog. It is not surprising, there-
fore, to find that observers differ widely in their estimate of the size
of the uncrossed bundle in this animal. In man stereoscopic vision
reaches a high state of development, although, owing to the prominence
of the bridge of the nose, it probably does not take such complete pos-
session of the retina as it does in the monkey, and we have now a
numerous series of pathological observations which show that in man
the direct bundle is of considerable size, and that it occupies the
external part of the optic nerve and chiasm. Most of the cases which
have been recorded of disturbance of vision due to cerebral disease
were complicated by the coexistence of cortical lesion, but certain
cases in which lesion was limited to the optic nerves and tracts have
been recorded. One such case in which disease affected the optic
nerve of one side and the optic tract of the opposite side would appear
to be absolutely conclusive, since the patient retained his sight only
for the nasal half of the eye with the sound optic nerve, the limit of
the field of vision passing accurately through the fixation point. The
view that the optic nerve is divided in the chiasm into crossed and
uncrossed portions is, moreover, supported by Von Gudden's and
Ganser's observations of the degeneration which follows enucleation
of the eyeball in the adult animal, as well as by the observations of
the former with regard to the arrest of development which results when
the eyeball is removed at birth. It does not necessarily follow, how-
ever, that the object of this partial crossing is to render stereoscopic
vision possible by the "superposition of images in the brain" after
the manner we have described at some length. Indeed, certain clini-
cians, for the sake of explaining cases in which disease of one occipital
lobe has seemed to produce crossed amblyopia, have propounded
schemes showing the direct bundle as crossing to the opposite hemis-
phere in the corpora quadrigemina; they regard the right optic nerve
as connected solely with the left hemisphere of the brain, its fibres
reaching this hemisphere in two groups, one of which crosses in the
chiasm, the other in the corpora quadrigemina. Anatomy is, on the
whole, opposed to such an arrangement, although it cannot be asserted
that it is impossible. The ultimate settlement of this question must
rest with the pathologists. Looking at the matter, however, from the
point of view of a comparative anatomist, we think that we may urge
very strongly that the evidence before us supports the simple and
practical view that the primitive crossed connection of the optic
nerves with the brain has been disturbed by the diversion of certain
fibres to the same side of the brain in number proportional to the area of retina used in binocular vision, and for the purpose of facilitating stereoscopy."

There are many tests for binocular vision, the most effective being that of Hering (q. v.). A good device is that of Harman (British Med. Journal, Oct. 2, 1909) which takes the form of a small screen with an opening, sliding on a horizontal rod with a handle, much resembling a hand stereoscope. The patient looks, at the usual distance, through a hole in the screen at a reading test-card. Only the central portion of this card is seen by both eyes, while the lateral portions are seen by each eye separately, by crossed vision. The size of the print varies from diamond in set paragraphs to paired capitals. Black or colored squares, or pictures, are used for children. The test is used to determine the equality of visual acuity in the two eyes; the presence, absence or defect of binocular vision; to exercise the vision in squinting eyes; to detect simulated monocular blindness, and to demonstrate certain phenomena of physiologic optics.

Example: A test-card is chosen with a single line of letters or figures:

123456789

The patient with good binocular vision reads 1234 with the right eye, 6789 with the left, and 5 with both eyes. In excess convergence, esophoria, the middle letters overlap and are suppressed, so that the patient reads: 123789. In undue divergence, exophoria, the middle letter is reduplicated, and the patient reads: 12345 56789. In vertical displacement the parts of the line of numbers seen by each eye are on different levels, thus:

12345
56789

All these phenomena can be tested subjectively by the surgeon himself by simply placing a strong prism over one of his eyes, or slightly displacing it by pressure with the finger. A malingerer can easily be detected. It is not necessary to ask any questions, as the co-ordinate movements of the subject’s eyes, looking from one area of crossed vision to the other, are proof of binocular vision. The one-eyed man makes no such motions. By varying the size of the hole in the screen it is possible to estimate numerically the degree of desire for binocular vision, or fusion faculty.

Pollock has found this instrument of use after prescribing reading glasses. It takes only a minute to read the line of figures, and the test shows whether the patient is using both eyes.

See, also, Diplopia and Binocular single vision.
Binoculars. (L.), m.n. A figure-of-eight bandage applied to the head in such a manner as to cover both eyes, and to procure as much immobi-
lization of the eye as possible, combined with a certain amount of pressure. See Bandages.
Biocellate. In biology, having two ocelli or spots resembling eyes.
Biograph. A machine for visualizing the movements as well as project-
ing the images of objects on a screen; a cinematograph or moving-
picture apparatus.
Biophthore. (F.) Mortal; deadly.
Biophotogenesis. The production of light by living beings, as a part of their life-functions. The beings that exhibit the biophotogenic faculty belong, some to the animal, some to the vegetable kingdom.
   (1) Vegetable biophotogenic organisms. In vegetables, the func-
tion in question exists only in those destitute of chlorophyll, or in parts in which no chlorophyll is produced (as the yellow flowers of the nasturtium and of the French and African marigolds). Many bacteria possess the photogenic function, and these are called "photobacteria." Some of these light-producing bacteria are marine; some terrestrial. Of the marine variety, some live independently, while others are attached to the surface of various sea-animals. These parasitic bacteria, strangely enough, produce no light till their host has been dead and exposed to the air for one or two days.*
   (2) Animal biophotogenesis. The splendid ocean-phosphorescence is not at all due, though the reverse has been a time or two suggested, to the presence of photobacteria, but to a light-producing animal, noctiluca miliaris. Then there is a luminous sponge, while numbers of polyps—Isis, Mopsea, and Gorgon, for example—illuminate with magic splendor the abysmal caves of the ocean. Many of the star-fish are brilliantly self-luminous, and certain Ophiuridae, when young, shine with a bright and beautiful emerald green. Self-luminous Crustaceae have been discovered, and, indeed, in Aristeon, Geryon, and Munida (a fact of especial interest to ophthalmologists) the eyes themselves are photogenic. The Orya barbarica (found in Algeria) exudes from the abdominal pores a liquid from which, as soon as it leaves the body, there emanates a light of a soft greenish-blue. Then too, certain orders of insects include varieties possessed of photogenic power: the Coleoptera, the Diptera and the Thysanura. In the glow-worm (Lampyra) it is the egg that shines while still in ovario, and even

*One should recall, in this connection, the fact that human cadavers, under certain rather rare circumstances, have been known to become luminous, while "phosphorescent" slaughter-houses have been observed with not so great in-
frequency.
prior to fecundation. The egg of *Pyrophorus* is also self-luminous, and, in addition, the adult animal possesses three tiny lanterns—two dorsal, one ventral. The "lightning-bug," so common in America, is a beetle of the family *Lampyridae*. It irradiates, as is well known, with an intermittent, suddenly discharged light, while the fire-fly (by way of distinction) glows with a remarkably steady and very much richer illumination. In Santo Domingo, and possibly other portions of the world, a number of fire-flies, confined by the primitive illuminating engineers of that country in a glass, or bottle, have been used for centuries to read by.

The subject of biophotogenesis is a very wide and deep one—indeed almost illimitable—and only its superficial aspects have been here adverted to.—(T. H. S.)

**Biophotophone.** A combination of the phonograph and cinematograph in such a manner that the movement of both animate and inanimate objects on the screen are accompanied by appropriate vocal and other sounds.

**Biorbital.** Relating to both orbits.

**Biplanar.** Lying in two planes.

**Bi-plates.** Two glass plates, cut from the same piece of glass, placed with their edges in contact and their faces tilted so as to include a very obtuse angle. Used in combination with a lens to demonstrate the interference of light.

**Bipolar cells of the retina.** This is another name for the inner nuclear layer of the retina. It varies in thickness in different parts of the retinal structures. In the neighborhood of the optic disk it measures about .035 mm. thick, while near the ora serrata it is only about .018 mm. See *Histology of the eye*.

**Bi-prism.** A glass prism with two faces of equal size subtending a very obtuse angle, nearly 180°, opposite to the third face at which the light is also refracted. It virtually represents two acute-angled prisms placed base to base, and was invented by Fresnel to produce interference fringes (q. v.). Also called Fresnel's bi-prism.

**Bi-prism fringes.** Interference fringes produced by Fresnel's bi-prism. See *Interference*; also *Bi-prism*.

**Bipupillate.** Marked with spots that exhibit two pupil-like dots.

**Biquartz.** A plane disc composed of two semicircular plates of quartz, one dextro-rotatory and the other laevo-rotatory.

**Birch-Hirschfeld, Felix Victor.** Born May 2, 1842, he studied medicine at Leipsic (where the teachers by whom he benefited most were Wunderlich and Wagner) and, from that institution, was graduated in 1867. For the next years he was assistant at the Leipsic Patho-
logico-Anatomical Institute. In 1870 he became Prosector at the City Hospital in Dresden, and, the following year, teacher of pathologic anatomy at the Military-Medical School for Graduates. Four years later, he became medical advisor to the Saxon Medicinal-Collegium, and, five years after that, physician-in-ordinary to the Dresden City Hospital. Among his most important articles are: "The Origin of Jaundice in the New-Born" (Virchow's Archiv, Vol. LXXXVII); "Seroftula" (in v. Ziemssen's Handbuch der Spec. Path., Vol. XIII, 2d ed.); "Diseases of the Liver and Spleen" (in Gerhardt's Handbuch der Kinderkrankheiten, Vol. IV, 2). He is known especially, however, for his great "Text-Book of Pathologic Anatomy" (Leipsic 1876; 2d ed., 1882 and '83). In many of Birch-Hirschfeld's writings are passages on the pathology of the eye; and, one year, the Graefe prize, founded by Prof. von Welz was awarded to him for his work pertaining to the action of the ultra-violet and the X-rays upon the eye.

He died Nov. 20, 1899, at the age of 57.—(T. H. S.)

**Birch-Hirschfeld's color tests.** Birch-Hirschfeld devised a cabinet into which light is admitted through two slits, which can be covered, one by green glass, the other by red, or red and blue. Ground glass is placed at the bottom of the cabinet, and a rod in such position that half the glass will be screened from one slit, the other half from the other, so that the ground glass appears half red and half green. The widths of the slits can be varied, thus varying the illumination of the ground glass. An opening on one side permits the patient, and on the other side the surgeon, to look at the ground glass. The color-blind fail to properly recognize the colors seen.—(C. P. S.)

**Birch oil.** *Betula*, Oil of. A reddish-colored, volatile oil obtained from several members of betula by decomposition of their most important constituent, the glucoside gaultherin. It closely resembles oil of wintergreen, and like it, is almost a pure methyl salicylate. As a substitute for tar ointments the oil of birch has been prescribed. It is applied with a brush or glass spatula to the skin surface of the lid as a counter-irritant in chronic blepharo-conjunctivitis. It is extremely irritant to the eye and should not be allowed to touch the globe or enter the sac.

**Birds, Eyes of.** Although this subject will be treated more at length in the section on *Comparative ophthalmology*, it will be not improper to say here that avian vision is not only the highest expression of eyesight both as to acuity and variety, but it repeats the oft-told tale of the correlation of sight in the animal to its life history, as witnessed chiefly in the pursuit of food and escape from death or injury. The
eyeball of the bird is unusually large in comparison with that of other animals and in proportion to the size of the avian body. Of course, size alone is not the only consideration in determining effectiveness of function in an organ, but when one pursues the subject still further it will be seen that the cerebral and spinal parts of the ocular system are proportionately better developed and larger than in the great majority of other vertebrates. Almost all birds whose habits require the widest range of vision—eagles, hawks and vultures, for example—are noticeable for very prominent eyeballs, laterally placed. In the owl, whose eyes are adapted to searching only space in front of the globes and orbits, they are disposed as in man and the higher apes. Like them, the owl has the power and possesses the apparatus common to all animals that enjoy the privileges of binocular vision.

The eyelids of birds. There is something very human about the true lids of most birds. They have, as a rule, the same dermal folds, apparently the same cilia, and much the same minute structures as man possesses—all employed in the same way for the same purpose. On examination of the eyelashes, as in the ostrich, for instance, it will easily be demonstrated by a lens that instead of hairs the cilia in birds are minute feathers.

The nictitating membrane. The third eyelid, found in reptiles, some mammals, and commonly seen as a vestigial remains in man (pleca semilunaris) and the higher apes, finds its highest development in birds. It seems to act not only as a scraper of the cornea for cleansing purposes—like the true lid margins—but probably enables some birds, like the eagle, for example, to see through it, with a degree of distinctness, even in the blinding sunshine. When in the pursuit of food or when engaged in fighting, the bird may at short notice draw the curtain of his nictitating membrane and thus prevent serious damage to his cornea. When the eye is at rest and the true lids are separated, the avian nictitating membrane shows only at the inner canthus. Law well describes this third lid as an "elastic fibrocartilage prolonged at its inner end as a thick prismatic stem and expanded anteriorly into a broad, thin expansion with a perfectly smooth, even border, fitting accurately on the rounded surface of the eyeball and covered by the mucosa. Its thick, deep extremity is continuous, with an abundant cushion of adipose tissue which fills the depth of the orbit and extends between the muscles."

In those mammals—the hoofed animals, for example—which are constantly grazing among thistles, nettles and other spiky plants, the cornea needs some protection other than lids, and this is probably found in the membrana nictitans. On the other hand, in the
marine mammals—whale, seal, etc.—in which a third eyelid can serve no useful purpose, it is wanting. This shutter-like membrane is drawn over the cornea chiefly by the musculus pyramidalis, attached to it in much the same way as the true lids are moved by their muscles.

The gland of Harder. That the cornea of birds may be constantly disinfected and its surface cleaned of foreign bodies of all kinds, the gland of Harder, a supplementary lachrymal gland, furnishes a copious supply of tears, which are forced out and sprayed over the eyeball as the third eyelid sweeps over the anterior surface of the globe. This gland is placed beneath the membrana nictitans and functionates simultaneously with it.

The lachrymal apparatus of birds differs materially from the same organs in man. The canaliculi, generally large and patulous, open almost directly into the nasal passages, so that fluids entering the conjunctival sac flow at once into the nose and throat.

The cornea and sclera. Practically every bird has a cornea much more conical than that of the human species. This largely accounts for the brightness of avian eyes, and is one of the factors in their wonderful power and range of accommodation.

The cone-like shape of the cornea is continued into the sclerotic, which is entirely unlike the same structure in most of the other vertebrates. The anterior segment of the bird's sclera is furnished with overlapping bony plates surrounded by connective tissue. These greatly strengthen the ocular walls, so that the marked pressure exerted upon them during accommodative efforts do not permanently affect the shape of the eyeball. The posterior half of the bird's eyeball is further strengthened by a cup of hyaline cartilage that extends to the bony plates in front.

The iris of birds. Even the most superficial observer can not walk through an aviary without remarking the brilliancy and extraordinary variety of coloration in the irides of birds. Zoologists* have even built up a classification based upon variations in the color of the eyes in the genera of aves. The sphincter pupillae in birds is unusually well developed, as are also the radial fibers.

The bird's pupil. This should receive some comment, since it, as in man, is closely related to the focussing apparatus, and forms an important part of the peculiar uveal tract of birds. The motility of the iris and pupil is most remarkable. In the majority of birds the pupils are round, but in some nocturnal birds, like the owl, these,

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round at one moment, may be contracted to a vertical slit, probably when the animal accommodates for a near object.

As the bird’s iris contains striated muscle-fibres and is not altogether under the influence of the sympathetic system of nerves, the pupil is probably under the control of the bird’s will. This may account for the constant contraction and expansion of the pupil of such birds as the parrot and owl, whose pupils appear to dilate and contract without reference to either distance or near fixation.

The anterior chamber in birds is generally deep and the quantity of aqueous humor correspondingly large. The wide space between cornea and lens permits of greater antero-posterior movements of the crystalline in realizing the wide accommodative range needed by the bird in its frequent and extensive change of focus. Incidentally, also, it contributes to the peculiar brilliancy of the avian eye.

The ligamentum pectinatum is an elaborate and extensive organ in the eyes of birds. According to Collins, (The Lancet, Feb. 24, 1900), it arises at the limbus corneae a little in front of the root of the iris and extends backward between the striated muscle of Crampton and that part of the ciliary body attached to the ciliary processes. The canal of Schlemm is proportionally large, and in sections of the bird’s eye is easily seen standing wide open. The presence of so capacious a lymph channel undoubtedly corroborates the view that the interior of the bird’s eye is the scene of great nutritional activity, requiring a drainage canal capable of carrying off waste products in considerable amounts from organs constantly functionating.

The ciliary body, although well developed, is not, like that organ in man and most other animals, the only source of the intra-ocular fluids and the nutritive supply to the lens. As we shall later see, that peculiar organ, the pecten (the analogue of the falciform process of reptiles and some mammals) largely supplements the supply of nutritive fluid required by the intra-ocular tissues.

The chief muscle of accommodation in birds is that known as Crampton’s. While variations in the shape of the globular lens of birds, under the influence of the ciliary fibers, undoubtedly result in increase of curvature and of refractive effect, yet the principal change in the direction of the light rays is produced by transforming a more or less round or ovoid globe into a tubular structure fitted with a conical lens. This alteration is brought about by the contraction of the circular muscle of Crampton—an intraocular band that encircles the bird’s eye about the equator. The unyielding walls of the globe direct the pressure forward, the ciliary muscle relaxes, and the internal pressure pushes the crystalline into the anterior chamber. This movement
is now assisted by the pectinate body, which fills with blood and occupies the space vacated by the lens; the cornea becomes more convex and the bird exerts his best efforts to fix a minute near object. Does he desire to see distinctly in the far distance, the converse is true; Crampton's muscle relaxes, the eyeball becomes more globular, the tense corneal cone becomes less prominent, the lens recedes and is less globular, the anterior chamber deepens, the pecten is flaccid, and the antero-posterior diameter sensibly diminishes. Thus the important

Cross Section of the Brain, Orbits and Eyeballs of the Kinglet (Regulus satrapa), showing the various ocular structures and their relations, especially the deep right fovea, the pectens, etc.

function of accommodation in birds is a much more complex and extensive performance than in man. In this way the bird is able, as no other animal can, to convert his organ of vision, as Beebe remarks, "from a microscope to a telescope" in a fraction of a second—to see small objects a quarter of a mile away and to pick from the ground seeds so small that one would need a lens to distinguish them from surrounding grains of dust.

The crystalline lens in most birds has, as just remarked, a globular form. It is comparatively larger than the human crystalline, and in the nocturnal birds of prey has such a markedly convex anterior surface as to be almost round. In birds requiring chiefly good distant vision the round lens is a compound structure built up of concentric
layers surrounded by a ring of radial fibre widest at the equator. This disposition of the lens fibers assists in producing the lenticular changes required by the active accommodation called for in birds. The globular lens, again, corresponds to the prominent cornea and deep anterior chamber. In water fowl the lens is flatter in front, i.e., more plano-convex in shape, and the cornea is not so conical.

In passing, it may be remarked that the postmortem appearances of the eyeball, especially of the cornea, are somewhat misleading, as there is always more or less rounding of the globe through sinking and retraction of the cornea shortly after the death of the animal. For this reason, also, microscopic sections of the globe generally fail to show the tubular-oval shape that the external eye generally maintains during life.

The pecten. This is the most peculiar organ in the whole ocular apparatus of birds. From the optic disc of every bird,* of their first cousins the reptiles, and of some other animals, there projects into the vitreous to the posterior aspect of the lens (or nearly so) a remarkable, pigmented, corrugated or plicated, solid or fenestrated, erectile body long known as the pecten, marsupium or "ruff." It is composed

*The statement that the Kiwi, or Apteryx, is without a pecten (vide, e.g., Bernd, Die Entwicklung des Pectens, Inaug. Diss. Bonn, 1905, p. 8) is disproved by Lindsay Johnson. The same error is repeated in most text-books, as in Claus's Lehrbuch der Zoologie, 5th edition, 1891, p. 845.
of large vascular trunks, about which are arranged smaller vessels with cellular walls—all bound together loosely by connective tissue and covered with a smooth, thin, homogeneous, pigmented membrane. Treacher Collins regards the pectinate body as a prolongation of the chorioid (which it resembles structurally), containing, however, a finer capillary plexus. Most authors, including Gegenbaur and Bernd, believe that it takes the place of the retinal vessels (which, in the avain fundus, are wanting), and arises from the optic tissues, having no direct connection with the chorioid. By this arrangement the perci-

pient part of the bird's retina is rendered more sensitive to light rays, because the branches of the central artery and vein do not ramify, as in the mammals, in the substance of the retina, and so do not, to any extent, present an opaque obstruction to vision.

The pecten varies in shape and size, as well as in the number (2 to 30) and the character of the folds of tissue that compose it, accord-
ing to the genus to which the bird belongs. Indeed, such a striking and varied picture does the pecten exhibit, both when seen with the ophthalmoscope during life and as prepared macroscopical and microscopical specimens after death, that one might almost recognize the species by studying this organ and its relations to other parts of the bird's fundus.

While there seems no doubt that the pecten carries the nutrient vessels of the retina, and probably of other intra-ocular structures, its erectile character and its capacity for being alternately filled with and emptied of considerable blood at short notice raises the presump-
tion that it takes an essential part in the function of accommodation, probably, as before stated, by pushing forward the lens by a sort of hydraulic pressure when it is filled with blood, and allowing it to recede when flaccid and empty. So far as I have noticed with the ophthalmoscope, although the free end of the pecten points toward the posterior surface of the lens, it is invariably found in the nasal half of the vitreous, and thus does not interfere with the passage of the light rays to the fovea or other visual area.

Slonaker (A Comparative Study of the Area of Acute Vision in Vertebrates, Journal of Morphology, xiii, No. 3, p. 477.), whose macro-
scopical observations of the interior of hardened birds' eyes have so far corresponded closely to the ophthalmoscopic view of the living fundi of birds' eyes we have both examined, has noticed that a line joining the visual area in birds with a single fovea and the optic papilla forms about a right-angle with the pecten.

That the hyaloid artery of fetal life is a vestigial pecten seems almost self-evident. No one who has examined a persistent hyaloid
artery and its branches, particularly if he has been fortunate enough to see the vessels carrying blood to and from their termination in the vitreous, can fail to be reminded of the structures that occur normally in some mammalian, most reptilian, and all avian eyes. This arrangement surely carries us back in fetal evolution to those sauropsidian ancestors who have left their mark in our embryology. It is not improper for me to mention here the admirable anatomical description by Treacher Collins (The Anatomy and Pathology of the Eye, The Lancet, Feb. 24, 1900) of a case of persistent hyaloid artery carrying blood and anastomosing with the iris—the ciliary processes being absent.

Mittendorf has reported that about 1 per cent. of all patients coming to him for ocular affections exhibit minute dotted opacities on the nasal aspect of the posterior lens capsule. These dots are without the visual axis; they do not increase in size and do not interfere with vision. He regards them as remains of the fetal hyaloid artery or its connections on the posterior aspect of the crystalline.

The retina and optic nerve of birds are both highly developed and closely resemble the same organs in the primates. The vascular supply to the retina is probably carried entirely by the pecten, although no direct connection with that membrane has been established.

The macular region or visual area is plainly differentiated from
the rest of the retina, and macroscopic sections generally show at least one well-defined, deep fovea. Writers* on this subject generally refer to the double macula of certain birds. Of 102 species examined microscopically by Slonaker a distinct visual area was present in all; no fovea was discovered in one; a single, round area or macular region was found in 59; two round areas (macular regions) in 11; while an additional band-like visual area was differentiated in 36. Seventy-two birds had a single, simple fovea, 11 had simple foveæ, and 22 had a trough-like fovea. The single fovea, almost invariably situated toward the nasal side of the animal, can generally be distinguished by means of the ophthalmoscope during life, but in birds with a double macula the second fovea, temporarily placed, will, I believe, be more difficult to locate. Slonaker found in most of the birds examined macroscopically after death a single fovea surrounded by a circular area—just as one sees them in man and the higher apes. In the goose and ring-neck plover he discovered a simple fovea in the center of a round macula, the latter area extending horizontally across the retina.

Two macular regions may be present, each with its fovea, joined by a short, band-like area, as in the sparrow-hawk, red-tailed buzzard, and kingfisher. He found the most complex arrangement of the visual areas in the tern. Here the fovea temporalis is surrounded by a small, isolated, circular macular region and is not connected with the narrow, band-like area. The latter, however, stretches across the fundus and near its middle widens out to enclose the fovea nasalis in a larger circle than that enclosing the temporal fovea.

So far, then, as concerns the shape and position of the areas of distinct vision in birds, a species may have one or two foveæ and from one to three visual areas.

The foveæ vary in depth and position. In the owls, which possess binocular vision, and in birds which require keen vision, the fovea is deep and clearly cut. According to Slonaker, in those birds that possess two foveæ, the fovea nasalis varies but little in position, while the locality of the temporal yellow spot depends largely upon the degree of divergence of the antero-posterior axes—the more divergence the greater the separation of the two foveæ. The more the eyes look forward the more dependence is placed upon a single, deep, sharply-defined nasal, macular region and the shallower, less distinct and more merged in it become the temporal fovea and visual area. In hawks and

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*Gegenbaur: Vergleichende Anatomie, Bd. i (1898), p. 937, remarks that many birds possess two foveæ, one in the nasal, the other in the temporal aspect of the retina.
other birds of prey—including insectivorous birds—which require binocular vision in each eye—the two foveae are more widely separated and the temporal macular region again becomes better defined and resembles the nasal area.

Vertical Section of the American Screech Owl (Strix or Megascops asio), showing very plainly the accommodative apparatus, scleral plates, Crampton's muscle, etc., as well as the peculiarly-shaped eyeball of the owl family. Only a small portion of the pecten is depicted.

A double macula, in one eye, furnishing stereoscopic vision and all the advantages of binocular sight, would help to explain the wonderful range and accuracy of the monocular eyesight of birds, especially in the eagles, hawks and vultures.

Color perception in birds. The color sense is supposed to be chiefly resident in the retinal cones; and this theory, Slonaker finds, is borne out in examining birds' retinæ. In the nocturnal birds he discovered few cones, while the proportion of rods to cones in mammals he found reversed in day birds, where the cones far surpass the rods in number. We may assume, as one might expect, that the appreciation of color is excellent in all avian species.

The extrinsic eye muscles in birds resemble those of the human eye,
and, although the internal and external recti vary somewhat in their attachment to the globe, the purposes of these muscles are evidently the same in the avian as in the human eye. The pyramidal muscle that controls the nictitating membrane has not, so far as I know, an analogue in man.

The refraction of bird's eyes is generally hypermetropic. I have examined quite a number of them by skiascopy and find, just as Lindsay Johnson discovered in mammals, that wild birds are invariably far-sighted, while domesticated species tend to become short-sighted, astigmatic, or both, and to present evidences of intraocular disease. This was especially true of the large collection of owls in the London Zoological Gardens that I examined in the summer of 1905 with the ophthalmoscope and skiascope. Those owls, it matters not what variety, that had lived in the gardens more than two years were generally less hyperopic than those recently introduced, while in the case of the former it was difficult to find one that had not a more or less marked form of chorioiditis of the disseminate variety.

Color sense and visual adaptation in birds. In an attempt to settle the question whether dark adaption is a function confined to the retinal rods and whether cones are able to adapt themselves for darkness or not, Hess (Woch. f. Ther. und Hyg. des Auges, Oct. 3, 1907) has made several interesting experiments on some domestic birds. He found that hens feed only when they can see their food. If allowed to feed with wheat grains scattered over a black ground so illuminated that the shadow of a thin lath falls on the middle of the lighted areas, the hen picks up the grains on both sides of the shadow, but does not touch the grains on the shadow. Experiments were made with one hen in a room, the illumination coming from one source and that controlled by an Aubert's diaphragm. The hen began at once to pick up the grain from the darkened ground and continued to do so until the illumination was reduced to a point where the human eye could no longer see the grains distinctly. If the hen and her observer remained in a completely dark room for an hour and the light was gradually admitted it was found that the hen began to pick when the illumination was far less than in the former experiment.

The observer also finds that he is able to see the grains distinctly at the same point at which the hen begins to pick. The same experiments conducted with pigeons give almost the same limits as for hens. These experiments prove that day birds, in whose retina rods are almost completely absent, show a very marked adaptation, the degree of which seems to be not very different from that of the human eye. This indicated that adaptation must exist independently of the ret-
inal rods. Owing to the presence of red and yellow "fat-balls" in hens' and pigeons' retina, it has been impossible to tell if the percipient layer contained visual purple. The author succeeded in removing the fatty globules with benzol so quickly that he was able to demonstrate that the hen's retina was nearly devoid of visual purple.

In order to determine the color vision of hens, Hess, by means of a mirror and an electric lamp of high power projected on the floor an objective spectrum. This was spread over a darkened ground on which wheat grains were distributed. The hens generally began to pick the red grains first and then the yellow and green grains, but the blue and violet grains they did not touch. The experiment shows that the hen sees the spectrum at the red end as far as we do, but at the other end it is much shortened. In order to imitate the action of the red and yellow fat balls on the cones of the hen's retina, he placed before one of his own eyes a red glass and a yellow glass before the other; he found that he could only see the red end of the spectrum, as does the hen. He explains this vision in the hen by the red and yellow fat balls acting as a screen between the two ends of the rods and believes that it proves that the outer segments of the cones are the percipitive ends, because if the reverse were true the hen would see as we do.

Ophthalmoscopic appearances of birds' fundi. The musculature of the iris differs so materially from that of man and the other mammals that it is extremely difficult to dilate their pupils for an intraocular examination during life. The interrupted galvanic current, eserine and nicotine enjoy a reputation for bringing about dilated pupils in birds. In my experience the former agent is effective, although not always convenient, but the two drugs usually bring about mydriasis at the expense of the bird's life. The pupil dilates quite wide when the bird is in articulo; in other words, when almost dead from the absorption of these powerful alkaloids. When a strong or toxic solution of either homatropine, eserine, cocaine or nicotine is dropped into the bird's eye it immediately flows into the bird's throat through the wide-open lachrymal passages and becomes absorbed in exactly the same fashion as if it were injected into the bird's mouth. Especially in the case of small birds, poisonous symptoms soon develop, the pupils dilate and credit may, perhaps, be given to the toxic agent—especially if the bird survives. For some time I had been using for purposes of examination a mixture of atropine, homatropin and cocaine. I now believe that such dilatation of the pupil as I secured by the use of this mixture resulted from the poisonous (sometimes lethal) action of that mixture.
The ignorance that has hitherto prevailed with respect to the ophthalmoscopic appearances of the ocular fundi of birds has led to all sorts of curious mis-statements, even by those who ought to be better informed. The fact is that the postmortem—especially the microscopic—appearances of the ocular interior are, especially in birds, not the same as those seen during life. This is especially true of the vascular pecten, projected forward in the posterior chamber, and seen during life as a moving, ever-changing, black body. We see with the mirror the living nerve-head, of all possible shapes and sizes, nearly always white or whitish, and generally covered with pecten, although sufficiently free of it to recognize its outlines and sometimes most of its surface. The coloration of the fundus in birds does not present that marked variety that one observes in the other sub-kingdoms, especially among the mammals and reptiles. It is, however, never "black," as alleged by some authors, but is generally gray, with a suspicion of red—the red color being more plainly seen and variably distributed according to the family to which the bird belongs. Within bounds more limited than in the mammalian fundi opaque nerve fibres are generally seen, and the foveæ can usually be distinguished. The macular region of the owls (following the rule that animals with binocular vision have this area ophthalmoscopically well marked) can be readily seen with the mirror, and it is generally observed as a well-defined reddish spot. During the course of a fundus examination continual variations in the size, position and shape of the pecten will at first confuse the comparative ophthalmologist, but after a while he will make his exploration of the background and ignore these changes, just as he does some of the annoying corneal reflexes in man.

The examination by the erect image will, on the whole, be found the most satisfactory method, although, as in viewing the human fundus, it is advisable to use the indirect plan at the outset. The self-luminous ophthalmoscope is quite satisfactory for this purpose.

In making an examination of the avian fundus it must be remembered that it is the wild species of birds that present invariable ophthalmoscopic pictures. It will be found that, after two or three generations of inbreeding, confinement and domestication, changes occur in the ocular apparatus coincident with variations in other parts of the organism.

The following description of a few bird fundi (see the colored plates) will show the variations in avian backgrounds, and is published as a note preliminary to further investigation of the subject.

The ocular fundus of the Kiwi or Apteryx mantelli. This is the
only background of the sub-class Ralitae, or birds with functionless wings, that I have to exhibit. It is one of the oddest of the Australian birds—something like a thin little cassowary with thick legs, no visible wings, and a long bill like a snipe. The nostrils are placed at the very tip of this slender beak, which the bird deeply plunges into the soft ground, smelling about for worms, which, when discovered, are drawn out and eaten. Kiwis are nocturnal in their habits and for that reason are rarely seen by visitors to our zoological parks and gardens. If aroused from their straw during the daytime they open their mouths several times in long-drawn and very human yawns and then fall asleep again.

The fundus of the Apteryx, in comparison with that of most carinate birds, suggests its nocturnal life. Indeed, all animals that prowl, run about or feed at night time have brilliant yellow, orange or yellow red fundi.

Macroscopical, Postmortem Diagram of the Left Eye and Orbit of the Tern (Sterna hirundo). N, optic nerve entrance; P, pecten; Ft, fovea; Fn, fovea, Fn, fovea; Ab, band-like area. (Slonaker.)

The almost uniform red, mottled background of Apteryx shows no blood vessels in his retina whatever. The choroidal pigment is less plainly seen in a concentric area surrounding the remarkable optic nerve entrance. Here the brilliant, white, round disk surrounded by short, opaque nerve-fibre rays is not entirely covered by the fenestrated base of the long, large and regularly conical pecten which reaches almost to the lens. If one were allowed to stretch his imagination, the combined picture of pecten and nerve-head might be said to resemble a black rubber teat from a nursing bottle, partly stretched over a white sea-urchin. How the Kiwi’s pecten could have remained undiscovered for so many years is difficult to explain, except that it emphasizes the difficulties in the way of a satisfactory exploration of birds’ fundi in general and the difference between the erect, vascular, functionating pecten of the live bird and the blanched specimen
that may easily escape recognition after death. To Mr. Head and
Dr. Lindsay Johnson are due the discovery—as yet unheeded by text-
books—that every bird, the Kiwi included, has a well-developed peecten.

The ocular fundus of the common Blackbird—Merula vulgaris. 
Everyone is acquainted with this member of the large order of Passeres
—his yellow bill, his yellow-edged eyelids, and his jet-black body. I
have chosen him as a fair example of a quick-sighted, insectivorous
bird, with monocular vision and daylight habits. These are all reflected
in his beautiful uniform, bluish-gray fundus, his canoe-shaped, whit-
ish optic nerve entrance, and his black-brown, club-shaped peecten. A
lateral view of his pectinate body shows that it arises by a rather
slender pedicle that covers less than one-half the optic papilla. The
body then spreads out and, projecting toward and almost reaching
the posterior surface of the crystalline lens, gradually enlarges until
it presents to the ophthalmoscope a dumb-bell or “nine-pin” appear-
ance. One will also observe the regularly placed opaque nerve fibers
covering the whole fundus, as well as the streaks of reddish chori-
oidal vessels showing through the gray-white background. There is
no macular region differentiated from the general fundus coloration,
although, in common with other birds, Merula vulgaris has a micro-
scopicallly deep and well-defined fovea.

The ocular fundus of the Tawny Owl—Syrnium aluco. The eye-
sight of the whole owl family should be of consuming interest to the
ophthalmologist because of the almost human arrangement of his
ocular apparatus. First of all, the owl has his eyes placed in front
of his skull, looking straight forward, just like man and the other
Simic. Like the higher apes, also, he has a well-defined macular
region and binocular vision. At the outset let me say that the popular
notion regarding the owl’s daylight vision is incorrect. That he does
see better at night than other birds is quite true, as the coloration
of his fundus amply proves, but that he is blind by day is far from
the truth. From observations made by myself in the London Zoo,
from the experience of the keepers and other observers, I think we
may conclude that almost all the owls have good vision both by day
and night. Bendire (Life Histories of North American Birds, 1892,
p. 336), for instance, remarks: “The Barred Owl is nocturnal in its
habits, but nevertheless sees well enough, and even occasionally hunts
in the daytime, especially during cloudy weather. I believe that owls
in general prefer to remain hidden during the daytime on account
of attracting the attention of nearly every feathered inhabitant of
the vicinity, who instantly attack and annoy them in every possible
manner the moment they leave their retreats.” Although owls live
almost exclusively on grasshoppers, mice, frogs, etc., yet few of them are able now and then to resist the attractions of a nice downy chicken or other bird—habits that justify the warfare carried on against them whenever or wherever they are found by other birds. As the owl has practically no nocturnal bird enemies he does not need to see behind him. His ocular apparatus is accordingly arranged to intercept with the highest degree of efficiency all the light rays, however faint, that fall upon his retina from the front. He is thus able to sit at night entirely motionless and watch for his prey without exposing himself to view.

The background of the tawny owl's eye at first glance reminds one of the light-haired Caucasian. It is yellowish-red with the chorioidal vessels conspicuous. The macular region is a round, red disk surrounded by a bright reflex ring of silver-gray. The latter is often so marked that it resembles an exaggerated "bull's-eye-lantern" macula—occasionally seen in human eyes—and the reflex may be so dazzling as to interfere with a clear view of the region itself. Surrounding the red macula is a very large, concentric area (which reaches to the nerve-head) that looks like a gray haze. There are few traces of chorioidal vessels here; probably we look at only the translucent retina against the underlying chorioidal pigment. The optic disk is a long, whitish, ovoid figure surrounded by the reddish chorioidal vessels. Springing from the whole length of the papilla and almost covering it is the pecten. Seen with the ophthalmoscope this organ presents a highly unique appearance—a smooth, black, corrugated, grub-like body slightly pointed at the papillary end.
Viewed laterally the owl's pecten closely resembles the dorsal view of a partially clenched hand.

Below both papilla and macula is a rather large area, abundantly supplied with large chorioidal vessels, between which are masses of pigment. The nerve-head occupies the center of a smaller, much lighter, yellow field. On the whole, this nocturnal bird of prey shows a background such as we would expect from what we know of the fundi in mammals of similar habits. The reflection of this owl is about 3 diopters of simple hypermetropia.

The cape eagle owl (Bubo capensis), has, in half-lights, large round pupils. He shows, with the ophthalmoscope, the same reddish background, the oval optic nerve and the pepper and salt area about the disk-like macular region seen in the tawny owl. In one specimen that had lived in the London Zoological Gardens three years, the refraction (as determined by the skiascope) was only + 2 D., and I found several well-defined, pigmented, chorioiditic exudates in each eye. In the chorioid, around at least three of these spots, there was distinct evidence of absorption of the epithelium.

The fundus of the British barn owl (Stix flammea) is more grayish-red than that of the foregoing. In ordinary daylight and even after flashing the light from the ophthalmoscopic mirror into his eyes the pupils continue to be round. In a specimen recently presented to the London Zoo I could find no trace of chorioidal disease, and the refraction without a cycloplegic was highly hypermetropic.

The so-called winking owl of Queensland shows an ovoid papilla almost entirely obscured by a pecten, from whose apparently perforated base a corkscrew-like body extends almost, if not quite, to the crystalline lens.

The eyegrounds of the gulls are well worth examining. These birds have excellent monolateral vision, which I have spent some time in studying. Although web-footed, the hind toe is free, like the other longipennes, and their pointed wings are well fitted for rapid flight. The visual aim of the average gull is as accurate at close range as that of any of the raptors. A gull will swoop down from a considerable distance and catch unerringly, by means of his long, compressed beak, a very small piece of meat or bread thrown into the air long before it reaches the ground or surface of the water —thus simulating in a small way the exploits of the true birds of prey. I have examined, among others, the fundi of several specimens of the British herring gull, the yellow-legged Mediterranean gull, and the greater black-headed gull.
The herring gull has a perfectly round, easily contractile pupil; the iris is of a beautiful lemon or yellow-white color. This was one of the birds in which I felt certain that no such reflex as the "consensual" contraction of the pupil could be demonstrated. The gulls generally give some trouble with their nictitating membranes while using the ophthalmoscope upon them. In the examination of most other birds the third eyelid offered no obstruction to a fundus view.

The ocular backgrounds of all the gulls examined by me showed very little variation.

The mocking bird. *Mimus polyglottus.* Erect image. This eye ground is blue-gray in colour, covered all over with irregularly-shaped whitish-gray dots and granulations. These dots give the fundus a bright gray appearance to the upper half of the eye ground. Near the upper end of the optic nerve and towards the nasal side is the macula. This part is rather darker blue in colour, the center being studded with a bright white dot and surrounded with a green reflex which is striated in appearance (the lines converging towards the *fovea centralis* and very translucent.

The optic disc is long and narrow, made up of brilliant white opaque nerve fibers and can be traced on either side the whole length of the pecten. Extending from the edge of the disc and all around the visible portion are a large number of very long opaque nerve fibers which can be traced to the periphery of the visible fundus.

The pecten is of the usual chocolate-brown colour and extends well below the edge of the pupil. It is rather like that of the cuckoo, but much larger and not so club-shaped. Looked at side-ways it is not unlike the tails of several reptiles.

The fundus of the Cuban mocking bird is similar in every respect.  

The nubian ostrich. (*Struthio camelus.*) (Africa.) The general colour of the eye ground is dull red, spotted all over with lighter red, round dots intermixed with gray granules. The lower half appears rather grayer in tone. This I find is due to the dull gray opaque nerve fibers which extend from either side, a short distance across the fundus from the margin of the optic nerve. The red colour of the fundus gets more intense towards the upper half of the eye ground. The optic nerve is very broad and oval in shape, similar to the Rhea and the Tinamous. The margin is white and can be seen all around the pecten. The center of the disc and (the area) near the root of the pecten is stippled with minute brown pigment dots like black pepper grains. The pecten arises from the optic nerve very similar-
Fundus of the Mocking Bird (Mimus polyglottus). Drawn by A. W. Head.

Pecten of the Mocking Bird (Mimus polyglottus).
Fundus of the Nubian Ostrich (Struthio camelus). Drawn by A. W. Head.

Pecten of the Nubian Ostrich (Struthio camelus).
to the (marsupuim of the) Tinamous and looks like a mass of warts or tuberules of a dull, dark-brown sepia color. It does not appear to extend up to the lens and can be distinguished both above and below the disc, its edge all around being formed of round or oval-shaped projections which fringe its margin. These nodules also compose the body of the pecten. The macula is similarly situated to the Rhea. It is not very striking in appearance and is in the form of a crescent made up of very minute gray dots situated towards the nasal side of the disc and near the upper end. I could not distinguish any reflex around the fovea. With the exception of the crescent-shaped mass of gray or silvery dots, the difference between the pecten of the Rhea and the ostrich is very slight (and undoubtedly points to these being of the same common origin and very closely allied).

The cassowaries are of quite another type. (In part I should not be surprised if it was discovered by the eyes that the birds are in two distinct and large classes, one class being much earlier in origin than the other. I believe the Kiwis and Cassowaries belong to one class, the Ostriches, Rheas and Tinamous, to the other, and that all the other birds could be classed accordingly. The seed-eating, or hard-billed, birds in one group, and the insect and soft-billed birds, the other.)

The greater black-backed gull (Laurus marinus) has a background that, seen with the indirect image, appears dull-gray. A direct view shows it to be generally dull-brown, with reddish chorioidal vessels running in a vertical direction. The disc is a long, white, narrow oval, with a number of fine gray lines (opaque nerve fibers) radiating from its margin and extending toward the macula. The foveal region is an oval, reddish-brown area, surrounded by a gray-blue, iridescent reflex. The pecten seems to be in folds (about eight), the lower or broader portion extending toward the nasal half of the eyeball.

The black hornbill (Sphagolobus atratus).—This curious member of the Coccygomorphæ has remarkably good sight for such a stupid-looking, top-heavy bird. In experimenting with his visual powers I found that he caught, with his enormous beak, grapes thrown into the air as quickly and as easily as a seal catches fish. Like the other hornbills, his lids are furnished with long, well-developed lashes. The specimen I examined had been in the London Zoo for years and did not present any disease of the fundus, although his refraction, determined at night by skiascopy, was about emmetropic. The background is of a drab or dull-gray color, and the retinal reflex is so marked that it is difficult to recognize the minute fundus details. The papilla
is, as usual, on the nasal side of the eyeground, in the shape of a long, white oval about which opaque nerve fibers extend almost to the periphery. Toward the equator are seen faint red chorioidal vessels. The pecten is quite large and its antero-posterior view shows a saw-like contour (with about 20 plications or teeth on each edge), except at its distal extremity, which is more club-shaped. The pectinate body in this bird can readily be seen to expand and contract, apparently with the movements of the pupil. The foveal region is a dark red-brown, disk-shaped area with a dark-red spot in its center. The retinal reflexes are very noticeable, and give the impression of an iridescent, bluish-green sheen, so much so that it reminds one of a dull mirror reflecting colored light thrown upon it.

In a future paper I hope to furnish a description of a still larger series of avian fundi.

From the foregoing I believe we are justified in drawing the following conclusions:

The highest expression of vision, including the most varied and widest range of accommodation, is found in bird life.

The owls possess binocular sight, and their eyes in many respects resemble those of man.

Probably every bird—carinate and acarinate—possess a pecten. This is quite true of the Apteryx (long thought to be without one) as it is of our common wild birds. The size, shape and relations of the pectinate body to the other ocular structures are so varied, and their appearances, as determined by the ophthalmoscope during life are so constant in each wild species, that the background picture of a particular wild bird furnishes certain data for a classification of quite as much value as the variations in any other organ.

The refraction of most wild birds is simple hypermetropia; of domestic species, hypermetropia, or myopia, with astigmatism.

The postmortem appearances of birds’ eyes are decidedly misleading, especially as to the shape and size of the eyeball and the relations of the parts in the interior of the globe.

The range and rapidity of accommodation far exceed that of man or other animals, and the accommodative and refractive apparatus is much more complex than in other sub-kingdoms.

The areas of distinct vision in birds are peculiar to them. In a single fundus may be present one or two foveæ, or one, two or three visual areas, thus enabling the bird to obtain the sort of vision most suited to its needs.

The color sense in birds is acute, as shown by the great preponderance of cones in the retinal elements, and by the experiments of Hess.
BIREFRACTING

A number of congenital anomalies in man are but evolutionary remains of birds' organs. For example, the posterior lenticulocapsular opacities, described by Mittendorf, and the human persistent hyaloid artery are undoubtedly unabsorbed pectinate tissues.

An extended study of the ocular fundi of birds may not only throw light upon the classification of doubtful species and so prove useful to the zoologist, but may possibly illuminate some of the problems of human ophthalmology. See, also, Comparative ophthalmology.

**Birefracting.** Same as birefringent (q. v.).

**Birefractive.** Doubly refractive.

**Birefringent.** Doubly refractive; possessing the property of separating a ray of light into two rays by double refraction (q. v.).

**Birotatory.** Rotating the plane of polarisation of light through an angle which is at first abnormally great, but decreases subsequently when the substance has been completely dissolved.

**Birth injuries.** Although some of these accidents will be considered under various other headings—see, for example, Injuries of the eye—yet it is only proper to say here that injuries of the cornea form, properly, the most common and interesting group of these indirect lesions. de Wecker in 1896, Truc in 1898, as well as Thomson and Buchanan in 1903, reported cases in which the corneal tissues were injured by the use of the obstetrical forceps. At least three different lesions of the cornea were noticed. Parsons describes these, first, as a diffuse opacity which is temporary and due to oedema. In the second instance, a diffuse opacity, indeterminate in position, which is permanent. It is also due to oedema but probably with consecutive inflammatory changes, and rupture of Descemet's membrane. Third, an opacity, linear in form and permanent, due to a rupture of Descemet's membrane and sometimes of the posterior corneal lamellæ. The cases of de Wecker, Truc, and some of those of Thomson and Buchanan belong to the last category. Probably in some of the cases injury is due to direct pressure of the blade of the forceps on the cornea: E. v. Hippel has reported rupture of Descemet's membrane without laceration of the corneal substance. He believes that it may be due to sudden increase of intra-ocular pressure during birth. Traumatic keratitis was seen by Thomson and Buchanan in eight cases, involving twelve eyes. The opportunity of observing so many cases is owing to the prevalence of rickets associated with contracted pelvis in Glasgow.

Hyphema, rupture of the choroid, retinal hemorrhages, luxation and avulsion of the globe, fractures of the orbital walls, have among other traumas, also been reported. Parsons (Pathology of the Eye, p.
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1180) says that "Birch-Hirschfield has collected eighteen cases due to injury during parturition. In several cases reported by Wolff, Servel, Reese, Rouchut, Tarpet, and Thomson and Buchanan exophthalmos was present, but the globe did not protrude in front of the lids. In fifteen cases forceps were used, often when the head was still high up in the pelvis. In most cases there was a narrow pelvis, and there is no doubt that this alone may be a sufficient cause. It practically never occurs with an after-coming head. It may be due to the finger of the accoucheur. In many cases orbital fracture has been caused by the forceps and the mechanism of the injury seems to be in the first place the forcing forwards of the globe by the diminution of the orbital space with the forceps, and secondly the arrest of the protruded globe under the unduly exaggerated promontory of the contracted pelvis. It is improbable that the blade of the forceps alone (Beaumont) can effect the injury. The shape of the infantile orbit is an important factor. Avulsion bulbii due to this cause shows the double action of pressure from behind effecting the protrusion and traction from in front tearing the eyeball out. The muscles separate near the tendinous insertions into the globe, the external rectus most frequently escaping, though there are exceptions. The optic nerve has ruptured a short distance behind the globe (1 in., Snell; 18 mm., Wichergiewicz, ½ in., Gad)."

Ruptures of Descemet's membrane have been described in various processes which produce increase of intraocular tension or stretching of the eyeball, as hydrophthalmus, intraocular tumors, keratoconus, high myopia, peripheral ectasia of the cornea in gerontoxon and traumatism through the obstetrical forceps. Stock clinically assumed ruptures of Descemet's membrane in a newborn infant as a consequence of delivery with forceps. There was severe parenchymatous keratitis, which disappeared after two months, but typical keratoconus developed. Rupprecht (Kl. Monatsbl. f. Augenheilk., p. 134, 1908) saw a slight diffuse parenchymatous haziness of the cornea with impressions above the eye of a newborn, delivered with forceps (narrow pelvis of the mother). Apparently the right blade of the forceps had been applied to the right eye. The child died the next day. Descemet's membrane presented two dehiscences, 1/3 and 2/3 mm. wide, and there were extensive hemorrhages between choroid and sclera, and within and in front of the retina. The forceps apparently had pressed the cornea into the interior of the eye like a rubber ball, causing ruptures of the now convex inner surface of Descemet's membrane.

E. von Hippel found in the eye of a newborn child hemorrhages at
the fovea and in the vitreous, which perhaps had also been produced by the forceps.

John Green, Jr., has also noted an opacity of the cornea. This, he says, may be diffuse and transitory, or of a linear or irregularly striped aspect, and permanent, depending on edema of the cornea due to tears of Descemet’s membrane. Buchanan has suggested that unilateral high grade astigmatism may be traumatic in origin. Fracture of the frontal bone and orbital roof may be due to direct pressure by forceps. Exophthalmus may be caused by compression of the skull or by a direct backward pressure of forceps, acting like the speculum which dislocates the globe in enucleation. Subconjunctival extravasations are usually accompanied by other injuries, as are hemorrhages into the anterior chamber. Optic atrophy may follow fracture running through the optic foramen. The lids may be bruised, cut, or partially torn off; even the globe may be gouged out. Traumatic cataract, oculomotor palsy, iridodialysis rupture of the choroid, deep intraocular hemorrhage, have also been noted, all after the use of forceps in delivery. Not over twenty-five per cent. of recorded cases can be classified as severe. Minute retinal hemorrhages are rather common. Many injuries are found to have occurred in non-instrumental delivery, as after version, in face presentations, spontaneous deliveries, breech presentation, and so on. Considering that it is frequently a question of losing or saving two lives, a possible injury to the child’s eyes can hardly weigh as a serious contraindication to the use of forceps, but the grave possibilities should always be borne in mind. Any marks of violence to the eyes or ocular adnexa should lead to thorough examination.

Bismuth amblyopia. Ocular symptoms set up by poisoning from any of the salts of bismuth have not been frequently seen in man. In one instance a patient who took eight grams of the nitrate complained of dim or cloudy vision for two days. Even when general toxic symptoms—including the so-called bismuthosis buccalis are induced—the eyes generally escape.

Bismuth dithiosalicylate, Basic. Thioform. A yellow-brown, odorless powder, insoluble in water, containing 72 per cent. of bismuth oxide. This antiseptic is one of that numerous class of bismuth compounds recommended as a protective and dusting powder in place of iodoform. It is employed in substance and is conveniently applied by means of an insufflator or a camel’s-hair brush.

In acute catarrhal conjunctivitis, when there is much secretion, finely powdered thioform acts very nicely when flecked upon the previously cleansed conjunctiva.
Bismuth oxiodo-subgallate. See Airol.
Bismuth subgallate. See Dermatol. This agent occurs as a fine, yellowish, odorless powder, insoluble in water or ether, and unaffected by light or 100° C. It is consequently admirably adapted to dressings when a sterile, neutral powder is needed—as in any of the eruptions on the lid skin attended by secretion. It is best known by its trade name of dermatol.
Bismuth tribromocarbolute. Xeroform. This useful agent is a yellow, insoluble powder, neutral, odorless and tasteless; containing about 60 per cent. of dibismuth trioxide, and has proved to be a valuable substitute for iodoform. It is used especially in wounds of the lid and as a dressing after orbital operations, where the former agent is especially offensive, as, indeed, it usually is, especially to the patient operated on. I have also employed it, with satisfaction, as a dusting powder, or applied with an insufflator, in corneal ulcer. In phlyctenular keratitis Ray H. Dean uses it as a dusting powder not only to the cornea and conjunctiva but on the skin surface of the lids. He also employs it where iodoform powder is usually required. In the form of dry xeroform gauze applied to the eye with a bandage he finds it to be of great value as an antiseptic dressing.
Bismuth tribromophenate. See Xeroform.
Bistouries: These instruments, when used in ophthalmic operations, should be small and well-balanced. For deep incisions the blade should be straight and narrow and set firmly into the handle. For enlarging a fistulous tract the curved blade is the best.
Bisulfure. (F.) Bisulphide.

Bisulphide of carbon. See Carbon bisulphide.

Bisymmetrical. Bilaterally symmetrical.

Bites of insects. As is well known, the cockroach (q. v.), mosquito, bedbug, flea, spider, and other more or less venomous insects occasionally attack the lids and skin in the neighborhood of the eye. Neal, in a report to the China Medical Journal, advises the following method of treating these injuries: Take one ounce of Epsom salts and dissolve it in one pint of water, wet a bath cloth so that it will not drip, and rub the body well all over, and not wipe afterward, but dress, and flies, gnats, fleas, bedbugs, mosquitoes, etc., will never touch you. If one is exposed more than usual, being near water, or in a forest, then make a somewhat stronger solution, wet a cloth and rub the face, neck, ears and hands well—do not wipe, but allow it to dry; it will leave a fine powder over the surface that the most blood-thirsty insect will not attack. Besides, the solution is healing and cleansing; it will heal the bites, subdue the consequent inflammation, and cure many diseases of the skin.

Bittere Mandeln. (G.) Bitter almonds.


Bitter salt. Magnesium sulphate. This well-known remedy occurs in the market as small, colorless, odorless, bitter, saline needles, very soluble in water, insoluble in alcohol.

This salt is rarely used as a local application in eye disease, but E. E. Holt advises that in any sthenic inflammation about the eye with swelling of the lid or conjunctivæ, the application of a saturated solution in several thicknesses of gauze, bound comfortably tight about the orbit during night time, will materially help to check the disorder.

Bittersüß. (G.) Solanum dulcamara; the bitter-sweet.

Bjerrum's method of perimetry. Although in the ordinary method of measuring the field of vision the test-objects are comparatively large and subtend an angle of from 2° to 4°, yet it would for many reasons be more satisfactory if fewer retinal elements were covered by the object. Bjerrum seeks to accomplish this end by the use of small, white, circular discs or balls of ivory fixed on the end of long, dull-black rods. The diameter of the former varies from 1 to 10 mm. He makes the examination of the fields at a distance of two metres, with a background consisting of a black screen, two metres broad. The examination is first at the distance of 30 cm. with a 10 mm. square, white object, this being continued at 2 metres with a 3mm. disc. The visual angle is, in the first distance 1/30, in the second
3/2000, which are 2° and 5′ respectively. In the first case the limits of the normal field are those commonly found on the perimeter chart, but with the Bjerrum method the field is smaller, but probably the latter test furnishes a more valuable means of diagnosis than in the case of ordinary perimetric measurements.

The Bjerrum method brings out slight concentric limitations, which are generally not important, but this procedure is of great value in measuring small sector-shaped defects, scotomata and irregular limitations of the fields.

**Bjerrum's test types.** In those affections that reduce the light-color-and-form-perception capacity either of the retina, optic fibres, central radiations or visual centres, but especially in the early stages of optic atrophy or in certain forms of chorio-retinitis the ordinary letters (or other characters of the black and white test-types) may show that the patient has normal or nearly normal vision. Bjerrum has suggested that in suspected cases of this sort the visual acuity be also measured with black letters (or other characters) with a gray or gray-brown background. In the normal individual the central vision will be almost as good (6/9) as with the more clearly printed black on white, but those with retinal or optic nerve disease will show vision reduced to 6/18, or even less.

**Black aqueous humor.** After the extraction of a cataract by R. Salus (*Deut. Med. Woch.*, 1910, No. 20, p. 939), in a woman, aged 39, who had diabetes (5.2 per cent. sugar), a thin, dirty, grayish-black aqueous oozed, especially upon massage. The iris was spongy. The healing was smooth, with V.O/vi. The aqueous showed numerous pigment granules, partly large, swelled cells with indistinct, frequently interrupted boundaries, and contained scanty pigment. This peculiar phenomenon has so far been seen in only in diabetes, except by Vossius and Kostenitsch, who observed it also in eyes of non-diabetic individuals. Salus gives the following explanation: Undoubtedly different kinds of cells show a different behavior towards sugar contained in the tissue fluids. It is possible that the pigment epithelia of the iris have a greater affinity for sugar and absorb it from the aqueous even if it contains only small quantities—a process similar to the coloring of dead and living cells by different stains. Hence they gradually acquire such a high percentage of sugar that the aqueous in comparison becomes hypotonic, the cells swell, become hydropic, displace one another and are deformed.

**Blackberry.** *Rubus.* Throughout antiquity and the middle ages, the leaves of the blackberry, smeared with honey, were laid upon the closed lids for the cure of epiphora. Blackberry leaves were also
employed in antiquity for "proptosis," or "oculus procidens" (panophthalmitis).—(T. H. S.)

Blackboard perimeter, The. The use of this method of working out the fields of vision was first introduced by von Graefe and afterwards much improved by de Wecker. It is now almost entirely discarded for the arc perimeter.

In the blackboard method, the patient is placed at a certain distance from the board and asked to fix its centre, the surface of the board being divided into concentric circles and meridians. A piece of chalk is slowly moved along towards the centre of the board, and the fixation following the different meridians and the points where this white object first becomes visible are marked. de Wecker substituted white ivory balls for the chalk object.

As Wilbrand has pointed out (Norris and Oliver’s System, Vol. 2, p. 193), "this method suffers from the fault that the various parts of the retina are measured at different distances. In the figure, DG represents the surface of the blackboard and F the point of fixation. Here the distance of the macula lutea (f), which is directed to F, is equal to fF. The point c, which is a distance of forty degrees from the macula (f), is at a distance cc from the retina. The point d, lying at eighty degrees from the macula, is at a much greater distance, dD. According to von Helmholtz, the deviation produced by the cornea and anterior chamber is so great for the outermost rays that rays of light are still perceived which fall upon the cornea perpendicularly to the optic axis. Hence, as the normal field of vision extends outward ninety degrees or even more, it is impossible to determine its extreme limits on the blackboard, for the reason that rays situated there would lie at infinity. Another fault is that the weaker peripheral parts of the retina are measured from the greatest distance. The greater the distance from the eye the smaller the retinal image must be, and the less bright the examined object becomes. Therefore, as the same object is used for examining the various parts of the field of vision, different standards of light and size should be used. Thus, in the figure the point c might be compared with c1, but c cannot be compared with D. See, also, Field of vision.
Blackboards, School. There is, perhaps, no article of furniture in the school-room that has given rise to more controversy and has been the source of more discomfort to the student than the blackboard so well known to school life. Although the form now almost universally employed is the slate or painted plaster blackboard with its very black, dull, non-reflecting surface, yet the older painted board still lingers in some schools and in some parts of the country. In whatever form employed the blackboard should be frequently washed of chalk dust so that its surface shall always be dead black and never greasy or shiny. The advantages of very opaque writing or figures on a very dull black surface, or vice versa, over any other combination of colour or contrast cannot be denied. See Hygiene of the eye.

Black cataract. An obsolete term for blindness or amaurosis; more recently, a nuclear cataract, very dark in color.

This latter condition was formerly thought to be due to the imbibition of hæmatin, but as a rule, no blood pigments are discoverable in the cataract. Gatti has shown that the dark color is due to oxidation of tyrosin, set free by decomposition of the albumins of the crystalline lens. The lenticular lesion is often complicated by intraocular diseases and a fluid vitreous. In most instances this form of cataract is due to complete hardening of the whole lens mass, the fibres losing their dentations and being transformed into a homogeneous mass. The capsule becomes thickened and the epithelial cells are flattened.

Completely black cataract is rare and is most frequently found in the eyes of myopes. The actual color is a deep mahogany brown, which is generally an exaggerated amber color.

Black heads. Palpebral chromidrosis. This dark-colored collection in diseased sweat-glands occurs mostly in anemic girls. It is best treated by attention to the general health of the patient, the expression of the glandular deposits and the local application of a mixture of liquor plumbi and glycerine.

Black eye. This is an extravasation of blood into the cellular tissue of the eyelids and beneath the ocular conjunctiva. The blood may assume the form of a diffuse ecchymosis or even hematoma. The common black eye disappears without treatment in two or three weeks, but where it is associated with fracture of the orbital walls, the ethmoid sinus or the frontal sinus, it may persist for a long time. Black eye is best treated with cold applications (cloths wet with iced water), or with an evaporating lead lotion; such as, Liq. plumbi subacetatis dr. 1; alcohol dr. 1; aq. destil. pint 1. Where a definite blood-clot has formed within the palpebral tissues, the common practice of incising the skin and allowing the blood to escape, or applying two or three
leeches to the orbital margin, is a good one. An antiseptic dressing should be subsequently used. Unless treatment is resorted to within two days, no remedy will be of use. It is then best to cover up the discoloration with flesh-colored paint. We would advise every practitioner to keep on hand some water colors for this purpose. No production of his artistic hand will be more appreciated than that which disguises such a noticeable blemish.

Black mirror. A mirror deeply-coloured with iron and manganese, occasionally used as a reflector in cloud photography.

Black, Sensation of. Black produces a real sensation: to see black is not the same thing as to see nothing at all. The most striking example is that of the spot of Mariotte, which corresponds to the papilla. In this spot we see nothing, but we do not see it black. By looking directly in front, one sees a part of the space in which one is; in regard to that which is beyond the limits of the visual field, one does not see it, but it does not appear black. The impression of black, therefore, is a true sensation, which corresponds to the state of repose of the visual organ. There exists no completely black object in nature; even black velvets still reflect a comparatively considerable quantity of light. A black object placed in the direct light of the sun may appear clearer than a white object placed in the shadow. Ordinary black paper (bristol black) returns nearly 5 per cent. of incident light; black velvety paper sends back about 5 per 1000 of the incident light. The most absolute black that we can produce is that of an aperture made in the side of a closed box, blackened internally. Compared with this black, even the velvety paper appears slightly grayish.

Black spot about the macula. An ophthalmoscopic sign of the probable increase in the myopia of a short-sighted patient and evidence that the outcome of the disease is unfavorable. It shows itself about the macular region as a deep black area, about the size of the papilla. It has a gray center and is surrounded by a well-defined, lighter-colored ring. A perimetric examination discloses a scotoma that corresponds to the diseased area. See Myopia.

Black vision. A few cases of so-called black-vision, occurring in chlorotic girls, after fainting attacks, have been described by von Noorden. In such cases as these, it would appear to be less a disturbance of the color-sense, than a temporary amblyopia or amaurosis following a suddenly developing anemia of the brain, as so often happens in this class of patients.—(C. P. S.)

Black wash. Aqua ophtalmica nigra. Lotio nigra. This is the well-known but, in these modern times, little used, "black eyewater" of von Graefe; given by him as a wash in purulent ophthalmia. The for-
mula is: Ext. hyoscyami 1.0 (gr. xv); Aquaæ roae 30.0 (f₃½); Aquaæ calcis 100.0 (f₃iiif₃ii); Calomelanos 0.6 (gr. ix). The limewater precipitates the soluble mercurous oxide which, with the hyoscyamus, colors the mixture black. It resembles somewhat the lotio nigra, practically the "black wash" of the English pharmacopeia.

Bladderworm. Cysticercus.

Blafard, —arde. (F.) Pale; dull; wan.

Blanc de Briançon. (F.) Talc.

Blanc de céruse. (F.) Carbonate of lead.

Blanc de graines. (F.) Glutin.

Blanc de l'œil. (F.) An obsolete term for the sclerotic, or white tunic, of the eye.

Blanc de plomb. (F.) Carbonate of lead; white lead.

Blanc de zinc. (F.) Oxide of zinc.

Blanc d’œuf. (F.) The white of egg.

Blanchiment. (F.) Bleaching.

Blarauge. (G.) Ectropion.

Bläschenkatarrh. (G.) Vesicular catarrh (of the lids).

Bläschenzellen. (G.) These cells, commonly known as the Blasenzellen of Wedl, probably do not arise from the lens fibres of beginning cataract but from the epithelium. Becker believes they are due to hydropic degeneration of the cells. The cells are large, swollen and generally polygonal from the pressure to which they have been subjected. They contain a faintly staining nucleus, which eventually undergoes degeneration and disappears, leaving a clearer spot to point out its former position.

Blasenausschlag. (G.) Pemphigus.

Blasenschwanz. (G.) Cysticercus.

Blasenwurm. (G.) Cysticercus.

Blastoderm. n. The germinal membrane or blastodermic vesicle (q. v.). See Embryology of the eye.

Blastomycetes. See Blastomycetic dermatitis.

Blastomycetic dermatitis. Protozoic disease. Saccharomycosis hominis. This is a chronic, rather rare, local, infective process which, beginning as a pustule or papule, involves almost exclusively the eyelids of the ocular apparatus. The growth superficially exhibits itself as irregular, papilla-like elevations between which pus oozes—especially on pressure. The margins of the lesion are of a reddish color, studded with minute abscesses. The disease may remain in this indolent state for years with occasional exacerbations, or it may heal at the center while it extends at the periphery. The lid disease sooner or later produces ectropion. Clinically, blastomycetic derma-
Blastomycetic Dermatitis may be mistaken for verrucous tuberculosis, lupus vulgaris, carcinoma and syphilis. The miliary abscesses and the distinct budding organisms seen by the microscope will generally settle the diagnosis. Although a rare disease, yet a number of cases have been carefully described and worked out pathologically; in fact, some thirty-five cases of blastomycetic lesions of various human organs, internal and external, had been recorded to 1905 in literature since T. C. Gilchrist described an example of it, on the back of a man's hand, in May, 1894. This observer was the first to recognize a distinct skin disease due to a yeast-like fungus. He named the tumor-lesion blastomycetic dermatitis, and this term is certainly appropriate as describing the alterations in the skin, the locality commonly preferred by the fungus.

It is perhaps an accident, but nevertheless one worthy of remark, that so far this condition is either almost exclusively an American disease (the great majority of cases having been observed and investigated in Chicago, especially by Nevins Hyde and F. H. Montgomery) or its true character has been appreciated only by American surgeons. The infection in even foreign-born patients (treated in Chicago) was shown to have occurred after immigration to this country.

The following brief history of a case of blastomycosis of the left lower lid in the Editor's practice is presented as an introduction to a study of the disease in the eye structures.

Mary Ryan, aged 14, had never before suffered from an eruptive disease and there is no history or other evidence of syphilis or tuberculosis. She appears to be a perfectly healthy girl. In July, 1903, she noticed a small growth, like a stye, on the central margin of the left lower lid. This formed a scab which, when removed, formed a raw, discharging sore. The growth is about the shape and size of a large peanut, 27 by 5 to 7 mm. long and 3 mm. thick, with abrupt, rounded walls of apparently normal but reddened skin. At the intermarginal space the growth has destroyed the dermal edge and the conjunctiva is red and thickened. The surface of the tumor, as well as its margins, is uneven, exhibiting many minute openings, through which a whitish fluid discharges, or can be squeezed. The tumor-mass is soft and compressible and does not present the hardened, ulcerated, nodules of epithelioma, or the half-healed, raw patches of dermal tuberculosis.

The palpebral conjunctiva is red, swollen and granular, but there is no abrasion or other lesion of that membrane.

The ocular conjunctiva is injected for about three-fourths of its extent. The lower lid margin forms the upper wall of the tumor and at some points the latter overrides the conjunctiva. The mouths
of the Meibomian ducts and the cilia follicles are invaded by the growth; but few lashes are to be seen.

The cornea was clear, the pupil reflexes were normal and vision was nearly 6/6. There was a slight mucoid discharge, with some secretion remaining in the lower conjunctival sac. The patient did not complain of pain in the eye at any time, nor did she suffer much discomfort except foreign body sensations, burning, smarting and occasional blurring of vision. The lids adhered in the morning and a slight crust was attached to the cilia.

There was no eruption or tumor elsewhere on the patient's body. I excised a portion of the tumor which Ludwig Hektoen kindly examined. In his report he says: "The section of the blastomycetic growth on the left lower lid which you sent me the other day shows the typical lesions of blastomycosis. There is great and irregular proliferation of the epithelium, and the intervening connective tissue is infiltrated with various forms of cells, scattered among which are occasional giant cells. Here and there, both outside as well as in the epithelium, occur small aggregations of polymorphonuclear leucocytes—the so-called military abscess. In one of these I found three typical double-contoured organisms.

The following are brief abstracts of cases of blastomycosis in which the eye was involved. Six of these have been published. The diagnosis in each instance was made by microscopical examinations, cultural experiments, animal inoculations, and other appropriate means.

Case I. Gilehrist and Stokes. A man, 33 years of age, in good health. History negative. Disease began eleven years before he was first seen, as a papule on the left mastoid process. Thence it gradually extended to the face and chin, encircling the ear, involving the supraorbital region and palpebral skin. Finally it crossed the nose to the right side of face, presenting lesions similar to those on the left side. Eventually the disease spread to other parts of the body.

Case II. Practice of W. E. Coates, Chicago. The patient, a healthy married man, age 38, was seen in February, 1900. In January, 1898, when recovering from an attack of rheumatism, he was attacked by what was diagnosed as pleuro-pneumonia. This was followed by a small nodule on the right lower eyelid. The growth was removed but other nodules, at different times, appeared elsewhere.

Case III. Practice of F. H. Montgomery and Oscar Dodd, Chicago. Man, age 38. Lesion appeared in a cut on his chin. Eighteen months afterward it had extended over the left cheek to the nose, had surrounded the left orbit and involved both upper and lower eyelids, the cicatricial tissue producing eversion of the lower lid. Treated with
iodide of potassium. Progress of disease arrested and verrucous growth replaced by smooth scar tissue. Dr. Dodd later operated on this case and corrected the marked ectropion.

Case IV. Practice of J. Nevins Hyde, Chicago. Farmer, age 33, came for treatment in December, 1899. An eruption began two years before and involved many internal and external organs, including the left lower lid, temple and cheek.

Case V. Practice of W. L. Noble and F. H. Montgomery, Chicago. Mrs. A. W., aged 28. Disease appeared twenty months before examination and had affected the tissues about the right orbit, including the cheek and forehead. The process had thence spread over the bridge of the nose and had involved the left upper eyelid and a small spot below the eye.

Case VI. Practice of W. A. Pusey, Chicago. "I have under treatment at present (May, 1903) one case of blastomycetic dermatitis involving the lower eyelid, which is a typical beginning case, and in which the diagnosis is fully established. Under small doses of potassium iodide three times daily, and with x-ray exposures to the point of producing an erythema the diseases has almost but not quite disappeared. There seems every reason to believe that a completely satisfactory result will be obtained. The patient has had only small doses of potassium iodide, ten grains three times daily, which is not sufficient to account for the very great improvement."

Case VII. Practice of W. H. Wilder, Chicago. S. Y., aged 40, Lithuanian coal miner. Has lived in the State of Illinois nine years. Two years ago noticed a red spot on the right side of his forehead. This spread and involved the skin of the right temple, forehead, right upper eyelid and right cheek. There is no history of syphilis, congenital or acquired, or of tuberculosis of his own person or in his family. There is no disease like his, so far as he knows, in the locality (Bureau county) where he lives. At the present date the blastomycetic process has not attacked the conjunctiva.

Case VIII. Practice of E. A. Fischkin, Chicago. An Italian, age 51 years, has been in this country six years. History negative; wife and family healthy. Last May a pimple appeared near the external canthus. He scratched it with his finger, shortly after which it became sore, painful and began to enlarge. Subsequently a similar lesion appeared on the back of the neck. The ocular growth, when first seen, covered an area three-fourths of an inch wide and one inch long extending along the lower eyelid, encircling the external canthus and reaching the upper lid. It was elevated about a quarter of an inch above the plane of the normal skin and was covered by a thick,
dark colored, adherent crust, on removing which a papillary growth was exposed. The growth at the external angle of the eye was ulcerated, the base of the ulcer being covered with thick pus. The margins of the growth had an abrupt slope, and on close inspection were found to be pierced by numerous miliary abscesses. The usual histological and bacteriological examinations showed the tumor to be a blastomycetic dermatitis.

Pathology of blastomycosis. A study of this rather rare and curious disease reveals the following characteristic:

The fungus cells are most numerous in the abscesses of the epithelial tissue and corium, although they are also found in more superficial pus collections, as well as between the cells of the rete and in the granulation tissue of the corium.

Howard F. Ricketts, who has published a most exhaustive report on this subject and has carefully examined, clinically and otherwise, many of the cases that have appeared in Chicago, concludes that "the so-called protozoic disease of Wernicke and others; Busse's and Curtis' saccharomyces hominis and Gilchrist's blastomycetic dermatitis are various manifestations of the same disease. The organisms isolated from various cases differ in minor respects among themselves, but are so closely related morphologically and biologically as to justify their inclusion in a common genus, Oidium. Of these there are three morphological types; (a) blastomycetoid, or yeast-like; (b) oidium-like; (c) hypomycetoid. There are two histological forms of the disease in the skin, the eosinophilous and the non-eosinophilous, the former being associated with the mould type of the organism. Hence oidiomycosis cutis is the term that best indicates the true nature of the disease. Aside from the infections considered, certain cases described in literature point to oidium-like organisms that may cause other severe pathological conditions in man."

Any part of the skin surface may be infected by this disease. As the palpebral skin was affected in at least nine known instances, we may assume that the lid skin is involved in about 25 per cent. of all cases. In all these the conjunctiva resisted the advance of the growth. Indeed, in two cases only can I find a history of a mucous membrane being infected by a blastomycosis.

As in similar processes we probably always have a traumatism sufficient to remove the protecting epithelium, with a subsequent implantation of the oidium spores. It is easy to predicate such an origin in palpebral blastomycosis, because it is a common habit to rub and scratch the lid edges, especially when, as in Chicago, they are constantly irritated by wind and dust—conditions favorable to the pro-
duction of a mild degree of blepharitis and the itching that accompanies it. Once established as a small reddish pimple, the disease gradually but steadily creeps over the skin. This papule soon becomes a pustule, which, in its turn, is transformed into a tumor with a rounded, elevated, reddened base, the whole surrounded by a reddish areola. In five or six months the tumor acquires a diameter of a couple of inches, with an irregular, wart-like surface that secretes a glairy, whitish pus.

There is very little pain in the facial lesions; the discomfort experienced by ophthalmic patients is mostly due to secondary infections of the tumor or of the conjunctiva.

**Prognosis** is always good. As Ricketts points out, of 26 cases of dermal blastomycosis tabulated by him, only one resulted in general invasion and death. He believes that there is a "protozoic" form of the disease, usually "primary in the lungs, where extension is much easier than in the skin, metastases occur with greater ease and general toxic disturbances are more easily produced."

**Diagnosis.** These tumors in some respects resemble carcinoma, tuberculosis and epithelioma of the skin. Although no patients are freer from the signs and symptoms of syphilis, it is quite possible that a blastomycetic tumor might also be mistaken for a syphilidderm. However, the comparatively rapid progress of a blastomycosis, its soft spongy walls and marked areola, the discharge of a tenacious mucopurulent pus from minute openings on its surface, the complete absence of glandular involvement—all these serve to distinguish it from any of the tumors just mentioned. Finally, an immediate diagnosis may be made by examining the pus from the "miliary" abscesses, or a piece of tissue from the tumor itself.

**Treatment.** Where it can easily be accomplished, excision of the tumor or thorough curetting under an anesthetic, is the best practice. This may be followed, as in my own case, by the use of the x-rays, and the administration of potassic iodide, in doses increased, if necessary, to 150 grains three times daily. For the last named remedy we are indebted to A. D. Bevan, who first observed, and to Nevins Hyde and F. H. Montgomery, who have repeatedly substantiated the fact that the iodides are almost a specific in blastomycetic dermatitis. Several cases under their care recovered entirely without surgical intervention. When operation is refused the exhibition of potassium or sodium iodide should be continued for the three or four months required for a cure. Local applications are not of much use. Hot bichloride solutions, with or without boric acid, may be used for cleansing pur-
poses. I found the one-per cent. ichthyol ointment in lanolin of some value.

The clinical history and appearances Ricketts briefly summarizes as follows: 1. An incipient papule which becomes pustular, yielding a glairy, somewhat tenacious pus. 2. Gradual extension of the ulcerating surface, which is soon covered with coarse, soft and pliable papillae, and is surrounded by a reddened areola in which many abscesses are visible. 3. Cicatricial healing in the oldest portions of the lesion as the border advances. 4. A variable amount of pain, depending on the site involved, or upon a temporary increase or decrease of the virulence of the specific infection present. 5. The absence of glandular involvement in a great majority of cases. 6. The protracted and progressive course of the disease, which may extend for years and cause great cicatricial deformity. 7. Periods of rapid extension, interrupted by periods of relative quiet. 8. The tendency of the scar to eventually approach the appearance of normal skin. 9. The upper extremities (hand and forearm) and the face (eyelids) are most frequently attacked, although no portion of the skin is proof against invasion. 10. Extension to mucous surfaces does not readily occur. 11. The absence of general toxic disturbances, attributable to the local infection.

Blastomycosis of the eyelid. See Blastomycetic dermatitis.

Blattaire. (F.) Pertaining to cockroaches.

Blatta orientalis. The cockroach. Although oily matter, blattaric acid, antihydropin (taracanin), etc., are obtained from the cockroach, yet it has little to do with ophthalmology except that occasional mention is made of the insect’s bites on the lids. Blatta orientalis is said also to yield small quantities of cantharidin which may account for the itching, swelling and other irritant signs set up by injury from the animal. The Editor has seen the lids and eyeballs of a number of young kittens severely bitten and almost destroyed by these carnivorous insects.

Blattern. (G.) Small pox.

Blatternaugenentzündung. (G.) Conjunctivitis variolosa. Small pox of the ocular structures.

Blätterpilz. (G.) A genus of Fungi, comprising the mushrooms and toad stools.

Blattes, Oeil des. (F.) Oily decoctions and various other extracts obtained from the cockroach.

Blaublindheit. (G.) Blue blindness.

Blaublindheit bei Gelbfärbung der Linse. (G.) Blue blindness due to a yellow tint of the crystalline lens.
Bleaching of the visual purple. Rhodopsin, or visual purple, the pigment found in the retinal rods of practically all vertebrates, is confined exclusively to those portions of the retina lying posterior to the equator of the eye. However, the macular rods contain none of this pigment. The bleaching of the visual purple is a photo-chemical change, superinduced by the effect of light transmitted to the rods. By means of the alum-fixing bath (Norris and Oliver's System), this bleaching can be carefully studied in its various stages.

The normal retina of frogs or rabbits (these animals are easy to study), after having been protected from light for at least two hours, shows a beautiful purple color due to the rhodopsin in the rods. A short exposure to light (2 to 10 minutes) suffices either to change or destroy this color entirely, dependent upon the character of the light employed. If the light has a short wave length, the purple turns to a rose or lilac hue. Whereas if the light has a long wave length, the visual purple fades into a colorless substance after passing through the transitional colors of red, orange, chamois, and yellow. By careful study, a predetermined transitional color may be obtained by graduating the length of exposure of the retina to the light employed. White light (sunlight) has the same effect as a monochromatic light of long wave length, due to the excess of rays that fall in the red and infrared end of the spectrum. Heat hastens the bleaching and cold has the opposite effect.

The bleaching of the visual purple is not a diffuse process, but is rather sharply circumscribed to the area upon which the light is concentrated. This is shown by the retinal photographs or optograms. If an atropinized eye be adapted to the dark by complete absence of light for at least two hours and then light be permitted to fall upon the retina so that an image (as, for instance, cross bars) be formed, there will be a sharply-circumscribed bleaching of the visual purple, cor-
responding to the light areas in the retina. The shadowed areas will still show the visual purple, although this may begin to change to a reddish tinge if the image be left in situ too long. These variations in color can be demonstrated to the naked eye by fixation of the retina in the alum bath.

The bleaching of the visual purple is purely a photo-chemical reaction. Rhodopsin, as the pigment in its purple stage is called, fades into xanthopsin (visual red) and eventually into leucopin (visual white) under the influence of either mono- or poly-chromatic light. The effect of white light is however, distinctly more rapid than that of a monochromatic light. Rhodopsin is not difficult to extract from the retina and forms a beautiful purple solution which, for the simpler experiments, offers the same opportunities as the retina, either dead or living.—(H. S. G.)

**Bleaching powder.** Lime, chlorinated. This compound is made up of calcium chloride and calcium hypochlorite with water that should yield not less than 35 per cent. of chlorine. It is a deliquescent, white powder with an unpleasant odor and taste. It is partly soluble in water and is sometimes employed like chlorine water, in eye diseases as a disinfectant collyrium in 4 per cent. solution. As a compress (15 to 30 parts in 1000) it is occasionally prescribed.

**Blearedness,** n. Chronic soreness of the eyes from blepharitis margin-alis.

**Blear-eye.** A vague popular term, generally applied to one with weak vision or indistinct sight from an evident disease of the eye.

**Bleeders.** See Hemophilia.

**Blefarite.** (It.), f.n. Inflammation of the eyelid.

**Blefarocalasi.** (It.) Blepharochalasis.

**Blefarofimosi.** (It.) Blepharophimosis.

**Blefaroplastica.** (It.) Blepharoplasty.

**Blefaropasm.** (It.) Blepharospasm.

**Blefarostato.** (It.) A speculum or blepharostat.

**Blei.** (G.) Lead.

**Bleiacetat, örtliche Wirkung am Auge.** (G.) Local action of lead acetate on the eye.

**Bleialbuminat.** (G.) Albuminate of lead.

**Bleiarbeit.** (G.) Worker in lead factories or mines.

**Bleifarbe, Blindheit durch.** (G.) Blindness produced by lead pigment.

**Bleiglasur.** (G.) Lead enamel.

**Bleiglasurarbeiter.** (G.) Worker in lead glass.

**Bleihüttenarbeiter.** (G.) Workmen in lead mines or smelter.

**Bleikolik.** (G.) Lead colic.
Bleirohrarbeiter. (G.) A maker of lead pipe.
Bleischmelzer. (G.) A worker in lead-enamel.
Bleivergiftung. (G.) Poisoning from lead. Saturnism.
Bleiweiss. (G.) White lead.
Bleematrope. An apparatus for showing the various positions of the eye in its orbit.
Blemmyes. A fabulous people of Ethiopia, described as headless and possessing eyes in their breasts. Written also Bleymes.—(T. H. S.)
Blende. (G.) Diaphragm.
Blendung. (G.) Diaphragm; also a dazzling or glare.
Blendungsblutadern. (G.) The ciliary veins.
Blendungsschutz. (G.) Protection from glare or excessive light.
Blendungsskotom. (G.) Scotoma due to excessive light or glare.
Blennophthalmia. (L.) Mucous or purulent inflammation of the conjunctiva. Catarrhal conjunctivitis.
Blennorrhagia ocularis. Gonorrhœal ophthalmia.
Blennorrhagic conjunctivitis. Purulent conjunctivitis. See Ophthalmia neonatorum; and Conjunctivitis, Gonorrhœal.
Blennorrhagic iritis. Gonorrhœal iritis. This form of iritis is of at least two clinical varieties. The first or non-relapsing variety is rare and attacks a patient but once. It is not associated with any definite changes in the fasciae or joints but comes on in the early stages of gonorrhœa. It generally affects both eyes that exhibit a severe form of iritis. There is generally an exudate and sometimes the pupils are occluded by a mass of lymph.

The second variety of gonorrhœal iritis is not uncommon and affects the patient during the late or gleety stage. Such patients nearly always give a history of rheumatism and swelling in all of the joints. The eyes are both likely to be affected sooner or later and relapses are the rule. These cases as in the first instance are very acute and the disease is very likely to attack the deeper portions of the uveal tract sooner or later. There can be no doubt of the direct connection between attacks of gonorrhœa of the iritis in this instance. The history of a gleety discharge is generally plain and the patient often speaks of the inflammation as flying from one joint to another and then to his eye. It frequently happens that when the iritis is better the joint affection is worse and vice versa.

The treatment of such cases is both systemic and local. It must not be forgotten that the original source of the poison should be borne in mind and the iritis itself, with its various complications, should be attended to as indicated in the section devoted to Iritis (q. v.).
Blenorrhrea adulorum. (L.) Purulent disease of the conjunctiva (generally gonorrheal ophthalmia) in the adult.

Blenorrhrea. Chlamydozoa. A form of ophthalmia neonatorum contracted before birth, which Halberstädtler and Prowazek regarded as a specially infectious disease, not due to the gonococcus but to organisms resident in the discharges in which the chlamydozoa were found. See Bacteriology of the eye (trachoma).

Blenorrhrea, Chronic. This is the name generally applied to chronic trachoma, a full account of which will be found under that heading. The discharge (from which the term derives its name) is favorably affected by copious irrigation. Kalt, who has written most upon the subject, has had his observations fully verified by Davids, who found that in 15 eyes of 12 patients very good results were obtained. The solution of hypermanganate of potash, suggested by Kalt, was reduced to 1-15000, and his tip was replaced by a blunt nozzle of glass. In all cases the suppuration markedly abated within one to two weeks. In none of the cases was the cornea damaged, while opacities, infiltrations and ulcers subsided rapidly. No eye was lost, which on admission had given any prospects of preservation.

Davids thinks that Kalt's irrigations may at once be employed in every case of adult blenorrhrea. They are not painful, but relieve the patient; the most profuse suppuration decreases from the second day; the cornea is not damaged while corneal affections are favorably influenced. Eyes, which formerly would have been completely lost, may be saved by Kalt's irrigations.

Blenorrhrea, Lachrymal, of infants. Mucocele of the new born. This is generally a congenital condition, as Donald Gunn has pointed out. He believes that it depends upon a dilated duct brought about during fetal life by obstruction at the lower end, probably due to some anomaly of development. After the birth of the child the lack of drainage brings about the same conditions that result in the adult condition, the retention of secretions and the formation of muco-pus that contains streptococi, pneumococi, the bacterium coli, etc.

The treatment of this infantile condition differs from that of the adult obstruction. Keeping the sac clear (by pressure over it) of stagnant secretions, the use of a simple boric acid lotion, and if necessary the employment of the lacrymal syringe (q. v.) will in the course of a few months bring about a complete cure. This happy ending is mostly due to the development of the nasal lacrymal duct, to whose congenital atresia the mucocele is due.

Blenorrhreal conjunctivitis. Blenorrhagie or purulent conjunctivitis.
BLENNORRHEA NEONATORUM

Blenorrhrea neonatorum. Infantile gonorrheal conjunctivitis. Although this subject will, in its various forms, be more fully treated under the caption Ophthalmia neonatorum, it may be here said that while the discharge is nearly always due to the ravages of the gonococcus, it is not invariably the result of infection by this microorganism. For example, a case of severe purulent conjunctivitis due to the colon bacillus is reported by Hanford McKee (Montreal Med. Jour., Oct. 1906). The child was four days old, and the eye had become inflamed and began discharging the day before. The clinical picture presented severe swelling of the lids with profuse virulent discharge, edema of the bulbar conjunctiva, blennorrhea neonatorum. The cornea was intact. The left eye was not involved, so was immediately protected. Smears were made and media inoculated. The stained slide showed a few Gram positive bacilli—the xerosis—and numerous Gram negative bacilli which looked like the colon variety. The gonococcus was not present.

The author ordered irrigation of the conjunctival sac every half hour with warm boracic solution. The discharge gradually ceased, and on the fifth day the eye was quite well. The cultures showed growths of the bacillus coli communis with a few colonies of the xerosis bacillus.

The case is of interest, says the author, inasmuch as the infection was caused by the bacillus coli communis, but gave the clinical picture of the blennorrhea set up by the gonococcus. Axenfeld reported a case in 1896, and later Bult. They both emphasize the fact that blennorrhea from the colon bacillus runs a much milder course than that caused by the gonococcus.

Greeff (Allgem. Wien. Med. Zeitung, March 24, 1908) thinks that blennorrhea neonatorum is in every case an absolutely curable disease. Notwithstanding this fact 20 per cent. of all cases of blindness are caused by this disease.

It is important from a prophylactic standpoint to instruct the parents of the nature of this condition and to employ the instillation of a drop of silver nitrate into the eyes immediately after birth. Concentrated solutions from 2 to 5 per cent. are too strong; a solution of ¼ per cent. is sufficient for the purpose.

If there is infection of the eye the local treatment consists in the irrigation of the conjunctiva with a 0.1 per cent. solution of silver nitrate. This mode of treatment is used by the mother or nurse for the first few days every hour or two. The method employed previously, that of touching the conjunctiva with a pledge of cotton, is dangerous on account of the possible injuring or infecting of the cornea.
A comparison of various agents in preventing ophthalmia neonatorum is made and reported by R. M. Williams (Klin. Monatsbl. f. Augenheilk, 48, 2, p. 417). He discusses in detail the prophylactic efficiency and irritating action of the different modifications of Credé’s method for the prevention of blennorrhea neonatorum, which are still in use, viz., the instillations of 2 per cent. solutions of nitrate of silver, of 1 per cent. and even weaker solutions, 1 per cent. acetate of silver according to Zweifel, protargol, and 5 per cent. sophol, (a combination of formaldehyde nucleic acid and silver), recently recommended by von Herff. In order to gain a broader base for the valuation of these various methods the writer collected new material by addressing the directors of all German, and some foreign, gynecologic clinics and institutes for the instruction of midwives, for the years 1904, 1905 and 1906, with regard to the prophylactic measures there employed. He received returns on over 100,000 births, which are presented in tabular form. Other tables record the prophylactic results and irritations, obtained by the application of 1 per cent. nitrate of silver in 50,550 births, of 1½ per cent. nitrate of silver in 1,513, 2/3 per cent. in 6,266 births, ½ per cent. in 1,264 births, acetate of silver in 10,000 births, and sophol in 10,000 births.

Fritsch and Leopold declare Credé’s method, if correctly applied, is absolutely safe. According to Meier (Copenhagen) Credé’s method with 2/3 per cent. nitrate of silver is generally used in all births in Denmark, and is compulsory for midwives, provided the parents do not object, which they hardly ever do.

Drawing a conclusion from the results of this inquiry, Williams says that with regard to safety of action 1 per cent. nitrate of silver is just as effective as 2 per cent. and less irritating. But on the strength of the communications from the clinic at Copenhagen even weaker solutions than 1 per cent. seem to warrant the same efficiency. He therefore recommends further tests with ½ per cent. and 2/3 per cent. solutions of nitrate of silver, as he sees the chief progress in the prophylaxis of blennorrhea neonatorum in the application of weak, non-irritating solutions of nitrate of silver, whereas the use of the 2 per cent. solution hardly seems to be justified. Sophol deserves attention as it seems to fulfil the requirements demanded by von Herff for an ideal prophylactic. Protargol has no advantages over sophol. From his own ophthalmologic experience Williams dissuades from a more general employment of protargol since the irritative effect of a 10 per cent. solution is subject to great fluctuations. The results with 5 per cent. sophol with regard to the safe prevention of blennorrhea are so favorable, and its preparation is so simple, that the writer is inclined to give it preference in practice.
Blennorrhea oculi. (L.) Purulent ophthalmia.
Blennorrhea oculi gonorrhoea. (L.) Gonorrheal ophthalmia.
Blennorrhea oculi neonatorum. (L.) Ophthalmia neonatorum.
Blennorrhea of the lachrymal sac. Acute or chronic purulent dacryocystitis (q. v.).
Blennorrhea purulenta infantum. (L.) Ophthalmia neonatorum.
Blennorrhoe des Auges. (G.) Gonorrheal ophthalmia.
Blennorrhoe des Thränensacks. (G.) Blennorrhea of the lachrymal sac.
Blennorrhösische Bindehautentzündung. (G.) Blennorrhagie conjunctivitis.
Blennorrhösische Thränenschlauchentzündung. (G.) Daeryocystitis blennorrheica.
Blenol. This is the proprietary name of a mixture intended for the treatment of simple, acute and chronic conjunctivitis, trachoma, etc., and said to be useful in both instances when diluted in the proportion of one part to 12 parts of water. Blenol is said to be a solution of the double citrate of bismuth and hydrastine, each fluid dram containing 2½ grains of the double salt, 25 per cent. of which is hydrastine citrate.
Blenolenicet salve. This ointment has been recommended by Adams and others in ophthalmia neonatorum, as well as in the gonorrheal conjunctivitis of adults.
Blenorrea dei neonati. (It.) Ophthalmia neonatorum.
Blephara. (L.) The eyelids.
Blepharadenitis. (L.), f.n. Inflammation of any of the (glandular or other) tissues of the lids.
Blepharanthracosis. Carbuncular inflammation of the eyelid. A condition of anthrax (q. v.) of the eyelids.
Blephareccopeus. (L.), f.n. Blepharopsalis, a name given by Kraus to Buzzi's blepharometrum (q. v.).
Blepharedema. (L.) Edema of the eyelids.
Blepharelasis. (L.) An old term for éotropion and entropion of the eyelids.
Blepharemphysema. (L.), n.n. Emphysema of the eyelid.
Blepharicus. (L.), adj. Palpebral.
Blepharides. (L.) The eyelashes.
Blepharidoplastica. (L.) An obsolete term for an operation on the eyelid performed for the purpose of giving a proper direction to the eyelashes.
Blépharique. (F.) Palpebral.
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Blepharis. (L.), f.n. An eyelash.

Blepharismus. (L.) Rapid, involuntary winking; spasm of the orbi-
cular muscle.

Blepharitis. Although Parsons divides this disease (or diseased condi-
tion) into only two forms, yet there are, as a matter of fact, so many
varieties described by various authors that it seems desirable to con-
sider them separately and in alphabetical order, as well as to give a
general description of the disease. The numerous synonyms for
blepharitis give some idea of its variety. A few of them are: blépharo-
adenitis; syccosis tarsi; psorophthalmia; blepharitis ulcerosa; bleph-
aritis ciliaris; seborrhea of the palpebral margins; tinea tarsi; ophthal-
mia tarsi; blepharitis marginals, etc. The major classification of Par-
sons into blepharitis squamosa and blepharitis ulcerosa makes, how-
ever, a fair clinical division.

In blepharitis squamosa the lid-margin is reddened, the palpebral
conjunctiva is hyperemic, and the space between the cilia is filled with
small, thin, whitish scales resembling dandruff. The scales can be
removed imperfectly by washing, or more thoroughly by forceps, leav-
ing the lid-margin reddened and succulent, but not ulcerated. The
cilia fall out easily. They soon grow again. Instead of the scale for-
formation mentioned, the lid-margins may present yellow crusts, with no
underlying ulceration, due to the drying of excessive sebaceous secre-
tion. Patients with blepharitis complain of a burning or itching
sensation. Generally there is also present a chronic type of catarrhal
conjunctivitis, with a slight formation of mucus, which may at times
spread over the cornea and cause momentary blurring of vision. The
eyes are sensitive to light, heat, and dust. They tire easily and styes
often are present.

Blepharitis ulcerosa is a more severe process. The lashes are matted
together with yellow crusts and on their removal a raw, bleeding sur-
face remains. From the centre of each yellow elevation a cilium arises.
The lid presents numerous abscesses from suppuration in the hair-
fOLLicles and their sebaceous glands. It shows an irregular, worm-
eaten condition from the cicatrices of healed abscesses and the exten-
sion of those yet existing. Where the cicatrices exist, the cilia are
absent because of destruction of their follicles. When blepharitis
ulcerosa has existed a long time few cilia remain, and those present
are often found in small tufts glued together with dried secretion.
This form of lid inflammation is much more serious in its sequelae and
prolonged in its course than the squamous variety. The sequelae are
chronic catarrhal conjunctivitis, destruction of the cilia (madarosis),
trichiasis, hypertrophy of the lid-margin, which becomes rounded and
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bordered with fleshy-looking conjunctiva (tylosis), ectropion, persistent lacrimation from eversion of the puncta, blepharospasm, photophobia, and eczema of the face. These conditions react upon the blepharitis, thus establishing a vicious circle. When, in an old case of blepharitis ulcerosa, the "lid-border becomes smooth, red, glazed, everted, thickened, weeping, and destitute of lashes," the term *lippitudo* is applied.

Blepharitis marginalis is a common disease among children and serofulous subjects. It is particularly frequent in blondes. Seborrhea of the lid-margin may follow in the wake of a similar disease in the hairy scalp. Eczema of the lid-margin is generally associated with eczema of the scalp, ear, and face. Uncorrected or improperly corrected errors of refraction certainly increase the local trouble, if indeed they do not cause it. Often blepharitis follows one of the exanthematos diseases of childhood. It is frequently associated with nasopharyngeal disease and with stenosis of the lacrimo-nasal duct. *Staphylococci* are found in the eczematous form of blepharitis. A minute parasite inhabiting the sebaceous follicles, *demodex folliculorum*, is regarded as a cause; and a vegetable growth, the trichophyton fungus, has been observed in some cases. The etiologic importance of the *demodex folliculorum* is doubted by Sulzer, who found it in the normal lids of one person in six examined.

Raeihmann has applied the term *blepharitis acarica* to those cases in which this parasite has been found. From what has been stated it is evident that the pathologic changes in this disease concern chiefly the glands and cilia in the simple forms, and in addition thereto the adjacent structures are involved in the ulcerous form.

Blepharitis may be confounded with conjunctivitis. If, after removal of crusts, the skin of the lid-margin is normal, the case is one of conjunctivitis. In blepharitis this area is either reddened or reddened and ulcerated. In phtheariasis of the lids the lid-borders look dark from the presence of the nits of crablice on the lashes. Careful examination under a magnifying glass will clear the diagnosis. This affection, which itself sometimes causes blepharitis, is found almost exclusively in children.

Blepharitis squamosa offers a favorable prognosis. The eczematous form is somewhat rebellious to treatment. Either form may persist for months or years, yet the majority will be cured. For madarosis there is no efficient treatment.

Many patients with blepharitis require tonic treatment. Attention should be given to the condition of the alimentary tract and the nasopharynx. The proper correction of errors of refraction or of muscle imbalance is of great importance. As regards local treatment, the two
BLEPHARITIS ACARIA

main requirements are: (1) to keep the lid-margins clean and (2) to apply appropriate and soothing remedies. The first object can be attained by the daily removal of scales and dried secretion by means of forceps. This should be done by the surgeon himself. If, after thorough cleansing of the lid-margin, there remains a reddened and succulent area without ulceration, an ointment of ammoniated mercury or yellow oxide (gr. i or ij to 3j) should be rubbed into the roots of the cilia. Persistent local treatment, together with attention to the general health and the wearing of proper glasses, will give favorable results in this, the squamous form, of blepharitis. In the eczematous form of the disease removal of the dried crusts will expose areas of ulceration. There will be free bleeding and some pain connected with the thorough removal of the crusts. After cleansing with peroxid of hydrogen, each ulcer should be touched with a strong solution of silver nitrate or with the mitigated stick. The resulting scab should not be disturbed. After it has dropped off, the lid-margin is to be cleared of all débris, and any bleeding points remaining are treated similarly. Each day the ointment of ammoniated mercury or the yellow-oxide ointment should be applied to the lid-margins. After the ulcers have healed the surgeon should examine for errors of refraction and properly correct them. Conjunctivitis, lachrymal stenosis, entropion, ectropion, and nasopharyngeal disease, which may be present, should be given appropriate treatment. Among other remedies for blepharitis are the oils of cade, rue, or juniper; creolin ointment, Hebra’s compound diachylon ointment, boric-acid ointment, solution of formalin, sulphur ointment, pyrogallol salve, and solution of chloral hydrate.—(J. M. B.)

For further consideration of the subject of treatment see Blepharitis, Chronic.

Blepharitis acaria. This form of marginal lid disease is, according to Raehlmann, due to the *demodex folliculorum* (q. v.) which is not, as it happens, uncommonly found in the normal lid.

Blepharitis, Chronic. Almost all of the infective diseases of the lid margin may run a tedious course or be chronic from the beginning. Although each variety of this disease should be treated after consideration of all of the factors in the case, yet most of them are amenable to certain applications.

In chronic blepharitis marginalis of the seborrheic form Melville Black has been successful in eradicating the disease after other methods had failed, by having the patient come to his office daily so that he could himself soften the scales with hydrogen peroxide applied with a cotton wound tooth-pick and then carefully remove every scale with
BLEPHARITIS, CHRONIC

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a foreign body spud. Many of them surround the lashes and have to be unstrung like beads. This should be done under a Jackson's binocular head magnifier. He then rubs in some 25 per cent. argyrol with a cotton-wound tooth-pick and allows it to dry. If care is taken to confine its application to the margin of the lid it does not look very badly. The patient is instructed to use the yellow ointment at night.

Webster Fox advises the use of boroglyceride for blepharitis in the following ointment:

\[ R \]

- Sol. boroglycerid. 25 per cent. \[ 0.610 \text{ (mx)} \]
- Ung. aquæ rose \[ 3.88 \text{ (5i)} \]

Fortunati recommends thigenol (q. v.) for eczema of the lids in ointments of 5 to 10 per cent.; blepharitis marginalis, 10 to 50 per cent.; blepharitis ulcerosa, 10 per cent. It is applied to the edges of the lids, while gauze smeared with the salve, from 10 to 60 per cent., should be left on all night. The next morning after these applications the lids are carefully cleansed with an alkaline solution and pure thigenol used. The results of this treatment are excellent, a cure sometimes occurring in 25 to 40 days.

de Schweinitz finds the plan of Koenigstein a valuable adjunct in the treatment of the accompanying hyperemia of the lid-margins. A small watering pot with a "rose" attachment is filled with water (to which a little eau de cologne is added) at 68° F. and the contents allowed to play for several minutes over the closed eyelids. This application will be found grateful to most patients with congested lids.

When it is of the eczematous type H. M. Lokey advises the following prescriptions:

\[ R \]

- Acid. carbolic. \[ \text{gr. ii} \]
- Sol. adrenalin. (1:1000) \[ \text{gtt. xxx} \]
- Enzymol. ad. \[ \text{fl. 5j} \]

\[ B \]

- Zinc. oxid. \[ \text{aaa} \text{ gr. xx} \]
- Acid. boric \[ \text{aaa} \text{ gr. xxx} \]
- Ungt. adrenalin. \[ \text{aaa} \text{ 5iv.} \]
- Vaselin. \[ \text{aaa} \text{ 5iv.} \]
- Lanolin.

The wash is to be applied to the lids with a cotton swab and the lid edges anointed with the salve.

von Sehlen advises the following formula in blepharitis eczematosa:
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Another formula by Michel is:

Ichthyol, zinc ox., gelatini 5.0 gm. (5iiss)
Glycerini 25.0 c.c. (f5vi. mxxv)

Sig: The ointment for the lids to be warmed before applying.

Fick's formula for moist, eczematous patches on the lids probably produces some zinc salicylate:

Zinc oxidi 1.0 (gr. xv)
Acid. salicylic. 0.1 (gr. iss)
Vaselinii 10.0 (5iiss)

Kummerfeld's lotion is applied as compresses or used as eyewater at night in the home treatment of blepharitis. The formula is:

Camphorae 0.40 (gr. vi)
Lactis sulphuris 4.0 (5i)
Aquæ calcariæ (P. G.)
Aquæ rosæ 40.0 c.c. (f51/4)
Gum acaciae 0.9 (gr. xii)

The following formula is also useful in acne palpebrarum:

Sulphuris 1.0 (gr. xv)
Camphoræ
Olei olivæ, 0.6 (gr. ix)
Unguenti rosati (P. G.) 15.0 (5ss).

In the form of ointment, tar is used in squamous blepharitis and other dermal affections of the lids. One of the best formulae I know is that with white precipitate:

Hydrarg. precip. alb. 0.5 (gr. viiiss)
Picis liquide 2.0 (5ss)
Petrolati 8.0 (5ii)

Mix thoroughly.
BLEPHARITIS, CHRONIC

F. C. Hotz used instead of yellow oxide ointment the following:

\[
\begin{align*}
\text{Iehthyol. ammon.} & \quad \text{gr. v} \\
\text{Zinc. oxid.} & \\
\text{Amyli.} & \quad \text{aa} \quad \text{gr. x} \\
\text{Vaselin. alb.} & \quad \text{5ii}
\end{align*}
\]

In the simple, hypertrophic form of marginal blepharitis Gradle advised the following resorcin mixture with sulphur, to be applied to the lid margins at night:

\[
\begin{align*}
\text{Resorcin.} & \\
\text{Lactis sulphur, aa} & \quad 1.00 \quad (\text{gr. xv}), \\
\text{Vaselini} & \quad 4.00 \quad (\text{5j}).
\end{align*}
\]

In cases of blepharo-conjunctivitis with undue secretion finely powdered starch is, alone or with other agents, sometimes dusted on to the conjunctiva. In the same way it is recommended for true eczema of the lids and face. It is also employed like (or with) zinc oxide in ointments.

In intractable, chronic blepharitis D. T. Vail prefers 1:2,000 to 500 solution of sublimate on a small cotton sponge which the patient uses at home wiping or sopping the lid margin twice a day—being careful not to allow the bichloride to get into the eye.

In the ulcerative form of blepharitis when the lesions do not readily heal they may be curetted and have applied to them on a cotton swab a small quantity of this solution:

\[
\begin{align*}
\text{Hydrarg. iodidi rub.} & \quad 1.00 \quad (\text{gr. xv}) \\
\text{Ol. olivae} & \quad 250.00 \quad (\text{fl. 5viii}).
\end{align*}
\]

The red iodide is also employed as an ointment (1:1,000) in the same affection but for that purpose milder salts of mercury are generally preferred.

With some surgeons picric acid is a favorite remedy for painting the lid edges in ulcerative forms of blepharitis. It is used as a 1 per cent. solution, afterward wiping it off with a cotton swab dipped in a 5 per cent. salt solution.

Oil of beech has been recommended undiluted as an application in blepharitis complicated by thickening or chronic infection of the conjunctiva. It is used as a more cleanly substitute for iodine and tar ointment, and as such should not be allowed to reach the conjunctiva but is to be painted on the dermal surface. The application had better be made at night and may be renewed at intervals, to irritate the skin without destroying its epithelium.
BLEPHARITIS CILIARIS

Vail in blepharitis ulcerosa, beats the white of a fresh egg with a few crystals of bluestone until turquoise-colored curds form. He orders this as a poultice, after thorough cleansing, all night for three nights. When the marginal lesions do not readily heal or respond to other treatment the ulcers should be curetted, after which they should have applied to them:

R

Hydrarg. iodidi rub. 1.00 (gr. xv)
Ol. olivæ 250.00 (fl. 5viii).

As Jackson points out, that one may procure permanent results in the treatment of chronic blepharitis, especially of children, the ointment and other remedies should be continued for several months after an apparent cure has been effected.

In obstinate cases of this affection, S. J. Bumstead has found nothing equal to the following prescription:

R

Cupri sulph
Ichthylol. āā gr. viii
Petrolati. 3i

This must be applied more carefully and less freely than the usual yellow oxide ointment and, if found too irritating, ought not to be used oftener than every second or third day.

Blepharitis ciliaris. See Blepharitis and Blepharitis, Chronic.
Blepharitis ciliaris ulcerosa. See Blepharitis.
Blepharitis eczematosa. See Blepharitis.
Blepharitis, Hypertrophic. See Blepharitis.
Blepharitis in hyperopia. See Blepharitis, treatment of.
Blepharitis marginalis. BLEPHARITIS CILIARIS. Sycosis tarsi.
Blepharitis ulcerosa. See Tinea tarsi and Blepharitis. Owing to the irregular classification in literature of blepharitis it is desirable to say something of this disease under different captions. Doubtless the various forms of marginal blepharitis are truly eczematous, but frequently they have nothing to do with true eczema. In any of them, however, the disease may be regarded as a varying manifestation of a number of different conditions both local and general and it requires some experience to apply treatment because successful therapy depends upon accurate diagnosis.

However, there are several agencies that should always be employed in the conduct of the majority of these cases. Inasmuch as the disease is frequently found in poor, ill-nourished and strumous children that fact should be borne in mind in the conduct of such cases. It also occurs in those whose occupations expose them to wind, dust and
BLEPHARITIS MARGINALIS

other irritating influences. Errors of refraction and defects in the muscular balance of persons who constantly use their eyes for near work and in a bad light are likely to cause suffering from the milder forms of this affection.

Treatment should first of all be directed toward the removal of crusts, if present. Very few patients persevere in this endeavor as they should, and it is, accordingly, often a wise measure to remove with the forceps every eyelash that harbors the scabby exudations. This prevents the reformation of the crusts, gives the remedies employed a better chance to reach the seat of the disease and set up healthy action in the parts affected. The best way to remove the crusts is to soak them well with a hot, 2 per cent. solution of sodic carbonate. After removal of all scabs an ointment of yellow oxide of mercury should be thoroughly rubbed into the edges of the closed lids:

B

Hydrarg. oxid. flav. gr. ii
Ungt. aquae rosae 5i

This may be done in the evening, shortly before retiring, while a boric acid solution should be applied several times during the day:

B

Acid. boric.
Sodii boratis aa gr. xv,
Aq. rosae fl. 3ii,
Aq. dest. fl. 5i.

When the case is one of eczema, with moist crusts, swelling of the lids, and conjunctivitis, various measures have been advocated. Benzoated lard alone, or with the addition of oxide of zinc, is a useful application:

B

Zinc. oxid. gr. vi
Adepis benzoat. 5i

Patients suffering from blepharitis should avoid dust, heat and wind as much as possible and should wear protective glasses when they leave the house. They should not themselves smoke, nor allow their eyes to be irritated by remaining in a smoking-room. The general health is worth looking after; indeed, it may be that a strumous diathesis lies at the bottom of the disease, for which cod-liver oil, arsenic, iron, etc., may be necessary.

If a blepharitis marginalis be perpetuated by eye-strain, glasses or other proper treatment should be ordered, especially if there be any astigmatism present. Whatever the treatment may be, a complete cure is not, in the majority of cases, to be expected inside of several months.
BLEPHARITIS MARGINALIS

The majority of cases improve with the application of yellow ointment and other greasy salves. Mild, detergent lotions (see Acid, boric) and soothing collyria containing holocaine are indicated. Mild emollients and dusting powders should also be employed. James Moores Ball (Text-book, page 165) recommends the following:

B

- Cocain. gr. x
- Bismuth. subnitratis 5iss
- Cerat. simplicis 5j

Internally the following may be prescribed:

B

- Acidi arsenosi gr. j
- Pulvis piperis nigri gr. ii
- Extracti gentianæ q. s.

Fiant capsule No. xxx
One capsule after each meal.

In blepharitis ciliaris, or squamosa, the lid margin is reddened and the interciliary spaces filled with whitish scales like dandruff. There is also an ulcerative form where the lashes are matted together with dried yellow crusts which on removal expose a raw surface. Nearly all these varied forms of blepharitis are accompanied by a conjunctival infection which should, of course, be treated in conjunction with the lid disease.

A. Duane, following in the main a prescription of H. Knapp directs the patient, first, to lather the eyelashes well as if he were going to shave them off; then to wash out the soap with tepid water, pulling the eyelashes at the same time, so as to remove any loose ones; then to dry the lids and apply yellow salve with gentle friction to the roots of the lashes; then to remove all excess of salve, so as not to leave the lids greasy.

In the usual forms of the disease F. B. Eaton advises soaking the lids with a saturated solution of sodic bicarbonate in warm water and thoroughly cleansing the palpebral margins. If there are any raw areas about the eyelashes these are touched with a 1 to 2 per cent. solution of silver nitrate on a probe and cotton. This treatment is followed by the application at night-time of the following mixture:

B

- Olei cadini fl 5ss
- Olei theobrom.
- Petrolati āā 5ss
J. F. Klinedinst advises the following formula:

\[\text{Hydrarg. oxidi flav. gr. viii}\]
\[\text{Ichthyol. gr. 10-30}\]
\[\text{Petrolati}\]
\[\text{Lanolin. ää 5iv}\]

Apply to eye-lids at night.

When there is irritation from the yellow oxide ointment or other preparation Percy Friedenberg orders the lids to be washed with pure castile soap, then carefully dried and the following salve applied at night with massage:

\[\text{Ichthyol. 0.20}\]
\[\text{Resorcin. 0.30}\]
\[\text{Lanolin. 5.00}\]
\[\text{Ungt. aquae rosae 5.00}\]

M. W. Ward prefers in the majority of cases of marginal disease the following prescription:

\[\text{Hydrarg. ammoniat. gr. iii}\]
\[\text{Petrolati alb. 5 ii}\]

Rub into the eye-lashes three times daily.

Hanford McKee has abandoned the use of yellow oxide in blepharitis and uses instead of it a mixture of ichthyol and oxide of zinc ointment.

J. W. Ingalls prefers:

\[\text{Acidi borici 5i}\]
\[\text{Ung. adrenalin 5ii}\]
\[\text{Petrolat. alb. ad 5 ii}\]

To be applied to the lids at night.

**Blepharitis pediculosa.** Phthiriasis. This marginal disease of the lids is due to pediculi. It and other parasitic lid diseases are uncommon in this country. When recognized they may be successfully treated by picking out the pediculi or other parasites by means of forceps and lens, and subsequently rubbing in sulphur or White’s ointment (q. v.).

**Blepharitis, pustular form of.** See **Blepharitis ulcerosa.**

**Blepharitis, Simple.** This classification is used by de Schweinitz (Text-book, p. 214) to indicate seborrhea of the lid-border; blepharitis cilaris or squamous blepharitis. This variety of palpebral disease depends upon an abnormal secretion of the sebaceous glands, and results in the formation of scales and crusts situated on the margin.
of the lids at the base of the eyelashes, or adhering to them, and may appear in either a dry or moist form. Removal of the hardened sebum exposes the skin, shining, red, and occasionally abraded. There is usually slight conjunctivitis. An accompanying seborrhea of the eyebrows and scalp may be present; both lids are invariably affected, and the patients complain of burning, inability to perform close work, and some dread of light. Exposure to cold and dust and the use of the eyes quickly increases the congestion of the lids. If the disease is of long duration or is subject to frequent relapses, considerable thickening of the lid-margins is evident, due to the inflammation surrounding the glands in the skin and tarsus. As to treatment see Blepharitis, and Blepharitis, Chronic.

**Blepharitis squamosa.** See Blepharitis, Simple.

**Blepharitis, Syphilitic.** The luetic variety occurs in the form of syphilis of the eyelids. It manifests itself either as a primary lesion or as a secondary or even tertiary change. See Chancro of the lid.

**Blepharitis trichophytica.** A form of the disease due to the presence of the trichophyton (q. v.) fungus.

**Blepharitis, Ulcerative.** Blepharitis ulcerosa. See Blepharitis.

**Blepharitis ulcerosa.** See Blepharitis, Chronic, and Blepharitis.

**Blepharitis, Vaccine.** The lid margins may be accidentally inoculated, especially by the finger when that has come in contact with vaccine virus or with the pustules of vaccination. When such infection takes place it may develop into a deep ulceration of the lid-margin, which may eventually involve the conjunctivæ. The treatment of such cases is that of ulcerative blepharitis.

**Blepharitis, Vasomotor.** A name for hyperemia of the lid-borders, which have a reddened and slightly swollen appearance. The symptoms result from exposure to external irritants such as wind, cold or dust. It may also be set up by eye-strain, and the symptoms are those of simple blepharitis, i. e., lacrimation, burning and a sense of heat in the lid and eyes. There is not much discharge in such cases, while scales and crusts are rarely present. The local treatment is that of simple blepharitis together with the removal of the underlying cause. It should not be forgotten that hyperopic astigmatism is not an uncommon source of this trouble.

**Blepharo-adenitis, or blepharo-adenitis ciliaris, is the name given by Arlt to the presence on the lid margin of circumscribed area of hyperemia and thickening. The eyelashes are matted together at their insertions into the free border of the lid by thick, yellowish crusts. The disease presents the appearance of a division of the cilia into isolated tufts of hair. There may be one or a number of
these collections, and the disease itself may affect one eye or both. On removing the crusts a little sero-pus exudes from beneath the exudate which when removed exposes a superficial ulcer. The eyelashes are readily removed and generally come away with the seabs. They have thickened roots. This disease is not uncommonly associated with eczema of the face, nose and scalp, and with it there is often a catarrh of the naso-lachrymal passages. The treatment of this disease is that of blepharitis (q. v.) in general. (See, also, Blepharitis, Chronic.) It is, however, of the greatest importance that the crusts and seabs should be removed as a preliminary to local applications and not allowed to reform.

Blepharo-adenoma. (L.) A rare form of tumor of the eyelid, first described by von Graefce. It consists of a new formation of epithelial tubes anastomosing with each other.

Blepharo-atheroma. A chalazion; also described as an atheromatous tumor imbedded in the tarsus.

Blepharocatochus. Blepharostat.

Blepharochalasis. Although this term was first suggested by Fuchs, in 1896, for that rare form of false ptosis, which involves the skin of the upper eyelids, yet Mackenzie, in 1854, accurately described it as a ptosis with hypertrophy and edema of the palpebral tissues, followed by their atrophy and relaxation. There is, however, no true ptosis but a sagging of the atrophied lid-skin over the lids.

One of the best expositions of the subject is by Walter B. Weidler (Pre-sessional Print, Ophthalmic Section, A. M. A., 1913), who believes that the disease ought to be classified with the dermal dystrophies. "Fuchs has included in this class ptosis adiposa and ephantiasis. Von Ammon spoke of this condition of the lids and called it epiblepharon, ptosis adiposa or ptosis atonica. The latter name fairly well describes the condition of the lids in the later stage of the disease.

Sichel, in describing a case, enumerated nearly all of the symptoms, but he regarded it as a true ptosis of the lids, which as we now know, from our further observations, is not the case. Arlt, reporting his case, called attention to the rosy appearance of the skin, but apparently overlooked the marked thinning and atrophy. Schwalbe was the first to use the term "blepharochalasis," but he used it to describe the results of his operation on the lids of patients who had shrinking and atrophy of the conjunctiva and the subcutaneous connective tissues of the lids after trachoma. His operation was designed to bring about a relaxation of these tissues and be called the procedure by the name just mentioned.

Many other names have been suggested from time to time by the
different authors and some of these will be only mentioned; the wisdom of their selection will be left to the reader. Panas called it *ptosis cutanea*; Terson, *dermatolysis palpébrale*. Frankel designated it as *paupières enbesace*; Dutoit, *pseudoleukemia lymphatica*, and Rohmer, who has reported four cases, thinks that *angiométralie des paupières* best describes the condition.

Blepharochalasis is the best name that has been suggested. Rejecting the idea of ptosis and admitting the existence of edema, with sometimes a consequent stretching, thinning and atony of the skin and subcutaneous tissues of the lids, this term includes all of the most important changes.

There are several cases in which the lesion appeared after severe physical exertion (Fuchs), but this in itself would not seem to be sufficient to explain all of the signs and symptoms of the disease. His case was that of a man who noticed the curious swelling of the lids after blowing a horn. A history of a profound mental shock or fright has preceded the appearance of the swelling, and in some of the cases it has been first noted after a long spell of crying. This all emphasizes the importance of carefully considering the emotional and psychic origin of the disease.

Recurrent attacks of angioneurotic edema has been given by Fuchs and Rohmer as the cause. This seems quite a possible explanation for some of the cases, considering the age of the majority of those reported, along with sex and history of repeated attacks of the edema and the consequent deformity present.

Errors of refraction have not been considered of much or any importance as a cause, and in neither of my cases were they of such a nature as to make me regard them as a possible factor. Schmidt-Rimpler thinks that it can best be explained by a hernia of the orbital fat. It has been suggested that it is directly due to changes in the vascular and lymphatic systems. But there has never been found in any of the cases any special involvement of the general lymphatic system. The change noted in the vessels has been an increase in the size but no increase in the number of vessels in the part affected.

Blepharochalasis begins with an edema of the subcutaneous connective tissues of the upper lid between the skin of the lid and the tarsal plate; the presence of this edema affecting, after a time, the elasticity of the tissues involved, with a consequent atrophy of the skin and subcutaneous tissues of the lid. The time of life at which it appears is often at the beginning of menstruation. Just why it affects the upper lid and remains confined to that portion of the orbital tissues is difficult to explain. There may be found in our
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further studies of this disease that autointoxication plays some part in the etiology of some of the cases of bleparochalasis. Inheritance has not been of great importance in the causation of this condition. In only two of the cases reported is there an indefinite history of the same condition having existed in one of the parents.

There has been considerable opportunity afforded for anatomic and pathologic investigation of this disease. Most of the patients have had one form or another of operation for removal of the affected tissues of the lid, thus permitting microscopic examination of the specimens obtained. It has not given us much information, however, because the findings have been so widely different in many reports. In most of the observations there has been an atrophy of the different layers of the skin, but more especially the rete Malpighii, the presence of fatty tissues, an increase in the size of the vessels, with a stretching and widening of the meshes of the connective tissue, is all that has been noted. No one seems to have given any explanation for the edema or the infiltrate which is found in the meshes of the subcutaneous connective tissue of the lids. It looked very much like a fatty infiltrate in my case and Bach found, when operating on his patient, that there was what looked like a fatty tumor which seemed to come from beneath the upper orbital wall.

Fehr describes very minutely what he found as far as the excised skin is concerned. He hardened the tissue in formaldehyde solution and stained it in various ways and at the same time treated some normal skin in like manner. The excised skin showed atrophy of all of the layers, but in the rete Malpighii layer he found almost complete destruction. The subcutaneous tissue was very lax and friable. The skin and the subcutaneous tissue were rich in blood-vessels, which were dilated and filled with normal blood-cells. In places there were pigment deposits which were probably due to the blood. Part of the sections were stained dark-blue with orcein for elastic fibers, according to the Unna-Tanzer method, and the remainder of the tissue decolorized to a grayish red. The elastic fibers were still present in great numbers but much thinned and stretched, forming wider meshes than normal. The thick masses of elastic fibers found normally at the junction of the skin and the subcutaneous tissues were entirely absent. Schmidt-Rimpler says that he was not able to find anything characteristic in any of his examinations.

Rohmer was able to examine the flaps removed from two of his patients. He found dilation of the lymphatics and new formed vessels, large sections of vessels (arteries and veins) engorged with blood in the skin and subcutaneous tissues. Not so much the number of the
vessels as the caliber showed increase. There was a general thinning of the skin, but no study of the elastic fibers was made. The elastic fibers were carefully studied (Unna-Tanzer) and no changes were discernible. Inflammatory features appeared due to the cicatrix from a former operation five weeks previously. Arteries and veins were much increased in size but no changes were noted in the lymphatics. He says that none of his studies has enabled him to form any conclusions that will throw light on the subject. Rosenstein has demonstrated some microscopic preparations with marked atrophy of the elastic fibers, showing, besides a flattening of the epidermis and a tearing apart of the subcutaneous connective tissue masses, dilated veins and thinned walls. This dilation of the subcutaneous connective tissue was noted by Fehr also and it is this portion of the lids which I think is the first to be involved in the disease. Whether this dilatation of the subcutaneous connective tissue is an edema or due to an invasion of fat is a question that, if once decided, will help a great deal toward clearing up the etiology of this disease.

There is no trouble in making a diagnosis of this condition after one has seen a case of blepharochalasis. In most of the cases reported it has occurred in young girls and is always limited to the upper lids; and it never gets well if left to itself, which is not the rule in angioneurotic edema. There are never any subjective symptoms, such as pain, heat or tenderness. It has been confounded with ptosis adiposa, but this should not occur if we remember that the latter disease is nearly always seen in the old, rarely or never in the young, and that it involves all of the lids, upper and lower, and is generally seen toward the inner half of lids.

Ptosis adiposa, as has already been said, presents some of the symptoms of blepharochalasis. There is a relaxation of the skin, but no true atrophy follows the condition no matter how long it may have existed. In ptosis adiposa the bagging of the upper lid is more marked at the inner side, and this condition is thought to be due to the relaxation of the bands of fascia connecting the skin with the tendons of the levator with the upper margin of the orbit. This condition has been referred to as ‘‘tear-bags’’ in the old.

Elephantiasis of the lids is seen in later life and often gives a history of having appeared after severe inflammation of the lids. It is frequently seen after attacks of erysipelas. In this disease the swelling of the lids may assume tremendous proportions. This swelling is a permanent thing and may hang down over the face. There is in some of the cases involvement of other parts of the body and it may be possible to demonstrate the presence of the filaria sanguinis hominis in
the blood. The skin is much denser and firmer than in the cases of blepharochalasis.

_Lymphangioma of the lids_ is usually of the upper lids and in some cases may be limited to one side. The growth in the lids is rather firm and dense and there is often a form of blood dyscrasia which helps in the making of the diagnosis.

_Plexiform neurofibroma of the lids_ is often seen in youth, but it has a rope-like feel to the touch, full of ganglionic nodes, may invade the temple, the lower lids and even extend into the orbit. It is usually unilateral.

Bilateral enlargement of the lacrimal gland simulates this condition very closely and might be easily mistaken for blepharochalasis. There is the slight bagging and sagging of the upper lid to the outer side, but there would not be the general fulness of the subcellular tissues and the thinning of the skin. Hirschberg thinks that bilateral enlargement of the lacrimal gland is not very rare and gives three causes for this enlargement: chronic inflammation following long-standing corneal inflammations; acute inflammation of the gland itself (this is very rare); subacute or nonsuppurative bilateral enlargement possibly due to paralysis of the third nerve.

_Mikulicz' disease_ is quite a different condition and consists in the coincidental enlargement of the salivary and lacrimal glands without pain and is chronic in its course. Mikulicz says this disease begins in the lacrimal glands. This disease is due to infection from the blood or by way of the ducts of the gland. In many of the cases of this disease there has been local disease affecting the conjunctiva or the cornea or a general disease was present, such as syphilis, tuberculosis, leukemia or menstrual disorders. As a rule it is not seen in the young but comes on in middle life. It might be possible to mistake such tumors as lipomas, adenomas, fibromas, affecting both lids, for blepharochalasis, but the bilateral appearance of such tumors is very rare.

The _treatment_ of blepharochalasis, as far as local means are a part, has been, up to the present time, quite unsuccessful. The local injections of alcohol, iodin and the solution of zinc chlorid has not produced any permanent results. In my first case the electric needle was used with the hope of setting up a cellulitis of the subcutaneous tissues of the lid, with secondary contraction and shrinkage of all of the surrounding tissues, but this did not follow a most persistent use of the needle. The Roentgen ray and the high-frequency current or the violet rays have not been of any service. The use of any general medication has not been followed by any improvement of any of the symptoms. The fact that none of the cases presents any general
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dyscrasias would seem to be a partial explanation why we should not expect any results from this form of treatment.

The only method of dealing with this condition is surgical. Many of the cases have been operated on with a varying degree of success. Simple excision of the skin of the lid with removal of a portion of the skin has not been found to be sufficient to correct the defect. Some of the operations have been followed by what looked like a keloid formation of the scar. Some of the operators have had hernias of the fat and subcutaneous tissues of the lid through the edges of the wound. Rohmer thinks that a special operation is indicated as the esthetic question is the thing that the patients have uppermost in their minds. One must not fear to excise too much and his experience has shown that all of the affected skin area must be extensively resected and even then the result won't be perfect. He has had ugly lumps form which swell at times. If a fatty lump should present during the operation, you should remove all that you can to prevent these hernias of fat as already spoken of. One must exercise great care in the closing of the wound, using catgut sutures and a pressure bandage after placing over the edges of the wound fenestrated silk tissues to avoid any possibility of the dressing adhering to the wound. One of his cases he has been able to observe five years after the operation and there is no tendency to recurrence because he removed with his incision all of the affected skin tissue. His other two cases have not been of more than six months' duration at the time of report and therefore no conclusion was justified.

Blepharo-chromidrosis. (L.), f. n. 'Colored sweat;' a rare affection in which bluish spots of different tints appear on the lids, especially in the cutaneous folds.

Blepharocleisis. (L.) Ankyloblepharon (q. v.).
Blepharoclonus. Spasm of the orbicularis palpebrarum muscle.
Blepharocoloboma. A form of partial ablepharia (q. v.) consisting in a fissure of the eyelid, generally of the upper lid.

Blepharoconjunctivitis. This term is generally applied to the Morax-Axenfeld bacillus conjunctivitis (q. v.) because of the involvement not only of the tissues of the lid-border but of the conjunctival covering. Moreover, the disease is generally due to the diplobacillus. See Conjunctivitis, Morax-Axenfeld.

Blepharoconjunctivitis durch Diplobacillus. (G.) Morax-Axenfeld (angular) conjunctivitis.

Blepharodyschrea. Discoloration of the eyelid from nevus or from any other cause.
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Blepharodyschroia. An obsolete term for discoloration of the eyelid from nevus or from any other cause.

Blepharoematidrosis. The rare occurrence of the sweating of blood from the cutaneous surface of the eyelid.

Blepharok-atoxon. Lid-holder. A kind of forceps, used by ancient ophthalmologists for holding fast the eyelid in operations on that structure.—(T. H. S.)

Blepharolithiasis. (L.) The formation of chalky concretions in or on the eyelid.


Blepharophimosis. Narrowing or shortening of the interpalpebral fissure. Sometimes this is a hereditary condition, having been observed to occur in a number of members of the same family. As was long ago pointed out by von Ammon, it is also one of the results of malignant trachoma. When the conjunctival atrophy is very marked the commissure becomes quite narrow and the eyeball appears as if it were attached to the posterior portion of the lid. The treatment of these cases, which is generally surgical, will of course depend upon their cause. See Blepharoplasty.

Blepharophlegmasia. Blepharitis.

Blepharophyplasty. n. Pertaining or referring to the plastic surgery of the lid and eyebrow.

Blepharophyrplastik. (G.) A plastic operation in which a lost portion of the eyebrow is replaced by a flap from the temporal portion of the hairy scalp.

Blepharophthalmia. (L.) Inflammation of both the ocular and the palpebral conjunctiva.

Blepharophthalmostat. n. An instrument for maintaining immobility of both the eyeball and the lids.

Blepharophthiriasis. (L.) A condition in which the eyelashes are infested with lice.

Blepharophyma. A tumor of, or outgrowth from, the eyelid.

Blepharophyperidrosis. Undue sweating of the eyelid.
Blepharoplasty. This operative procedure includes many canthoplasty, canthotomy, cantholysis, tarsorrhaphy and "lid-building" methods, as well as operations for ectropion, cicatricial orbit, symblepharon, and restoration of the ocular cul-de-sac. It may be defined as the reformation, replacement, readjustment or transplantation of any of the lid tissues. It also embraces the formation of a portion or the whole of an eyelid that is congenitally defective or that has been destroyed by disease or by injury of any sort.

Plastic surgery of the lids is concerned chiefly with the palpebral and superciliary regions and the skin immediately surrounding. Within this particular area are several lines of surgical interest, because incisions which follow natural curves or wrinkles produce a minimum of scarring and these lines may frequently be advantageously followed in lid operations. Above the brow are two or more corrugations especially well marked in some, while at the upper and lower boundaries of the orbit and at the convex borders of the tarsi are certain more or less pronounced furrows or sulci. Below the orbit is a curved line (or lines) extending from the inner canthus downward and outward over the cheek. These lines on the cheek are scarcely discernible in the young or robust but are usually well marked in the corpulent, the emaciated and the aged.

As a knowledge of the surgical anatomy—including the histology—of the lids is essential to a clear understanding of blepharoplasty a review of the principal points connected with that subject is herewith presented.

The eyebrows, or supercilia, which consist of a ridge of prominent, thickened integument supporting short, thick obliquely-placed hairs, frequently demand attention, either as an obstacle to bringing a pedicled graft down from the forehead, or as a possible substitute for eyelashes.

The hairs of the upper half of the eyebrow point downward, and those of the lower half point upward; hence the lower half seems well suited for replacing the cilia of the upper lid, and the upper half for a like substitution as regards the lower lid, as they thus most nearly approximate the natural curve of the lashes. This is theoretically correct and generally true in a practical sense. The obliquity of their direction, however, renders it impossible to have the same position as the normal cilia, and there is apt to be an interlacing of the upper and lower lashes when the eyes are closed. This will cause constant disarrangement of the cilia, some of which will probably rub the cornea and cause irritation.

In old age the supercilia frequently become coarse and long,
especially in men. For this reason the substitution of eyebrows for cilia is a more favorable operation for women than men, though it has been the writer’s good fortune to restore the entire upper lid and cul-de-sac by a sliding flap from the forehead, whose lower margin included a row of the uppermost supercilia, which admirably simulated cilia when slid into place.

The eyebrows are connected with the orbicularis, corrugator supercilii and occipito-frontalis muscles; hence all operations depending upon the action of the occipito-frontalis for the elevation of the lid will inevitably produce a certain amount of disfigurement by also elevating the brow. Certain operations for ptosis are lame in this particular.

The integument of the upper, lower and outer regions of the lids is so lax that the eye may be closed by tension in the direction of the outer canthus. Owing to this fact too much tension at this point should be avoided, although the dangers of horizontal tension are slight compared to those of vertical which, even if of small degree, produces ectropion. At the side of the nose the skin is more adherent, hence an anchorage for grafts whose tension is outward. The skin under the upper border of the orbit is thinner than of the supraorbital region and forms a deep fold where it turns over the border of the tarsus. Allowance for this fold must be made in using thick skin-grafts. The integument covering the lid proper is very thin and is loosely joined to the underlying tarsal cartilage by extremely lax and delicate areolar tissue, devoid of fat. This thinness is quite essential to free movement of the lid, hence in substituting other skin for that of the lid, thin grafts should be chosen from protected surfaces, such as the inner aspect of the arm, and not from an extensor surface, where the integument is thick and the hair coarse.

The looseness of the areolar tissue and the elasticity of the skin covering the lids permit rapid and extensive extravasations of blood and inflammatory products and allow the emphysema sometimes seen after fracture of some of the thin bones of the inner side of the orbit, which also help to form the walls of the accessory nasal sinuses. This same extreme mobility allows the skin to be easily drawn away by the contraction of neighboring cicatrices, and distortion of the lids thus produced; because, at the free border of the tarsal cartilage the skin is firmly attached and the effect of the traction is felt most at this point.

The anterior border of the free edge of the lid is rounded and the seat of the cilia, whose roots are deep and spring from the muscular and connective tissue. Hence the difficulty of their destruction by electrolysis. They are arranged in two or three rows and curve away
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from the eye-ball. This angle between the cilia and the globe must be restored in the final result of all successful operations for entropion and trichiasis. To accomplish this a prononneed over-effect is usually necessary at the time of operation.

The sebaceous follicles of the eye-lashes are known as the glands of Zeiss.

The outer margin of the free border of the lid is rounded and soft while the inner presents a sharp, angular edge and resembles cartilage in firmness. In health this sharp edge lies smoothly upon the globe, whose surface it cleanses with every act of winking, but if, either from disease or operation, a deformity is produced, so that this sharp edge is turned in upon the cornea, it becomes a serious irritation and often leads to complications of the cornea; or the sharp angle, through chronic blepharitis, may become absorbed, in which case the cilia are brought down in contact with the cornea, to rasp and roughen it. Ulceration and pannus are frequently thus engendered.

At the inner extremity of this sharp-edged border, and about 6 mm. from the inner canthus, are located the lachrymal papillæ, two small elevations on whose crests are the puncta lachrymalia, the minute orifices of the canaliculi. As the drainage of the conjunctival sac depends upon their patency and proper apposition with the globe it would seem that a word of warning about injuring them or altering their position is superfluous were not such needless and baneful distortion, ectropion and trichiasis.

The space between the cilia and the sharp inner margin of the free border is called the intermarginal space, and its covering is more like dermal than mucous tissue. This space is of considerable surgical importance as it is the seat of incisions in many operations for entropion, ectropion and trichiasis.

Just behind the cilia are found the openings of the glands of Moll (modified sweat glands), and just in front of the sharp posterior lip are the openings of the Meibomian glands, which produce a sebaceous secretion that lubricates the lid edges, the conjunctiva and the cornea. This secretion, together with that of the caruncle, serves to counteract the macerating action of the tears upon the lid margins and act as a dam to prevent their overflow upon the cheek. It effectually seals the conjunctival sac when the lids are closed, and protects the cornea from extremes of heat and cold by covering it every few seconds with a poorly-conducting material heated to body temperature. When these glands are destroyed, or their secretion perverted to a more oily nature, the cornea and those portions of the conjunctiva exposed by the open palpebral fissure become xerotic and otherwise diseased.
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The palpebral fissure is irregularly elliptical and the direction of its long axis is somewhat upward and outward. Hence it might seem that in an incision for a canthoplasly this upward line should be followed. As a matter of fact, however, an incision whose direction is slightly downward gives a much better cosmetic result in consequence of the normal inclination of the furrow at that point.

The shape and width of the palpebral fissure are principally responsible for the expression and apparent size of the eyes. The so-called large and beautiful eyes are really so not because of the actual size of the globe but because of the width of the palpebral orifices. This fact is noticeable in the results of canthoplasly, especially following the phimosis of old trachoma. It is also made use of by the "beauty specialist." Cocain widens the palpebral opening and the effect of the enlarged opening is further enhanced by the accompanying mydriasis, thus giving the eyes an unusually large and dark appearance.

Beneath the epithelial covering of the lid is a layer of loose areolar tissue, in and behind which are the palpebral muscles. The levator palpebrae superioris takes its origin from the under surface of the lesser wing of the sphenoid, above and in front of the optic foramen. It is inserted into the upper border and anterior surface of the tarsus and the skin of the middle of the upper lid. Between the tarsus and the skin lies the orbicularis palpebrarum. It is a horse-shoe-shaped muscle, attached to the nasal process of the superior maxilla (in front of the lachrymal groove), the internal angular process of the frontal bone and to the border and anterior surface of the internal tarsal ligament. It is also attached to the overlying integument but glides freely over the tarsus. In canthotomy for spastic entropion it is necessary to divide the fibres of this muscle, or the external canthal ligament, well out to the mid-point to secure the temporary inhibition of its action which the operation is intended to produce. Likewise, in a canthoplasly, as a step in operations which have for their object the eversion of the tarsal cartilages, the external tarsal ligaments must be severed so as to give the tarsus sufficient freedom to allow it to be turned out. Failure to divide these ligaments renders nil many entropion operations.

Mueller's muscle, a layer of unstriped muscular tissue arising from the tarso-orbital fascia, is also inserted into the upper border of the tarsus.

The tarsi are two plates of dense connective tissue, which give the lids rigidity of form and furnish attachment for the muscles. They are about 25 mm. in length, and the two extremities are connected with the lateral walls of the orbit by the internal and external
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palpebral ligaments. The upper tarsus is about twice the width of the lower. Between the superior edge of the orbit and the convex border of the tarsus stretches a thin aponeurotic membrane which, with the foregoing structures, forms the septum orbitale. This membrane fuses with the tarsal ligament externally but internally it separates therefrom to find attachment on the lachrymal bone immediately behind the lachrymal sac, while the internal tarsal ligament is inserted in front of it.

The tissues of the lid naturally divide themselves into two parts or leaves; the outer leaf containing the integument and muscular tissue, the inner the tarsus, its attached aponeuroses and the conjunctiva. The two parts are loosely connected by areolar tissue. This arrangement facilitates many operations on the lids.

The inner or palpebral surface of the lid is covered with the conjunctiva, a mucous membrane closely adherent to the tarsus and reflected over the anterior part of the sclerotic and the cornea, thus forming the conjunctival sac. Over each of these tissues it undergoes considerable modification. The palpebral portion is thick, opaque and closely adherent to the tarsus. It is richly supplied with blood vessels, its surface presents numerous papillae, and its stroma contains an amount of lymphoid tissue. The reflection of the conjunctiva from the tarsi to the globe forms the fornix, or retro-tarsal folds. These folds are much convoluted, thus permitting great freedom of motion of the globe. On account of this laxness marked chemosis may occur in inflammation of the conjunctiva. The necessity of this looseness of the retro-tarsal fold to the unrestricted movement of the globe should be borne in mind in operations for symblepharon and restoration of the cul-de-sac. At the inner angle of the eye this reduplication of conjunctiva is most pronounced, forming a well-marked semilunar fold, the plica semilunaris. The bulbar conjunctiva is very loosely attached to the underlying sclerotic coat by the episcleral tissue, except at the sclero-corneal margin where it is closely adherent. The laxity and elasticity of the conjunctiva most admirably adapt it to plastic operations on this part of the globe. It is transparent, only slightly vascular and contains no glands. The part of the conjunctiva forming the outer layer of the cornea is so modified that it consists of only a thin layer of stratified epithelium.

The arteries of the lids are continuations of the ophthalmic and facial arteries at the inner side of the nose, and a branch of the temporal near the upper-outer angle. In making pedicled flaps the long axis of the flap should correspond with the direction of the larger
bleed vessels, where this is possible, in order to give them the best possible nourishment.

The veins of the lids for the most part empty into those of the forehead and into branches supplying the ophthalmic vein, to reach which they must pass through the fibres of the orbicularis. Consequently contraction of the orbicularis, be it from inflammatory infiltration or blepharospasm, interferes with the return circulation and leads to edema of the lids and an aggravation of any morbid process in these parts. This fact explains why these cases often resist treatment until a free canthotomy is done, which paralyzes the sphincter action of the orbicularis and relieves the pressure upon the globe.

The lymphatics form two nets, before and behind the tarsal plates. They drain into the preauricular, parotid and submaxillary lymphatic glands.

Canthoplasty. As this surgical measure frequently forms a part of blepharoplasty it is included under this heading. Literally, the word signifies an operation for the correction of an anomalous condition of the external commissure of the lids, and is to be distinguished from canthotomy or tarsodialysis, which is merely a cutting of the canthus. The term is used, however, in both senses, yet with this difference; simple incision of the canthus, without the addition of sutures, is called provisional canthoplasty; while the more finished operation, wherein there is an external canthotomy and the divided conjunctiva and skin are stitched together, or yet further elaborated, is known as definitive canthoplasty.

The former term is applied, for example, to the temporary elongation of the palpebral fissure that is made preliminary to exenteration of the orbit, to the enucleation of a globe of extra size, to the extraction of cataract where the conjunctival sac is much shrunken, and to relieve pressure, as in phlegmon of the orbit, in the intense chemosis of gonorrheal ophthalmia, and in panophthalmitis.

The second refers to permanent extension of the outer commissure for the correction of blepharophimosis, for ankyloblepharon, and for relief of the damaging lid tension in chronic trachoma. It is also an important part of many operations for entropion, and is occasionally the sole measure adopted for the cure of spastic entropion.

It may be stated in passing that canthotomy, pure and simple, is seldom practised nowadays, as even in most of the instances just given it is followed by sutures.

C. R. Agnew, of New York, was the first, in 1875, to demonstrate the immense value of canthoplasty as a therapeutic measure in inflam-
mations of the conjunctiva and cornea, such as the more severe phases of phlyctenular and interstitial keratitis and trachoma.

Agnew's cantholysis is a modification of the operation devised by von Ammon in 1839. It is the simplest method and the one chiefly in vogue among American surgeons. The instruments employed are large and small straight, blunt scissors, mouse-tooth forceps, needle-holder, and two or three fine curved needles. General anesthesia is resorted to only when absolutely necessary. Local anesthetics help slightly. The patient lies on the table.

First step. The canthotomy. The outer commissure is held moderately open by the left thumb and index finger; one blade of the large scissors is slid into the the outer cul-de-sac as far as it will readily go, its edge exactly beneath the angle of the lids and in line with the closed palpebral fissure. The other blade is closed down until it touches the skin, a good grip is taken on the handles, so that the blades will not "buckle," and with one firm snip the cut is made. The skin incision should be from 1 to 1 1/2 cm. long, according to the demands of the case; the conjunctival cut should reach to the bottom of the cul-de-sac. Although the cut is usually made in a perfectly horizontal direction, in many individuals the scar conforms better to the natural topography of the outer canthus if it be given a somewhat downward inclination.

One should bear in mind that a part of the accessory lachrymal gland lies in this region and strive not to injure it wantonly.

There will be some bleeding, but it usually ceases spontaneously.

Second step. Division of the external canthal ligament. The free border of the upper lid is grasped by the left thumb and index, pushed slightly up to open the spaces between the severed skin and conjunctiva, and the small scissors, closed, are put into the upper opening to feel for the ligament. The lid is now pulled forward toward the nose, so as to make the ligament taut, when the scissors are opened slightly, the blades are pushed up astride the ligament about midway of its length, and it also is cut with a single snip, and at right angles to the primary incision. Some authors state that the conjunctiva is unavoidably incised in dividing the ligament; such is not the case, for with delicate scissors and a little care, neither the skin nor the conjunctiva need be wounded. If the snip is successful the lid at once gives way under thumb and finger. If it fails to yield, another and more careful effort must be made. The same procedure is repeated on the lower section of the ligament.

Third step. Placing and tying the sutures. An assistant opens wide the extended commissure. It will be observed that the cut in
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the skin is longer—often very much longer—than that in the conjunctiva. Now, all the descriptions of the operation I have read, and all the many cuts I have seen illustrative of it, teach that the angle of the conjunctival opening should be joined to that of the skin. This is precisely what Agnew insisted should not be done, and with substantial reasons; for, because of the inequality in the length of angles alluded to, thus to unite them means the obliteration of the external cul-de-sac; not only this, but it also means undue stretching of the conjunctiva to force it to meet the skin at this point, hence, the form-

![Agnew’s Cantholysis, or Modification of the von Ammon Canthoplasty.](image)

ation of an unseemly bridle or band that is particularly noticeable and restricting when the globe is in adduction. Instead, therefore, following Agnew, after picking up the conjunctival angle with the needle, it is carried outward as far as it will go without any stretching and is joined to the upper lip of the incision. (See figure.)

Another suture is placed to unite the lower skin and mucous lips, and sometimes a third to perform the same office above, and the operation is finished—unless, perchance, one chooses to put in a fourth or superficial suture to close the small skin angle thus left unclosed. Care must be used not to include the canthal ligament in suturing. As each suture is put in, if it be not tied at once, the two ends of thread are laid together on the temple where an assistant places a finger on them to insure keeping each pair separate. They are tied with the canthus stretched open, in order to see that they are true, and not too tight lest they cut out of the conjunctiva.

Several other ingenious and effective varieties of canthoplasty have been devised and extensively practiced. Attention is here called to three: Richet resected a dart of skin and tarso-orbital fascia whose base is the canthus and whose point reaches outward horizontally 1½ cm. A median horizontal incision is made in the outer wall of the external conjunctival cul-de-sac thus laid bare, and the cut edges stitched to those of the skin.
David Prince, of Jacksonville, Ill., made a cutaneous incision, beginning on a level with, and 3 or 4 cm. from the commissure, down and in, parallel with the lower lid border, one-third to one-half of the length of the latter; then from this point out and up back to the level of the canthus, but several millimeters further toward the temple. The curved angle of skin thus marked out was dissected up from apex to base. A third incision joined this base and the canthus, the upper lip of which was undermined for a centimeter or more toward the brow. A double-armed suture was put through the point of the curved flap outlined by the first two incisions; it was then tucked up into the pocket made by the undermining of the upper lip of the horizontal incision, the suture was brought out through the skin beneath the supercilia, and tied over cylinders of buckskin or other material. The remaining angular opening was closed by sutures, which completed a clever method for combining canthoplasty with correction of moderate ectropion of the lower lid.

V. Chalot makes an incision through the skin only, extending from the canthus outward 1½ cm. This he crosses with a vertical skin incision, made flush with the canthus, the two forming a capital T supine — against the canthus. The two angles he dissects or undermines, exposing a bridge of conjunctiva. This is incised above and below, turned outward, and sutured to the angle of the cutaneous incision.

[In chronic infiltration of the conjunctiva and in shrunken conjunctival sacs von Ammon’s canthoplasty does not prove efficient, on account of the lack of elasticity of the conjunctiva, which prevents a sufficient covering of the wound, or the fixating sutures cut through too early. Kuhnt accordingly covers the wound with Thiersch’s flaps taken from the inner side of the upper arm. The flap must be large enough not only to cover the incision, but also to be inserted 3 to 4 mm. under the undermined edges of the skin and conjunctiva.—Ed.]

Tarsorrhaphy or blepharorrhapry aims to produce adhesion of the lid edges and a consequent closure of the palpebral fissure. It may be complete or partial, internal, median or external, depending upon the extent and part of the lids operated on. It may be permanent or temporary. Its use is indicated for the protection of the exposed cornea, as in paralysis of the seventh nerve, neuroparalytic keratitis, and pronounced exophthalmos; for the correction of some forms of ectropion; for eversion of the puncta and of paraphymosis; also to partially immobilize and hold the lids in position in certain surgical operations for the restoration of the lids and conjunctiva, and to
prevent cicatrical ectropion after extensive destruction of the palpebral skin.

The external method was first practised by Walther and antedates the median method by several years. Before the introduction of median tarsorrhaphy it was very extensively used, and is still often resorted to where a permanent union is desired but should not be used as a provisional step if one wishes, later, to free the lid edges which it is the object of this operation to unite.

This adhesion is accomplished by excising strips of skin from the margins of both upper and lower lids, of sufficient depth to include the follicles of the cilia and extending as far out from the canthus as the degree of closure desired seems to demand. (See illustration.) The raw edges are united by sutures which pierce the entire thickness of the skin, tarsus and conjunctiva and hold its parts in correct apposition. They should usually be removed at the end of from four to six days.

Fuchs' tarsorrhaphy operation is a modification of Walther's and it produces a more firm union than the original. Like the other operation it, too, destroys the cilia, hence should be used only where a permanent result is desired. It is performed as follows: An intermarginal incision 5 mm. deep is made in the lower lid corresponding in area to the part to be closed. This incision divides the lid into two leaves, one of skin and subcutaneous tissue, the other tarsal cartilage and conjunctiva. At the nasal end of the incision a vertical slit is made in the outer leaf, allowing the leaves to gape. Like incisions are made in the upper lid with the addition of a second horizontal incision in the skin half, which entirely removes this part, leaving a denuded area about 5 mm. wide and the length of the incision. Over this denuded space is drawn the skin flap of the lower lid by double-armed sutures which are tied over a roll of gauze, or suitably protected in some other way. One or two fine skin sutures may be necessary to complete the operation.

Internal tarsorrhaphy. Occlusion of the inner commissure, under the name canthorrhaphy, was first resorted to for exophthalmos from Vol. II—21
too free tenotomies practised in the early operations for strabismus. The operation was given definite technic and systematized by von Arlt, who called it median tarsorrhaphy, to distinguish it from the external or lateral variety. Its principal indications, perhaps, are in slight degrees of atonic ectropion with eversion of the lachrymal punctum, and in the sagging of the lower lid from the wearing of an artificial eye. By some, however, it is considered preferable to the median form for lagophthalmos. Its results are certainly less disfiguring than are those of external tarsorrhaphy.

**Fuchs' Operation for Tarsorrhaphy.**

*Arlt's operation for internal tarsorrhaphy.* The operation is performed as follows: A narrow strip of skin is resected from around the inner canthus, being very careful not to wound the underlying canaliculi, and the two raw edges brought together by fine sutures, as shown in the illustration. The incisions should not, of course, be so extensive as to encroach on the puncta. In a few days union will be complete and the stitches may be removed.

**Graefe's Operation for Tarsorrhaphy.**

*The Bowman-Panas operation of median tarsorrhaphy.* Median tarsorrhaphy was first introduced by Bowman and later modified by Panas, who performed it in the following manner: The eyelids are closed and the point selected for occlusion marked on both upper and lower lids. If the eye has useful vision this part should not be
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more than half a centimeter in length and situated a little to the inner side of the center so that the outer opening may be used for distant and the inner one for near vision. The location of the bridge having been properly marked the lower lid is held firmly against a horn spatula, or grasped by a fixation forceps, and a thin slice of the tarsal portion of the free border removed without injuring the cilia or their follicles. The upper lid is treated in the same way. Two sutures are next passed through the entire thickness of each lid, the denuded areas drawn into accurate coaptation, and the sutures tied over a section of small rubber tubing, roll of gauze or a cylinder of cotton. They may also be tied in bow knots and the slack in the thread taken up if they become loose. In either case the sutures should be reinforced by means of adhesive strips. Removal after four or five days. If found desirable the entire bridge, or any part of it,

![Diagram of eye with sutures]

Position of the Sutures, Before Tying, in the Arlt Operation.

may be subsequently freed without causing any deformity, since the cilia have not been destroyed. The immediate result is to close the lids completely. After a variable length of time, however, the free portions of the lid become so curved that they form two ellipses of sufficient width to allow fair vision but not to cause trouble from exposure of the cornea.

The Graefe operation has proven most satisfactory at the hands of the writer in those cases where the cornea is in danger from over-exposure. Not the least of its advantages is that when the occlusion thus produced is no longer needful it may be relieved in a moment, by a simple incision, and not a trace be left.

Bossalino's tarsorrhaphy produces permanent union of the lids, conserves the ciliary margin and is simple and effective. Both lids are split the distance of the proposed union and divided into two leaves, the outer consisting of orbicularis and skin, the inner of tarsus and
conjunctiva. One end of a double-armed suture is then passed from the conjunctival surface forward through the posterior leaf of the lower lid and into the apex of the cleft in the upper lid, passing diagonally up through the orbicularis and skin, emerging at a point about 14 mm. above the lid margin. The other end of the suture is similarly inserted parallel to this, but a few millimeters away. When the ends are drawn tight the posterior lip of the lower lid is pulled up into the cleft in the upper lid giving an extensive surface for union. The ends of the suture should be tied over a piece of rubber tube or roll of gauze.

*Total tarsorrhaphy* is, literally speaking, of course, never made, as an outlet must be left for the lachrymal and other secretions. Lisfranc was the first, in 1836, to make the so-called total occlusion. He did it to stop the progress of anterior staphyloma of the globe.

It is the best preventive of cicatricular ecropion after extensive destruction of the palpebral and adjacent skin from burns, blastomycosis, etc., and is useful to enhance the effects of operations for such ecropion. The simplest and best method is merely an extension of that of Panas for median tarsorrhaphy. A small opening should be left both internally and externally for the double purpose of drainage and to facilitate reopening of the palpebral fissure at the proper time.

_Blepharoplasty in general._ Plastic surgery of the lids finds its chief indication in the relief of those malformations due to the contraction of cicatrices, either of the lids themselves or of neighboring parts;
also for correcting deformities due to deficient or excessive congenital development, to the loss of parts from injury, burns or operations for malignant growths, or to the destructive ulceration of syphilis, tuberculosis, lupus and other diseases. Hyperplasias from chronic inflammation frequently call for surgical intervention, as does also loss of function of the lids due to lesions of the seventh and third nerves.

Operation is contraindicated if the patient have a syphilitic infection not under proper treatment, if he be in an advanced stage of diabetes or Bright's disease, give a history of hemophilia or be in a state of marked debility. Local contraindications are lupus that has shown signs of active ulceration within six months, any acute infection of the conjunctiva or lids, or chronic dacryocystitis.

The exact results of plastic operations can never be accurately foretold, which should deter one from resorting to them except in cases where it is evident that even a moderately successful result would cause less inconvenience and disfiguration than the original lesion. A guarded prognosis should be given if the operation is to be an extensive one, for while many plastic operations are functionally satisfactory, the majority are cosmetically disappointing to the patient. Care in minor details, especially accurate approximation of skin edges, will do much to minimize extensive scarring.

These operations naturally divide themselves into four groups:

1. The replacement or readjustment of tissues. This may be done by the excision of parts and coaptation of the edges, with or without undermining the adjacent skin; commonly known as the French method and usually produces a minimum amount of disfiguration.

2. Transplantation with a pedicled flap. (a) From adjacent parts (as in the Indian method), (b) from distant parts (as the arm in the Italian operation for restoration of the lid), (c) from another individual.

The first method is in common use, the second is rarely used, and the third, while theoretically possible, is practically never resorted to. These pedicled flaps may be slid, twisted, rotated, everted, stretched or freely manipulated in almost any way to get them into position. They may, if necessary, be bridged over healthy tissue or moved from comparatively distant parts by repeated transplanting of alternate ends.

The pedicled flap usually survives, hence this operation is satisfactory so far as function in concerned, but sometimes results in disfiguring scars.

3. Cutaneous grafting or transplanting without a pedicle is usual-
ly done by one of three methods, (a) Reverdin's, by means of isolated islands of skin; (b) Thiersch grafts, thin sheets comprising the epidermis and the upper part of the corium; (c) the Wolfe graft, in which the entire thickness of the skin is used.

The grafts for any of these three methods may be taken from other parts of the patient's body, from another living individual, from a cadaver or amputated limb not more than 12 hours dead, or from one of the lower animals, as a live rabbit, chicken or frog.

The Reverdin graft is seldom used in lid surgery. The Thiersch grafts frequently give a large measure of relief but seldom look like normal skin. The difference is not so apparent at about body temperature but becomes evident in extremes of heat or cold.

4. Benign cicatrization tends to correct deformities by the contraction of properly placed cicatrices. These scars may be produced by sutures, linear cauterization or cauerty puncture. The method is useful where the deformity is slight. It causes little disfiguration and may be repeated as often as necessary to produce the desired result.

In doubtful cases it is well to err on the side of conservatism. The results of plastic surgery, especially of skin-grafting, are so uncertain and the resultant contractions are so long continued that the ultimate accomplishment of radical interference is frequently as bad as, or worse than, the defect it was intended to correct.

The replacement or readjustment of tissues by fashioning and mobilizing flaps of adjoining skin should be chosen whenever possible, unless it is obviously unsuited, or will produce too great tension. So far as the life of the tissue is concerned these operations are practically all successful, and usually leave a small amount of scarring if properly performed. By extensive undermining of the adjacent skin, and taking the proper precautions to prevent too great tension by means of tension sutures and adhesive strips, this form of operation has a wide field of usefulness, especially in restoration of the lower lid, and should be more frequently employed.

In transplantation with a pedicle the flap practically always survives if the pedicle be not too narrow, but it is frequently attended by considerable disfiguration. It finds its greatest usefulness in restoration of the lids or the canthi where there has been extensive loss of tissue. It is also useful where the seat of operation furnishes poor nourishment to a skin-graft, as close to or upon bone. The operation should not be too complicated or involve more incisions than are absolutely necessary. The great elasticity of the skin makes numerous
incisions unnecessary, especially if the integument has been exten-
vatively undermined.

Transplantation without a pedicle. The Reverdin, Thiersch and
Wolfe methods possess certain advantages and drawbacks, the pre-
ponderance of which must determine their adaptability for individual
cases. They are employed only when the extent of the injury or its
location renders either of the preceding methods impracticable.

The Reverdin graft is seldom used except in cases of indolent ulcer-
ation which is destructive to the lids. These grafts are poorly nour-
ished and are followed by pronounced contractions. Even after
the surface becomes covered with new epithelium it not infrequently
breaks down and the ulceration becomes active again. There rarely
is any indication for their use about the lids.

Thiersch grafts are suitable for small areas in any location, or in
more extensive ones where body is not essential. Their nutrition is
always poor. They are frequently used in operations upon the con-
junctiva, on account of their thinness, but here they are constantly
subjected to the macerating action of the tears and must be frequently
wiped off to keep them free from dead epithelium. Mucous grafts,
as from the human lip, or the conjunctiva of one of the lower animals,
(rabbit), are not open to this objection. One advantage of Thiersch
grafts is that if a part perishes the defect can, without affecting the
ultimate result, be easily remedied by a subsequent operation. About
75 per cent. of these grafts survive.

In comparatively large areas, Wolfe grafts give the best cosmetic
and functional results. They have a better color and are not so sub-
ject to prolonged contraction as the thin grafts; while their use is
free from the disfiguration due to extensive scars or secondary graft-
ing following the use of large pedicled flaps. They are especially
useful where secondary contraction would produce disaster.

*Preparation for plastic operations on the lids.* Since the same gen-
eral procedures are followed in the various kinds and modifications
of these operations they will be given in full here and not repeated.

If the operation is to be at all extensive a general anesthetic should
be given lest the contortions of the face from pain, and the surgeon's
reluctance to cause suffering, prevent that thoroughness, that nicety
of arrangement and accurate coaptation upon which success so much
depends.

The field should be cleansed in the usual manner and all strong
antiseptics thoroughly washed away with sterile normal salt solution.
Asepsis is here much preferable to antisepsis.

If the seat of operation is an old cicatrix every vestige of cicatrical
tissue should be cut away, the edges of the wound made even and its base comparatively smooth. If a granulating surface, the superficial granulations should be curetted away and the edges of the wound freshened. In either event all hemorrhage must be stopped by pressure or hot applications, since a clot beneath a graft will prevent primary union.

If a graft is to be used the healthy skin from which it is taken should have been previously scrubbed lightly with water and green soap, washed with boric acid or normal salt solution and afterward carefully protected by a secure sterile dressing.

Where the skin is simply readjusted no general directions are necessary except a warning against attempting an operation which would put too much tension on the sutures, or produce tension in such a way as to cause deformity in the ultimate result.

In using pedicled flaps they should be fashioned, where possible, by means of curved lines and with broad-based attachments and rounding ends; long, tapering or pointed ends are apt to perish.

Reverdin’s method of skin grafting. Epidermic grafts. After proper preparation of the wound and the site from which the graft is to be taken, the small pieces of skin for the graft are picked up with small forceps, a short hook or a sewing needle, and the graft cut off with small scissors or a scalpel. The piece removed should not be more than 5 mm. square and should include the epidermis and the superficial part of the dermis. These small grafts are placed immediately upon the wound, where they are arranged about 10 mm. apart.

They are covered with thin sheets of cotton moistened with boric acid solution, strips of gutta percha, a sheet of perforated gutta percha or very coarse-meshed gauze such as unstarched mosquito netting. Upon this is placed a hot gauze compress wet with sterile physiological salt solution, and over this a sheet of oiled silk, rubber tissue, paraffin paper or other material impervious to air, in order to retain the moisture. This in turn is covered with a generous layer of absorbent cotton, and over all a bandage of such material and firmness as to prevent any possibility of displacement. Starch bandages, mosquito netting or roller bandages freely painted with collodion serve the purpose admirably. At the end of 48 hours the dressing is changed down to the last layer of rubber tissue, which it not disturbed. The wound is then irrigated with warm normal salt solution and redressed as originally. This dressing should be repeated each day for a week, when the rubber tissue may be carefully removed, the wound well covered with vaseline, and a lighter dressing applied. This protection
should be continued until the intervals between the islands of skin are well covered with epithelium.

Reverdin's method was modified by Ollier, who made the grafts larger, from 10 to 15 mm. long by 1 to 3 mm. wide. He also made them thicker to include a part of the corium. To do this, the entire thickness of the skin was removed, as in the Wolfe graft, and then pared down to the proper dimensions with a razor. The graft thus prepared was implanted upon granulation tissue of about three weeks' standing. In cases where healing had occurred the cicatrix was carefully removed and the surface allowed to granulate before the graft was applied. Lawson was the first to use this graft in blepharoplasty.

Thiersch followed in the steps of Ollier save that he did not implant the graft upon a granulating surface. He held that granulations form a layer of scar tissue and, therefore, make an unfavorable base for the transplanted integument. He advised the removal of all granulations by curettment and thus to make the wound a fresh one. He cut the grafts thinner than Ollier, but not so thin as did Eversbusch, who inaugurated the translucent grafts in use today—the true epidermic graft, known in America as the Thiersch graft, and in Europe as the Thiersch-Eversbusch graft.

The Thiersch graft in blepharoplasty. The preliminary preparations as outlined above are followed in this operation. The graft is usually chosen from the inner aspect of the upper arm or the thigh and removed in as few pieces as is adequate to cover the bared space. It is very difficult to obtain pieces larger than 3 by 8 cm. For obtaining the graft a special knife with a perfectly flat blade—the Thiersch knife—has been designed, but an ordinary razor that can be sterilized will do. Both the knife and the skin should be perfectly dry and the skin put upon the stretch by an assistant. This can best be done by having some straight-edged instrument dragged along just in front of the razor. The blade is held perfectly firm and flat, and the graft removed by a wide, sawing motion. If properly cut the blade can be constantly seen through the graft, and the raw surface from which it is removed will be thickly studded with minute bleeding points which mark the location of the severed papillae. That is, the graft should be of a thickness sufficient to include the epidermis and the upper part of the papillae. Without removing it from the razor blade the graft is transported to the wound, which has been dried as thoroughly as possible. The graft is deposited upon this comparatively dry surface with little manipulation. There will be sufficient exudation to cement it firmly to its new bed. The common practice of flooding with salt solution only tends to its displacement. The grafts
should slightly overlap each other and the edges of the healthy skin, as there will be considerable shrinking.

The cutting of a large and perfect graft is greatly facilitated if the lower side of the blade be smeared with vaseline.

Two dressing methods are used. Some surgeons apply no dressing at all for several hours and allow the drying serum to glue down the strips of skin. Usually, however, they are immediately dressed, precisely as in the Reverdin grafts, and given the same after-treatment. There is considerable immediate and subsequent shrinkage. For this reason the aim in cutting the graft should be to make it about one-third larger than the wound it is intended to cover.

In the preparation of the Wolfe graft the constant thought should be provision for the enormous amount of shrinking which these grafts undergo, and the consequent primary over-effect which must be secured.

The preliminary operations having been made, as previously described, a pattern of sterile paper or rubber tissue should be cut to conform to the shape of the open defect. This pattern is then placed on the skin from which the graft is to be taken and an outline made with the point of a knife conforming to its shape, but far enough from its borders to make the uncut graft about four times the size of the wound-defect to be covered. It is a good plan to partially dissect up the ends of the graft first and put a fine suture through each from the epithelial side. The stitches are most easily inserted at this time, thus effecting a saving of manipulation of the graft and minimizing its exposure to the air. It also facilitates orientation when the graft is placed on its new bed, as these stitches are easily inserted into the ends of the wound and the graft made secure. Following this outline a deeper incision is made through the entire thickness of the skin, and the graft removed with as little traumatism as possible.

All subcutaneous fat is rapidly snipped off with scissors, the graft being occasionally moistened with warm, sterile, normal salt solution, to prevent its becoming dry. It is then adjusted to its new bed, the edges accurately approximated and sutured where necessary. Many stitches are not only unnecessary but a positive injury. The seat of the graft should in some way be immobilized, and the wound dressed as in other forms of skin-grafting.

The first dressing need not be disturbed for 2 or 3 days, when some of the stitches may be removed, especially if they show signs of suppurating. The moist dressings should be continued for about 7 days, when the surface of the skin is covered with sterile vaseline and a light dressing applied. During this time the graft may present a widely
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varying appearance, ranging from a continuous healthy pink tint to the greenish black of dry gangrene. The color of the graft during this time furnishes little ground on which to base a prognosis as to the final result. Some of the best results follow where the superficial layer of the graft turns black and sloughs off, while in other cases grafts which look healthy for several days may perish entirely. As a rule, however, the graft first appears blanched, but at the end of twenty-four hours, if all is well, something like its normal tint is present. On the second day it has a rosy hue. On the third day it appears whiter, due to the shedding of the epithelium. After this process is completed it becomes again slightly redder than the surrounding skin, but ultimately fades out until it is somewhat paler than the adjacent parts. It cannot be considered entirely safe until about the 9th day, for the entire graft or any part of it may perish from gangrene, secondary hemorrhage, stitch-canal or superficial infection, phlegmon or erysipelas. Should these complications appear they will become manifest in the first few days. For sloughing, hemorrhage or gangrene little can be done. Infections are to be treated by removing the sutures, if they are causing the trouble, and copious warm irrigations of mild antiseptics, such as boric acid or potassium permanganate, 1-6000. Many days after the graft has become viable progressive ulceration may appear and destroy it in a short time unless vigorously combated. An effective treatment is to paint the affected surface with 12 per cent. silver nitrate, followed by warm normal saline solution.

Operations for spastic and mechanical ectropion. Spastic ectropion, also known as mucous or acute ectropion, usually affects only the lower lid. This is perhaps due to the comparative narrowness of the cartilage and to the absence of such a correcting influence to eversion as the overhanging supraorbital ridge furnishes to the upper lid.

This form of ectropion is caused by the contraction of the orbicularis, opposed by a globe surface farther forward than normal. The lower lid is thus pulled up and back by the action of the muscle, which has the effect of pushing the free edge down and out by the resistance offered by the protruding eye-ball. As a result the action of the marginal fibres is overcome and eversion results. Once established the condition is perpetuated by the action of these same fibres, and by the swelling of the palpebral conjunctiva which results from exposure to the air and from congestion due to interference with the circulation. When both lids are affected and the condition becomes extreme it is called blepharo-paraphymosis.
The commoner causes are chemosis of the conjunctiva, and protrusion of the globe from orbital cellulitis.

For the correction of spastic ectropion the essential is to remove the cause, if possible, and restore to position and mechanically support the lids until the acute trouble has subsided. If the exciting agent be a pronounced chemosis the conjunctiva may be freely incised to promote its reduction. If a conjunctivitis it should be treated according to the indications. Whatever the cause proper corrective measures should be taken and the lids restored to position and held there by strips of adhesive plaster, by bandaging or other means. If the cramp in the muscle has produced an eversion which will not remain reduced, a canthotomy, combined with free severing of the external canthal ligament, is indicated.

Mechanical ectropion is produced by the same forces as the spastic form, with the difference that the exciting causes are chronic. It is produced by the action of the orbicularis opposed by an advanced anterior surface of the globe, due most frequently to exophthalmos, staphyloma, tumors and hypertrophy of the conjunctiva. In the last condition it is also called mucous ectropion.

As has been previously stated, the shrinkage which the Wolfe graft undergoes is very great, and the surgeon who does not take this into account will uniformly fail to produce the desired effect in most cases of blepharoplasty. The following figures show in graphic fashion the degree of contraction which a Wolfe graft generally undergoes when it is used for the purpose indicated. The photographs also illustrate other phases of the operation, which was undertaken for the restoration of the right lower lid. The patient had extensive destruction of the palpebral skin from deep ulceration. The ulcerated area, on healing, had been followed by an exaggerated ectropion. For the cure of this an incision was made parallel with and about 3 mm. from the free border of the lid. This was extended beyond the canthi and in both directions, the dissection being directed well beneath the surface, so as to loosen freely the everted lid to such an extent that it could be readily turned up over the upper lid. When in this condition the cilia of the lower lid were in direct contact with the eyebrow. Of course, this left a large, elliptical defect in the lower lid skin, to cover which a Wolfe graft, measuring 7 by 10 cm. was carefully excised from the inner aspect of the arm. The defect in the skin of the extremity was very extensive, so much so that in spite of free undermining of the surrounding skin and the employment of "bracket" incisions, the wound could only be partially closed; and the bare space was eventually covered with Thiersch grafts.
The edges of the Wolfe graft were lightly stitched to the borders of the facial and lid skin. The upper threads, well shown in the accompanying illustration, were left quite long and were fastened to the eyebrow by collodionized gauze. The photograph, from which the cut is taken, was obtained at the time of the first dressing, about 48 hours after the completion of the operation.

The companion illustration furnishes a faithful picture of the result one month later. The proportions existing between the Wolfe graft, even after its removal from the arm (when considerable shrinkage had already taken place) to that which it eventually shrank, is a fair example of what may be expected in most of these operations. Nevertheless, if such cases are treated according to the rules laid down and great care be observed, not only in the preliminary preparation but in carrying out the important indications of sterility, sharpness of instruments, degree of graft shrinking, technique, etc., there is no reason why they may not be satisfactorily operated on.
For the correction of mechanical ectropion the exciting cause should be removed. Ablation of an anterior staphyloma or removal of a tumor may sometimes bring about relief. If there is a thickening of the conjunctiva due to chronic inflammation this should receive appropriate treatment.

Case of Complete Restoration of the Entire Lower Lid One Month After Operation.

Combined with the treatment of the cause of the ectropion it is usually necessary to aid by restoring the lids to position and holding them there by adhesive strips, collodionized strips, bandages or the author's laced dressing. The last named consists of a strip of tarlatan ribbon, near one edge of which is attached a row of tiny hooks similar to those used in fastening ladies' dresses. One strip of this is fastened by flexible collodion to the lowered lid and another to the brow. The two are now laced together with a small cord and the lids drawn as tightly together as desired. For holding up the lid
for a more extended period, as in exophthalmos, median tarsorrhaphy gives the most satisfactory results.

Snellen suture in ectrion. In cases where the thickening of the lid is not due to swelling but has become an actual hypertrophy the redundant tissue must in some way be disposed of before the lid edge can be restored to its natural position. Where the hypertrophy is of moderate degree the device most commonly employed, perhaps, is the Snellen suture (see figure) which seeks to draw this excess of conjunctiva down into the cul-de-sac where it will do the least harm,

Snellen's Operation for Ectropion, Showing the Position of the Suture.

and at the same time exert traction in such a way that it tends to invert the lid. This well known operation is performed as follows:—Double-armed sutures are prepared from No. 2 braided silk thread boiled in paraffin. The needles are inserted about 2mm. apart and a short distance inside of the line of eversion of the lid. They are passed diagonally through the lid so as to emerge from the skin about opposite the rim of the orbit. The sutures are now drawn tight—until the deformity is slightly over-corrected—and tied over rubber tubing or other protective. Two or at most three such pairs of sutures, equidistantly placed, will be sufficient. They may remain in position for several weeks or until they suppurate out, the eye being bandaged and dressed daily in the meantime. As suppuration progresses the sutures will become loose and may be tightened from time to time, the ends having been left long for the purpose. It is claimed that these lines of suppuration leave the cicatrices which tend to hold the lid in place. Some surgeons use silver wire instead of silk thread on the assumption that it is better tolerated.

Ziegler's operation for slight ectropion. Ziegler attempts to reduce the deformity in mild cases by producing benign cicatrization in another way. Instead of depending upon sutures and suppuration to produce a scar he uses galvano-puncture. The punctures are made
from the conjunctival surface about 4 mm. from the lid margin and about 4 mm. apart. The cautery point is heated to a white heat and plunged into the conjunctiva and through the tarsus. There is a mild reaction and the operation may have to be repeated before the effect is sufficiently pronounced. The author of this method claims that its results are immediate and permanent and that it leaves no scar. It is a comparatively new procedure and has not been extensively practised.

Ar
gyll Robertson operation for ectropion. It is perhaps unusual for an out-curving of the tarsal cartilage to be the cause of ectropion, or even a contributing agent of sufficient importance to demand attention.

For the correction of those few cases where such a deformity does seem to be a pronounced feature Argyll Robertson has performed the following operation, which is a modification of the Snellen sutures. A double-armed ligature of No. 2 braided silk, previously prepared by boiling in paraffin, is passed from the front straight through the entire thickness of the lid, 2 mm. below the ciliary margin and about 6 mm. from the middle. It is carried free over the conjunctiva and
reinserted at the bottom of the cul-de-sac, passing diagonally down and out so as to emerge 32 mm. below the lid margin. The other end of the suture is similarly placed 6 mm. to the other side of the midline. This arrangement leaves two vertical loops of thread crossing the palpebral conjunctiva about a centimeter apart. Beneath these loops is now inserted a lead plate (25x6x1 mm.) whose edges have been carefully smoothed and rounded off and which is bent to fit the curve of the globe. A roll of gauze is placed beneath the horizontal loop on the outside of the lid and the sutures are secured over its lower end. The sutures are allowed to remain in position seven days. If the lead plate is covered with paraffin it is less apt to cause irritation.

Fox’s operation for ectropion. Fox and others have developed an operation adapted to mild cases of mechanical ectropion where a hypertrophy of the mucous surfaces of the lid which fails to yield to treat-

The Fox Operation for Ectropion.

ment is the active agent in producing the deformity. This redundant tissue is removed in the following manner: An incision extending the entire length of the lower lid is made 2 mm. from and parallel with its margin. The conjunctiva along the posterior edge of this incision is dissected back and a V-shaped piece of hypertrophied tissue removed. (See the figure.) Double-armed sutures of No. 2 braided silk thread, boiled in paraffin, are now passed through both lips of this wound 2 mm. below the ciliary margin of the lid and at the junction of the middle and outer thirds. After piercing the lid it passes free over the palpebral conjunctiva to be reinserted in the fornix and pass down and out, emerging from the skin about 1½ inches below the free margin of the lid. The other needle is similarly inserted 3 mm. from and parallel to the first one. When this suture is tightened the V-shaped wound in the border is closed and the lid restored to its natural position. Pieces of rubber tubing protect the loops of
the suture at either end. A like suture is placed at the junction of the middle and inner thirds of the lid. Two are usually sufficient. The conjunctival wound is not sutured but the edges are trimmed, if necessary, to produce good coaptation. The sutures are allowed to remain only sufficiently long for the edges of the wound to heal—usually about three days—as it is not intended to produce suppuration here, as in the Snellen suture.

In atonic ectropion there is manifestly too great laxity of the lid. Operations for its relief have all been devised with the idea either of shortening the excessively long free border, by excising a V-shaped piece from its center, elevating and shortening by means of sliding flaps and excising tissue from the outer canthus, or supporting the drooping lid by attaching it to its fellow above.

*Adam's operation for atonic ectropion.* Of these ideas the removal of a triangular piece from the center is evidently the simplest, as it was the first attempted. Sir William Adams boldly excised from the center of the lid a wedge that included conjunctiva, skin and tarsus. He then closed the resulting notch by means of fine, interrupted sutures and a hare-lip pin. This operation removed the excessive tissue of the sagging lid but always left a prominent scar and frequently failed to heal properly at the lid margin, resulting in a disfiguring cleft.

*The von 'Ammon operation.* These facts led to the von Ammon operation, which strives to remove a part of the free border of the lid and still leave the remainder intact. To this end he took the gore cut from the entire thickness of the lid from the outer canthus, then closed the wound with the pin and sutures, as did Adams. (See the figures.)

The same principle was also utilized by Walther, who cut out a triangular piece both above and below for the correction of cases of ectropion of both lids.

While removing the segment from the canthus, instead of the center,
maintained the integrity of the remaining lid border it was so far removed from the punctum, the point which it is most desirable to restore to the normal position, that its result was frequently unsatisfactory.

von Ammon's Modification of Adams' Operation for Ectropion. (After Beard.)

Kuhnt's operation for atonic ectropion. In an effort to avoid these objections in the previous operations Kuhnt devised another modification of the Adams operation. (See the figures.) A keratome is inserted between the skin and tarsus and the triangular piece of tarsus and conjunctiva thus liberated removed without cutting the skin. The edges of the cartilage and conjunctiva are then brought together and sutured, a proceeding that produces a fold in the skin at that point; and therein lies the weakness of the operation.

S. Mueller attempted to do away with this fold of skin by splitting the lid to the outer canthus, removing the wedge from the center of the tarsus, as did Kuhnt, and so arranging the sutures that the fullness of the skin was evenly distributed over almost the entire lid.

Walther's Operation for Ectropion. (After Beard.)

(See figures.) This is in a large measure successful. Helmbold accomplishes the same end by splitting the lid and removing a V-shaped piece of tarsus from a point to the nasal side of the center of the lid, and a corresponding piece of skin from a little to the temporal side, so that the two clefts thus produced fall on different points on the lid. They are sutured separately, then a few sutures placed in the lid margin.
Beard's operation for atonic ectropion. The writer has successfully dealt with atonic ectropion by combining the idea of shortening the free border of the lid and at the same time holding the lower lid up by attaching the shortened, lower, tarsal cartilage to the external canthal ligament. In this operation a canthotomy is made in the regular way and the skin incision slightly extended outward. The skin is then undermined below this incision and over the outer part of the inferior tarsus, and a portion of the outer end of the free border of the lid removed. The size of the piece cut away depends upon the excess of length of the lid and should contain the cilia. The outer extremity of the lower tarsus is then laid bare, seized with fixation forceps and, while skin and conjunctiva are retracted, a No. 2 silk-worm or catgut suture is passed through the cartilage at a distance from the cut end proportioned to the length of the proposed shortening, and the superfluous bit of tarsus cut off. A small triangle (base in) of integument and muscle is now cut from the upper lip of the canthotomy, exposing the external canthal ligament. Through this ligament is passed the suture just put into the lower tarsus, the two parts drawn together, the sutures tied, and the ends cut off short. The skin opening is closed by means of fine silk sutures and the conjunctival wound left to itself. The buried suture is afterward absorbed or encapsulated.
Dieffenbach's operation for atonic ectropion. Shortening the lower lid by drawing it to the outer canthus without sacrifice of any considerable part of the tarsus was an idea introduced by Dieffenbach in 1838. His plan was to remove from the region of the outer canthus a section of skin (and muscle) shaped like an equilateral triangle, with apex down and horizontal base on a level with the outer commissure. The length of the base of this triangle is equal to the excess of length of the free edge of the sagging lid. Through the opening made by the removal of this triangular piece the skin of the lower lid is undermined well past its center and down to a level of the apex of the triangle. The outer edge of the lower lid is now evenly pared off for a distance corresponding to one side of the triangle, the external canthal ligament of the lower lid severed so as to allow the loosened skin and tarsus to be slid outward, and the denuded triangle closed. Thus the raw edge of the lid margin is brought into apposition with the base of the triangle and the "slack" in the lower lid taken up. This disposition of the redundant lid edge was satisfactory in
ordinary cases but in those of extreme degree the lid needed to be elevated as well as pulled over. This was attempted in a modification of the operation of Dieffenbach which was designed by Szymanowski,

Müller's Operation for Ectropion. Second Stage. (After Beard.)

in which the triangular piece of skin removed from the region of the outer canthus had its apex at the commissure and a short side extending up and out to a long vertical base. The third side was of intermediate length. This arrangement gives the procedure an added power of lifting the lid as well as pulling it over. It is also claimed

Beard's Operation for Atonic Ectropion.

that the resulting cicatrix has less tendency to displace the commissure than that in the original operation and that the effect may be more accurately graduated.

Dieffenbach's Operation for Ectropion. First Stage. (After Beard.)
Operations for cicatricial ectropion. For eversion of the lid due to a slight and superficial scar the mere subcutaneous division of the restricting band, followed by strapping the lid in place with adhesive plaster and the application of a compress bandage, will sometimes give relief, especially if followed by vigorous vaseline massage and stretching of the affected skin. But in the great majority such simple means will not suffice.

As cicatricial ectropion is the result of loss of tissue, its surgical cure must necessarily involve replacing the lost substance. For this reason operations for the correction of these deformities will also apply in large measure for the relief of all conditions involving loss of substance of the lids, as from the removal of malignant growths, burns or destruction from any cause whatever.
Dieffenbach's operation for cicatricial ectropion. For a lesion of moderate size, if not too near the commissure, an operation devised by Dieffenbach, or a very slight modification of it, is still in common use. Three straight incisions in the form of an inverted triangle are made around the affected portion, which is excised. From the corners of the base of the triangle two slightly curved incisions are made and the integument in the angles thus formed undermined. The skin all along the lower edge of the lid is dissected up, the lid restored to its position and the edges of the incisions brought together in the form of a capital letter T. A more pronounced effect is obtained by combining the operation with an external tarsorrhaphy. This operation is suitable only for comparatively small lesions of the lower lid.

The Wharton Jones operation for cicatricial ectropion. For lesions of either lid the Wharton Jones operation, as modified by Sanson, may be used. From a point near the commissures two converging incisions are made which meet at some distance away from the scar. The V-shaped flap thus made is dissected up to the roots of the cilia and the skin along the sides of the incisions freely undermined. The lid is restored to its position and the incisions united so as to form a Y.
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Wharton Jones' Operation for Ectropion. First Stage. (After Beard.)

Graefe's operation for cicatricial ectropion. Von Graefe devised an operation for correcting extensive cicatricial ectropion which was based upon the same principle—that of relieving the tension by loosening the cicatrix and drawing up the adjacent skin. From the commissures two vertical incisions are made, extending down on the cheek about 12 mm. An incision uniting these two is made along the intermarginal space and the lid split into two leaves, composed, respectively, of skin and muscle and tarsus and conjunctiva. The entire flap is then dissected up. The ectropion is now corrected by forcibly drawing up both the tarsal and skin segments and the skin flap is sutured to the borders of the vertical incisions for about the lower half of their length. The upper edge of the flap is now trimmed to fit the border of the tarsus to which it is sutured, while the sutures are left long and fastened to the forehead by some such adhesive as collodionized cotton. A few shallow skin sutures, to close gaping edges, complete the operation.

Wharton Jones' Operation for Ectropion. Second Stage. (After Beard.)
Jaeger's operation for ectropion of the upper lid. For extreme ectropion of the upper lid, where the free edge of the lid is drawn up almost to the supercilia, a method originated by F. Jaeger in 1831 is quite effective, though it might be improved by being slightly modified to conform to modern surgical ideas. He made an incision along

Graefe's Operation for Cicatricial Ectropion, a, b and c. (After Beard.)

the entire length of the lid close to and parallel with the ciliary border. The tarsus was then dissected free from the scar tissue and turned down into its natural position. Then the skin at the upper edge of the wound was freely undermined well onto the forehead and out onto the temple, and the integument thus loosened was drawn down to cover the denuded lid, where it was secured by sutures. If the lid was too lax a V-shaped piece, embracing the tarsus and con-
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junctiva, was cut from the center of the lid and the edges firmly secured before the flap was drawn into place. This operation as originally performed necessarily produced considerable disfigurement by drawing the eyebrow down upon the lid, an objectionable feature that could be eliminated by covering the raw lid with a skin-graft or pedicled flap, as is usually done today. The triangular piece cut from the cartilage could also be advantageously taken from the outer canthus instead of the center of the lid, thus doing away with a scar immediately over the cornea and in a position where its contraction could produce a maximum amount of deformity of the lid.

Dieffenbach’s blepharoplasty. For the restoration of an extensive defect of the lower lid, involving either the integument alone or the entire thickness of the lid, an operation originated by Dieffenbach in de Wecker’s Procedure for the Relief of Ectropion of the Lower Lid.

1835 has stood the test of time. From the lower lid is taken a triangular piece of sufficient extent and thickness to remove the scar or other offending tissue, care being taken to preserve all of the healthy conjunctiva. An incision is now made extending horizontally outward from the canthus and of a length corresponding to that of the base of the triangle from which the skin was just removed. A second incision is made from the outer extremity of the first one equal in length and parallel to the outer border of the triangle. The flap thus formed is dissected loose and slid over to cover the defect in the lower lid. In Dieffenbach’s day the denuded space which this transposition left was allowed to heal by granulation. Today it would be covered by a skin-graft. Following a suggestion made by Angelucci the temporal incision may be extended well out toward the ear and the skin undermined and stretched over to cover much of this defect. This new flap must be held in position by means of adhesive strips attached to the bridge of the nose or forehead or by other means.
To have the secondary defect, with its inevitable contraction, farther removed from the eye Szymanowski made the original triangle with a much broader base, as shown in the illustration.

*The Kuhnt-Szymanowski operation*. Kuhnt added to the Szymanowski operation by excising the outer end of the tarsus, proceeding as follows: Intermarginal incision whose length corresponds to the degree of shortening desired; canthotomy or skin incision, extending upward and outward the same length as the intermarginal incision. This serves as the base line of the long triangle of skin, which is fashioned in a downward and outward direction and excised. The inner side of this triangle is freely undermined. Straight, blunt scissors are inserted at the inner extremity of the intermarginal incision,
where the tarsus and conjunctiva are divided vertically. The outer end of tarsus thus severed, together with its adherent mucous lining, is excised. The remaining tarsus is then moved bodily outward, closing the triangular skin defect, when, first, the opposing edges of conjunctiva and, lastly, those of the skin are united by fine sutures.

Harlan's Operation for Ectropion. (After Beard.)

*Harlan's operation for ectropion.* With the same end in view Harlan planned a rather elaborate operation in which he used two flaps in such a way as to leave little raw surface to be covered by a graft, and that so situated that its contraction produces no harmful effect on the eye. He contends that the flaps had better nutrition than
with their edges left exposed, as in the other operations. He also asserts that the deformity following it is slight. Since it involves so many straight lines of sutures in prominent parts such a good

result must demand most careful work on the part of the surgeon. After the flaps are dissected loose the borders of the denuded areas are freely undermined, so that their angles can be brought together and sutured before the flaps are slid into place.

Czermak's modification of Dieffenbach's operation. For defects which involve from two-fifths to two-thirds of the horizontal measurement of the lid Czermak recommends a moderation of Dieffenbach's operation (q. v.). First, he makes a free canthotomy and extension outward of the incision for an equal distance through the skin of the

temple; second, excision of the lid defect; third, undermining of the tissues of the lower lid down to the tarso-orbital fascia. From the outer end of the incision another is carried up and out; then another, beginning at the centre of the primary incision up and out, to meet the upper extremity of the second, and the triangle thus outlined excised.
Burow's operation for ectropion. Another operation making use of triangular incision is that of Burow. (See the illustration.) It differs from others, however, in that it sacrifices healthy skin and endeavors to accomplish the result by stretching instead of by trans-

position of flaps. Here the triangle of healthy skin is excised and thrown away. A second triangular incision removes the offending tissue. The borders of the denuded area are then freely dissected loose and the skin pulled over so that the sides of the triangles are in apposition. Only the most extensive undermining of these edges and the greatest care in providing for the relief of tension during the heal-

ing can make success possible. It is doubtful if it should ever be selected where the entire width of the lid is involved so as to necessi-
tate wide triangles, and seldom in any case.

von Ammon's operation. It occasionally happens that ectropion is caused by a deep, circumscribed cicatrix with its long axis vertical to the lid and so firmly adherent to the bone that it cannot be easily excised. In such von Ammon surrounded the cicatrix (see the figure) by an elliptical incision and removed its surface to a sufficient depth to allow the adjacent skin, which was now undermined, to be drawn
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over it. Free dissection should be made all about the opening so as to sever any cicatricial bands that hold down the lid. The lid is now righted and held in place by the closure of the wound, which is secured by a few interrupted sutures.

von Ammon's Operation for Cicatricial Ectropion. (After Beard.)

Hotz's blepharoplasty in ectropion. Since the free border of the lid offers little or no resistance to the shrinking of the graft it is here that the baneful effect of its contraction is most pronounced. The larger the graft, the greater the subsequent shrinking and displacement. To divorce the free border from as much of this contraction as possible Hotz divided the wound area into two sections, one representing the bared surface of the lid proper and the other that beyond the lid, each of which he covered with a separate graft. Before placing the graft in position the lid is put on the stretch and held by strong

The Hotz Method in Blepharoplasty. (After Beard.)
silk threads which pass through the lid edge and are fastened by collodionized gauze to the brow or cheek, as the case may be. The lid graft is now implanted and anchored by sutures but the graft on the other division of the bared space is left unsutured. By thus firmly supporting the lid he endeavored to overcome both the shrinking of the graft upon itself and its traction upon the free border.

![Lagleyze's Operation in Ectropion of the Lower Lid](image)

The Terson and True operations for the relief of ectropion are depicted in the accompanying figures.

Cicatricial skin may occasionally be conserved and used to good advantage if it is adjacent to the lid border. In such a case Hotz, instead of dissecting out the scar and covering the entire defect by one of the methods usually employed, dissected up the scar so as to make it a semilunar flap with its attachment at the lid margin still intact. Deep cicatricial bands which bound down the lid were then severed and the lid turned up into position and secured by ligatures and collodionized gauze attached to the forehead. With the flap well relaxed its free border is made secure by a few sutures, while the remainder of the defect is covered by a Thiersch graft which is left unsutured. This procedure is, of course, best suited to old scars whose contraction has practically ceased.

The sliding-flap operation is one of the simplest and most satisfactory for restoring part of a lid. The incisions are so situated that the resulting scars are inconspicuous, and after healing has once occurred there is little secondary change from contraction. The
Knapp operation is a good example of this class. The relief of tension until healing has occurred is the important point in these operations and may be secured by means of adhesive straps or tension sutures.

Tweedy’s operation for ectropion seeks to shorten the lower lid by removing a section near the outer commissure and to utilize the segment thus removed in elevating the lid. This ingenious economy has been imitated by few. A flap about 30 mm. long and 8 mm. broad is designed down and out from the external canthus. The incisions are continued through tarsus and conjunctiva until they meet at the bottom of the cul-de-sac. The flap is then dissected up to its base. An inci-

Tweedy’s Operation for Ectropion.

sion is now made below and parallel to the lid border, through the skin and orbicularis. This allows the lid to be drawn up into place and sutured at the canthus. The flap is turned into the secondary defect and secured by sutures.

Denonvilliers’ operation for the elevation of the outer third of the lower lid makes use of the same principle of transposition of flaps utilized by Richet and others, with the difference that the lines of his incisions are almost straight instead of curved, and the operation is purely a transposition as it does not replace lost parts. Its use is very limited since it does not do away with the redundant tissue, replace scar tissue or shorten the lid. It also necessitates several extensive incisions which are apt to prove disfiguring. It does not sacrifice healthy skin, however, a fault upon which many plastic operations may be indicted, and does elevate the outer part of the lid, but to hold the ciliary border in proper apposition to the globe it is usually necessary to combine a tarsorrhaphy with this operation.

Argyll Robertson’s strap operation for ectropion is efficient in selected cases. The author evidently kept in mind the two essentials
in the correction of pronounced ectropion—that is, the removal of the redundant lid edge and raising the shortened lid into position and holding it there. This operation is obviously suited only to those cases in which the eversion is most pronounced in the outer half of the lid.

The Argyll Robertson Strap Operation for Ectropion.

A short distance from the outer canthus a wedge-shaped piece is removed, which includes skin, tarsus and conjunctiva, and disposes of the excess of length of the lid ledge. To bring the cut edges into approximation and hold up the lid a strap is fashioned as shown in the illustration, the lid pulled up into position and the overlapping end of the strap cut off.

Combination of Kuhnt and Dieffenbach Operations for Ectropion.

The Kuhnt operation for cicatricial ectropion. Here the excess of lid skin is drawn into a bunch in the center. This generally disappears in time but may never be wholly obliterated. To overcome this objection some operators have combined the Kuhnt and Dieffenbach operations, taking the triangle of skin from the region of the canthus and the cartilage from the middle of the lid, which, of course, necessitates separating the skin and orbicularis from the tarsus at its outer half. The wound in the cartilage and conjunctiva is united with sutures and the skin-fold left by the old operation obliterated by drawing it out toward the canthus.

Helmbold accomplished the same end by removing a triangle of skin corresponding to the triangle of cartilage, but farther out, splitting the lid between them. The two clefts thus made were sutured separately. These methods are especially applicable where a small scar may be included in the incised skin.

Kenneth Scott’s operation for ectropion is best suited for atonic ectropion characterized by a moderate degree of drooping of the lid.
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It is extremely simple and, in suitable cases, just as effective as some of the more disfiguring and elaborate procedures. A free external canthotomy is performed and the lower lid freed from the external canthal ligament so as to allow it the greatest degree of mobility. The lid is now stretched out sufficiently to restore it to its normal position and the part of the lid edge which extends beyond the canthus is cut off. The angle of this newly formed canthus is now secured with two silver wires which are removed in ten days. The remainder of the wound is sutured with fine silk which is removed in three or four days. This proceeding will, of course, leave a bunch of skin at the lower border of the canthotomy. However, this usually disappears in time and if it does not may be easily remedied at a subsequent operation.

*Snydacker's method of autoplasty.* In 1905, Snydacker, of Chicago, presented to the Ophthalmological Society of that city the first subject

The Snydacker-Morax Method of Autoplasty. First Stage.
of his operation. By it the disfiguring scars consequent upon obtaining the flaps from the immediate vicinity of the eye are avoided. Moreover, it is especially applicable to those cases in which extensive cicatricial areas in that vicinity render them unavailable for blepharoplasty. The essential feature consists in fashioning a flap from the skin overlying the sterno-mastoid muscle, with its base beneath the ear and of sufficient length for its free end to reach the inner extremity of the lid defect and cover the latter. The neck defect is readily closed by undermining and suturing, leaving an inconspicuous linear cicatrix. When the portion covering the lid defect is firmly adherent the long pedicle is abscised.

Morax, of Paris, has recently utilized a modification of Snydacker's operation for the restoration of extensive destruction of the skin in
the palpebral and superciliary regions which he calls autoplasty with pedunculated cervical flap in two sittings. Supposing the area to be restored comprises both lids or a rather extensive part of the fronto-palpebral region, Morax at the first sitting proceeds as does Snydacker, repairing say one-half, or less, of the destroyed surface.

Then at the expiration of 12 to 15 days, when the circulation is well established in that part, he prepares the remainder of the area, freshens and makes aseptic the unattached portion of the flap, after having severed it at its base, trims, turns, and otherwise adjusts and sutures it so as to complete the desired restoration.

The Indian method, or transplantation of pedunculated flaps. This method was first practised by the ancient Hindu surgeons for the restoration of the nose. In the latter part of the nineteenth century
it was adapted to plastic surgery of the lids and the first successful case was reported by von Graefe in 1858. It was adopted and extensively used by Fricke, whose success brought it into immediate popularity. His good results were perhaps due to the fact that he limited its use mainly to cases of cicatricial ectropion, where only the superficial tissues had been destroyed and the tarsus and conjunctiva merely displaced. The broad base which he gave to the flap was also a factor in the good results, for the base was made broader than the body of the flap, which guaranteed its good nutrition. The operation was performed as follows: An incision was made at the distal edge of the cicatrix and parallel with the border of the lid. The scar tissue was removed and the tarsus dissected loose from the adhesions and restored to its normal position. A flap, about one-third larger than the oval raw surface thus produced, was cut from the forehead and temple and twisted upon its base sufficiently to fit into the defect in the lid. If necessary, one corner of the base was trimmed to allow the flap to lie smoothly in place and it was then sutured in position. Fricke left the wound from which the flap was taken to heal by granulation. Today it is usually closed by one of the methods of skin-grafting—sometimes combined with undermining the edges of the wound and drawing them as nearly together as possible. The peculiarities of each case must determine the shape of the flap and the region from which it is taken, as well as minor changes in the operation.

Blasius' operation for restoring a lid. This same principle was used by Blasius as early as 1842 for the restoration of the lower lid—the flap being taken from either the nasal or temporal side, as seemed more expedient. Only a flap of limited size can well be cut from the region of the forehead, however, so when an unusually large flap is demanded in restoring the lower lid it may be taken from the cheek

Fricke's Operation for Cicatricial Ectropion. (After Beard.)
after the method of Denonvilliers. This, of course, leaves a large denuded area where it is apt to produce a disfiguring scar, to avoid which Fauk has taken the flap from well down on the neck and transplanted it to the lid by using an extremely long and narrow pedicle, which of course militates against chances of its surviving, even if it were not bridged across an interval of intact skin. When the flap has taken, the pedicle is of course cut away. This operation
leaves only a slight scar in an inconspicuous place, but it is questionable if this extremely long-pedicled bridged flap has any advantages over a simple Wolfe graft.

Denonvilliers' Flap Method of Blepharoplasty. (After Beard.)

[The following cases further illustrate the possibilities of this method. A woman who had suffered for two years from syphilitic ulceration of the face lost both lids of her right eye from the disease.

The eye was without protection, the cornea vascular and eroded, a purulent discharge came from the exposed conjunctiva. Vision reduced to light perception. An upper lid was formed by C. H. Baker, (Ophthalmic Record, April, 1906), who made a horseshoe-shaped incision from canthus to canthus with its highest point an inch and a half up on the forehead. The flap thus created was dis-
sected down to its attachment to the conjunctiva. It was then slid down over the eye and anchored below the eye with two sutures. The upper edge of the flap was stitched to the fibrous tissue below the orbital ridge, so that contraction from above would not draw the flap up. The exposed area above was covered with skin-grafts. The result was that a lid was made which about half covered the cornea. The same operation, only reversed, was performed below to form a lower lid. The cosmetic result was good, and the cornea became free from vascularity and healed, but the eye had but little vision. For a year the eye did well and then the conjunctiva became reininfected and discharge was again profuse. The cornea ulcerated and the patient suffered so much pain that enucleation was finally performed. The second case was that of a man who had a malignant growth of the eyelid, demanding that the temporal half of the upper lid be removed.

This defect was corrected by a pedicle flap from the temple which healed nicely in position, giving a good cosmetic result. This operation was performed ten years ago. There has been no recurrence of the angiosarcoma.—Ed.]

Hasner's blepharoplasty. Canthal defects involving both lids have produced a class of operations for their relief, of which Hasner's is typical and was perhaps the first, also one of the most satisfactory.
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Instead of a simple flap, the distal end of it is bifurcated in such a manner as to best meet the indications. In repairing the inner canthus it is best to take the flap from the naso-maxillary region, since one taken from above usually contains hairs that are both disfiguring and troublesome in their new location.

Hasner's Blepharoplasty for Restoring Loss of Tissue at Either Canthus. (After Beard.)

For lesions in the neighborhood of the commissure but not involving it Richet’s operation is sometimes used. If the tarsal cartilages are much distorted it may be necessary to do a provisional tarsoorrhaphy in order to get them back into place and to retain them, by means of suitable dressings, during the early stages of the healing process.

The other steps in the operation are best explained by the illustrations.

Rollet’s operation is illustrated in the text.

Blepharoplasty by means of double pedicled flaps. Another class of operations includes taking a strip of tissue from the forehead (leaving both ends attached) to replace the upper lid. This was first practised in 1879 by Businelli, who took a flap from the forehead, with a pedicle near each end of the eyebrow, to replace the skin and to correct complete ectropion of the upper lid—precisely what has been more recently done by Lagleyze of Buenos Aires—and here it has served admirably. Landolt modified it by taking from the upper lid
the integument to repair a defect in the lower. The great advantage this method has over others is that the flap, being attached at both extremities, is better nourished, especially valuable when the defect to be filled in is long and narrow. The thickness of the skin flap thus obtained is also better suited for the purpose than that from other regions. It is permissible only where a narrow graft would fill the requirements, for a wide graft removed from the healthy lid, together with its subsequent contraction, results in undue shortening.

The illustration explains the operation as practised by Landolt. The upper lip of the wound in the upper lid is extensively undermined and the skin drawn down and sutured to the lower. When the growth of the graft is well established the pedicles are severed and the ends trimmed off.

It would seem that the indications for such an operation would rarely occur, since a flap so narrow as not to endanger the lid from which it is borrowed would be almost obliterated by the shrinkage that follows its transplantation. Still more rarely would one be justified in following the example of Panas by taking single-pedicled flaps
from one lid to restore the other. In his operations he usually performed a provisional tarsorrhaphy.

The Italian method, heteroplasty. This operation, in which pedicled flaps are taken from remote parts of the body, was devised and used by Branca, a Sicilian surgeon, several hundred years ago. According to the custom of that period knowledge of the operation was handed down from father to son so that it was practised by members of that family for many years. In 1597 Gaspard Tagliacozzi wrote a treatise on the operation, hence it is sometimes called the Tagliacozzi method. It was used by these early surgeons for the restoration of the nose and was performed by removing the integument from the part to be reconstructed and fashioning a skin flap from some part of the arm or leg and allowing both to granulate. After about three weeks the granulations were freshened and the flap brought into place by binding the limb bearing it securely to the head. When union was established the pedicle was cut and the limb released. On account of the severity of the operation and the time required to accomplish its object, it fell into disuse for many years, to be revived in 1816 by Carl Ferdinand Graefe, who employed it for restoration of the lids. He modified it by uniting the raw surfaces immediately, instead of waiting for granulation to occur. Even this improvement, which greatly lessened both the inconvenience and time required for healing, failed to make the operation a popular one.

Berger's modification of the Italian method. Between the years 1879 and 1889 it had another revival at the hands of Paul Berger, of Paris, who performed the operation in the following manner: A leather corset, collar and cap, articulated with laces and straps and strengthened with steel braces, are fitted to the patient's head and body. On the forearm is laced a leather gauntlet provided with straps by means of which it can be immediately attached to the head at the proper stage of the operation and the arm fastened firmly to the head. (See the illustration.) To test the immobility of the parts the dress should be worn and the patient kept in bed for a few days before the operation, and alterations made until the limb is held perfectly secure. This also accustoms the patient to the confinement and constraint which must be endured. An exact pattern of the lid defect is cut from oil silk or court plaster, the arm from which the graft is to be taken is then brought up to the eye and the spot which makes the easiest and most natural contact is chosen as the site of the pedicle. The pattern is then applied in such a position that the pedicle of the graft will be as little distorted as possible, and the graft outlined one-third larger than the pattern. The graft is excised in the usual
way, the fat removed, and all hemorrhage stopped. The pedicle is slightly loosened, that the nourishing vessels may be free from torsion or pressure. The wound on the arm is dressed and the arm strapped into position. The flap is applied to the raw surface of the lid wound and held by a few fine silk sutures. Near the pedicle a few deep tension sutures are placed to resist involuntary pulling from the arm. Adhesive strips may also be used to advantage. The eye is dressed as in other flap operations and is given the same after-treatment; at the end of a week the pedicle may be divided.

Berger tried plaster moulds for holding the arm in place while the graft was taking but found them too cumbersome and that they added to the patient's discomfort by masking the face.

More recently, however (in 1905), Lagrange, of Bordeaux, has had recourse to this mode of fixation of arm and head. He declares a properly constructed plaster mould to be equally as effective as the Berger apparatus in this particular; and, it goes without saying, that it has the advantage of being infinitely cheaper. It can be so padded, both in the original application and (particularly) afterward, as to render it more bearable, and it may be cut away about the face sufficiently to obviate objection.

Lagrange employed it in the restoration of both lids, everted from extensive burn of the face and neck. The mould was put on several
days before the operation and worn for a short time that both patient and surgeon might know what to expect from it. When finally applied it was trimmed so as to interfere least with its usefulness. As soon as the primary dressing of the tarsi was accomplished, median tarsorrhaphy was resorted to and this was not divided till after the expiration of eight months. The mould was removed on the tenth day.

For the first few days the patient should remain in bed and be constantly watched by an attendant. Opiates or bromides may be given, if necessary to calm excessive nervousness or restlessness incident to the long-continued and unwonted position of the parts. At the end of the fifth day he may be propped up in bed and in a few days allowed to cautiously walk about. The success of the operation depends largely upon ability to keep the parts quiet. If this can be accomplished it offers the same excellent chances of success as other pedunculated flap operations.

**Blepharoplasty for the restoration of a portion of the entire eyelid.** If the entire surface of the lid has been destroyed its satisfactory restoration by means of pedunculated flaps or otherwise can seldom be accomplished. While the skin surface may be replaced, the tarsus and conjunctiva are absent and in their stead is a surface of scar tissue whose continual contraction against the unresisting new lid will sooner or later draw it into a rolled up, shapeless and useless mass which performs no protective function, but whose rough borders rub against and irritate the cornea. Efforts to overcome this tendency have been rewarded with a very scant measure of success.

Budinger makes use of a section cut from the ear, including the cartilage and skin of the posterior surface. This is placed on the raw surface of the restored lid at the time of operation, or at a secondary operation after the nutrition of the new lid has been well established and before its cicatricial lining has begun to contract. This operation substitutes skin for mucous membrane and the removal of the graft from the ear is apt to produce deformity of that organ. The author’s associate, Dr. Charles Clement, suggests that possibly some of the portions of the cartilaginous nasal septum, with its mucous covering, could be thus utilized. So also could the tarsi and adherent conjunctiva of certain of the lower animals.

Restoration of cul-de-sacs with epidermal lining may be successfully undertaken at a much earlier period than that to restore the outward parts of the lids.

**Goyanes’ operation for restoration of the eyebrow.** A horizontal incision is made through the middle of the healthy brow dividing it
into two equal parts. A second incision, a short distance above the brow, divides it from the skin of the forehead. These lines are continued so as to form a broad-based flap above the nose. The defect on the other side having been suitably prepared to receive the flap it is dissected loose and turned into its new position where it is sutured into place. The skin of the forehead is freely undermined above the secondary defect, pulled down and sutured to the remaining half of the brow. It is held in place by adhesive strips until union is established, to prevent displacement of the brow, although slight elevation is not undesirable. The flap should not be too thin as it is more apt to perish.

Operation for the relief of symblepharon. Symblepharon is a term used to distinguish any union between the lids and globe. This union may vary in extent from the smallest, thread-like bands which join the ocular and palpebral conjunctiva, to those extensive adhesions in which the entire cul-de-sac is destroyed and the globe and lids are immovably bound together. By different authorities it has been classified as outward, inward, upward, downward, anterior and pos-
terior, according to its location, and partial or complete according to its extent.

Under the head of symblepharon is usually included also those cases where the conjunctiva, sclera and tarsus are involved in the adhesion which binds them into an immovable mass, or an ankyloblepharon.

Anterior or Circumscribed Symblepharon.

The division into anterior and posterior symblepharon is the classification most commonly adopted. Anterior, or circumscribed, symblepharon is the simplest form and refers to those cases where the junction between the opposing portions of conjunctiva does not reach the fornix.

Posterior or Partial Symblepharon.

Posterior or partial symblepharon is where the adhesion does extend into the fornix. This term is also sometimes applied to a partial obliteration of the cul-de-sac from gradual shrinking, as that following trachoma or pemphigus.

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Total or complete symblepharon includes the pronounced cases, where the attachment involves the whole of one or both lids and the cul-de-sac is utterly effaced.

Symblepharon may be produced by any lesion which denudes opposing surfaces of the palpebral and ocular conjunctiva. Burns from lime, molten metals or acids cause the larger percentage while wounds, ulcerations, trachoma, diphtheritic or gonorrheal conjunctivitis, or xerosis, and the effects of operation are the commoner causes of the remainder.

The indications for or against surgical intervention are usually plain. Any adhesion of sufficient extent to limit the excursions of the globe, to cause pain, or to constitute a cosmetic defect can usually be relieved or improved by an operation. The restoration of a completely

[Diagram: Obliteration of the Cul-de-Sac from Shrinkage.

or partially obliterated cul-de-sac to provide for the wearing of a prosthesis is included under this head. Operation is contraindicated so long as contraction is still active in the adhesions if the fornix is involved. So long as there is no involvement of the fornix the case presents no especial difficulties and may be operated upon at any time. The more extensive the involvement of the fornix the more formidable becomes the operation and the smaller the chances of ultimate success, (hence the necessity of awaiting the most favorable moment when all activity in the adhesions has ceased) so that the relief of total symblepharon has always been considered a difficult and, sometimes, a hopeless task. With the improved methods introduced during the last few years the prognosis has become somewhat more favorable.

The same procedures for the covering of raw surfaces and the obliteration of adhesions in other parts of the body are available here
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—only slightly modified on account of the delicacy of the structures involved. The means employed are; (1) severing the adhesions, (2) sliding flaps of conjunctiva, (3) pedicled flaps of conjunctiva or skin, and (4) grafts, cutaneous or from the conjunctiva of both human and lower animals.

For symblepharon of limited extent and not involving the fornix it is usually sufficient to sever close to the globe and prevent re-at-
double-armed suture through the apex of the adhesion by which it may be held instead of with forceps. This suture should be so inserted as to have the loop lie upon the outside of the adhesion, as it can thus be best utilized when the apex of the cicatrix is buried, in a later stage of the operation. The apex having been freed from the cornea, the adhesion is abscised from the globe by blunt, curved scissors, after which the scar tissue is completely cut out of the loosened bulbar conjunctiva by two incisions made from apex to base. This leaves the adhesion a freed tag, or flap, which is turned into the opening at its base and secured by sutures which pass out through

Arlt's Operation for the Relief of Symblepharon. (After Beard.)

the entire thickness of the lids and are tied over a small roll of gauze or piece or rubber tubing. The edges of the bulbar wound are freely dissected loose, or undermined, with blunt scissors, and then united with fine silk sutures. If the corneal involvement has been extensive it may be necessary to cut the conjunctival flaps free for a short distance around its edge, to secure good coaptation. Especial care should be taken to close the wound in the bulbar conjunctiva well down into the fornix, as it is there that recurrence is most apt to take place. The turning of the tag into the lid produces a pronounced bunch of scar tissue and conjunctiva which, however, usually disappears in time.
Teale's operations for symblepharon. Instead of dissecting the apex of the symblepharon off the cornea it may be simply severed from the body of the scar at the limbus and the corneal portion allowed to remain in position where it usually undergoes some degree of atrophy. This idea was first advocated by Teale in 1861. The same surgeon also devised several flaps for covering the raw surfaces left by the removal of extensive scar tissue. In one he took vertical flaps from either side of the cornea and turned them upon their pedicles so as to lie horizontally across the wound, where they were sutured into place (see the illustrations). The secondary defects were then closed by drawing the edges together and suturing them.

At a later period he made an arched bridge flap from the healthy conjunctiva opposite the symblepharon. This bridge was left attached at both ends, slid over the cornea and sutured into position where it covered the denuded surface left by the removal of the symblepharon.

The Teale-Knapp operation for symblepharon combines certain features of the methods of von Arlt and Teale. The pterygoid apex of the symblepharon is cleanly dissected away from the cornea and buried in the sulcus after the manner of Arlt, while the bulbar wound is covered as in the Teale procedure. The lower edge of the newly adjusted conjunctiva is firmly sutured into the fornix to prevent its riding upon the raw area of the cornea and producing an opaque scar. To prevent this Schirmer grafted onto the human eye a thin layer of the cornea of a rabbit.

Burying the freed end of the symblepharon in the fornix is theoretically a satisfactory way of disposing of it, but for some unaccount-
able reason this buried mass is prone to gradually push its way up and nullify the good primary result of the operation. Various expedi-
ents have been tried to overcome this tendency. Panas made a button-
hole in the lower lid through which he carried the detached apex and buried it beneath the skin of the cheek, but with such indifferent success that his example is seldom followed.

Teale-Knapp Operation for Symblepharon.

If there is much dense scar tissue deep in the fornix it is well to remove as much of it as possible, because the more dense the tissue the more apt is it to cause trouble after it is buried.

_Himly’s symblepharon operation._ Since anterior symblepharon is so easily overcome and the removal of posterior symblepharon is encompassed with such difficulty, Himly attempted to first transform the posterior into the anterior type and then operate on the latter, simple form. To accomplish this he pierced the adhesion along the fornix and introduced a large lead wire, which was allowed to remain in position until the opening had become lined with epithelium, as is done when the ears are pierced. This measure was only partially successful.

Where the symblepharon is so extensive that it is impossible to obtain from the conjunctival sac sufficient mucous membrane to cover the defect left by its removal, it obviously becomes necessary to secure a substitute for the conjunctiva from some outside source. For this purpose there have been utilized mucous grafts taken from the fellow eye or from that of a donor, from eyes of rabbits, dogs and sheep, also from the vagina and prepuce; cutaneous grafts after the methods
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of Wolfe and Thiersch, and predunculated skin-flaps turned in from neighboring parts of the face.

Each of these tissues has its own field of usefulness in meeting special indications. The better the state of preservation of the eye, particularly as regards the cornea, the more essential it is that it should be surrounded by conditions and tissues as nearly normal as possible. In such cases mucous grafts undoubtedly afford the most suitable material as they are well tolerated by the cornea and do not suffer maceration from the tears as do tissues whose habitat is free from moisture. Skin-grafts are always more or less irritating to the sensitive cornea, either from dryness, oiliness, from the fine hairs they contain, or from the dead epithelium that accumulates on the surface. For, while the character of a skin-graft implanted in the conjunctival sac becomes in time somewhat modified, on account of its new surroundings, it cannot assume the nature of mucous membrane, but still remains dermic and exfoliates thick masses of dead epithelium which require frequent mechanical removal to prevent irritation. The ease with which mucous grafts can be secured, either from man or the lower animals, and their usual survival of transplantation seem to add to their adaptability and furnish grounds for a good prognosis. As a matter of fact, however, the ultimate results of their employment have been almost uniformly disappointing. The immediate result is usually satisfactory, but there almost invariably follows an insidious shallowing of the cul-de-sac until, at the end of a few months, the good effect of the operation is entirely nullified. Against this gradual pushing up of the fornix no known force is of much avail; artificial eyes, plates of glass or metal and all other measures have been equally unsatisfactory.

The first recorded attempt to substitute the conjunctiva of the lower animals for that of man was made by Wolfe, of Glasgow, in 1872, who used rabbits’ conjunctiva. In 1873 Stellwag tried not only rabbits’ conjunctiva but the mucous membrane from the mouth and vagina. Attributing their failures to the extreme frailty of the membrane, Panas tried the conjunctiva of a dog, but fared no better.

In transplanting mucous grafts from the conjunctiva of the lower animals, the technique usually practised is as follows: The patient’s eye having been cleansed in the usual way the symblepharon is completely detached, the field of operation flooded with warm normal salt solution, and bleeding stopped, by pressure if necessary. The animal chosen having been chloroformed, its eye is held open by means of sutures run through the lids, and the conjunctiva cleansed by copious irrigation of boric acid and, finally, normal salt solution. Two
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or more sutures are now inserted in the conjunctiva at the borders of the area to be excised, to facilitate handling and to aid in identifying the epithelial surface after the piece has been removed. If this is not done it is almost impossible to tell front from back. The graft is dissected from the globe and transferred directly to its new bed if it is ready to receive it; otherwise it is dipped into the warm salt solution while the patient's lid is everted and strongly drawn away from the globe, which is rotated in the opposite direction so as to expose the bottom of the cul-de-sac. The graft is now adjusted by means of the sutures referred to, care being taken to have it right side out and sutured to the borders of the healthy tissue. In order to draw the graft well down into the fornix, loops of thread may be passed over it at this point, run diagonally downward through the lid and tied over a cylinder of gauze on the skin of the cheek. Some operators allow these threads to remain until they cut through, while others lay a piece of sterile oil silk along the fornix before inserting the stitches (to prevent their cutting through) and remove them in about a week. A more modern method utilizes a plate of sheet lead cut to fit the fornix. This is protected by a coating of paraffin which is inserted in the cul-de-sac to hold the graft down in the fornix. The plate may be of the half-moon type, secured by sutures; or the oval plate, whose shape and size hold it in position.

In some cases of extensive symblepharon pedunculated skin flaps have proven more satisfactory than mucous grafts, yet their results leave much to be desired. Their resistance to ultimate effacement from gradual contraction of the fornix is somewhat greater than is the case with the more delicate mucous grafts on account of their better nutrition and greater thickness, but this apparent advantage is offset by the disadvantage of transplanting dermic tissue into an environment suitable only for mucous membrane—a condition whose evils have previously been dwelt upon.

One of the first surgeons to attempt this method of dealing with extensive symblepharon was Taylor, who in 1876 reported an operation in which he took a flap from the lower lid and introduced it into the cul-de-sac through a buttonhole cut through the fornix near the pedicle of the flap; twisting it 180° on its long axis to bring the raw surface in contact with the defect on the inside of the lid. Here it was stitched into position with its epidermal surface next the globe. The outer defect was closed with sutures.

Harlan's operation for symblepharon. Another variation of the flap and buttonhole operation, practised by Harlan, is performed as follows: A bridge flap (with relatively narrow pedicles at each end)
is designed on the cheek below the lid by two horizontal incisions, the upper one of which is cut through into the bottom of the newly prepared fornix. Through this slit the flap is pushed and twisted on its pedicles so as to bring the raw surface in contact with the inside of the lid. The secondary defect is closed by sutures or grafting, according to its size.

It is to be inferred from reading the descriptions of most of these measures that the transplanted flap is used only to line, or cover, the palpebral part of the defect, and that the ocular, or bulbar portion is left to care for itself as best it can. This method, of course, is not good surgery. The transposed tissue should be of dimensions sufficient to cover the entire raw area, i.e., either one flap broad enough to fold upon itself so as to lie in contact with both globe and lid, or two flaps, one for the globe, the other for the lid. If the folded flap is used, loops of thread are put into the fold, and if two flaps, the edges that lie in the cul-de-sac, constituting the new fornix, are stitched to the tarso-orbital fascia at the rim of the orbit by sutures that pass outward through the lid and are tied over rolls of gauze.

The Panas operation for symblepharon. Panas covered both the bulbar and palpebral wounds with skin flaps, taking one from the temple and the other from the cheek, introducing them through a buttonhole in the outer orbito-palpebral furrow and applying them to the globe and lid respectively. After they had become firmly adherent the pedicles were cut and the cheek wound closed. For total symblepharon of both lids he took from the temple a large flap the shape of a tennis racquet and turned it in through the palpebral fissure so as to bring its raw surface in contact with the inside of the two lids, which were stitched together. At the end of three months the flap was bisected along the lid edges and the palpebral fissure re-established. This operation was a failure, perhaps to a large extent because there was no attempt made to cover the defect in the ocular conjunctiva, or to anchor the cul-de-sac for the purpose of counteracting the effects of shrinkage. The only operations of this class which have enjoyed any considerable degree of success have been those in which a capacious cul-de-sac has been provided, both sides of it protected by grafts and means provided for preserving it and protecting it from shrinkage. Aside from anchoring down the fornix by means of skin flaps passed through a buttonhole in the cheek the most successful supports, both to retain the shape and depth of the cul-de-sac and hold the graft in position, are the glass and porcelain eye shields and
the paraffin covered lead plates cut to size and moulded to fit over
the globe.

Samelsohn is the originator of a successful but formidable opera-
tion in which he cuts a quadrilateral flap from one lid, leaving its
edge attached along the ciliary border, and turns it into the opposite
cul-de-sac to line the inside of that lid. When union has become
firmly established the flap is severed at its base and the same thing
repeated for the other lid, if necessary. This procedure leaves a lid

Snellen's Blepharoplasty for the Relief of Symblepharon.

with engrafted tissue on both sides, because the secondary defect
must of course be covered to avoid producing a bad scar in a place
where contraction is liable to cause serious deformity. Under such
conditions it seems that it would be almost impossible for the lid to
retain its natural shape.

_Thiersch grafts in extensive or total symblepharon._ Epidermic, or
Thiersch, grafts afford the best known means of repairing extensive
posterior or total symblepharon if the globe is present and to be pre-
served, as also for the restoration of the cul-de-sacs in anophthalmos.
Small bits of skin were used to a limited extent in replacing con-
junctival tissue by von Arlt, who applied them after the manner of
Reverdin, upon a granulating surface. Later, Eversbusch and others
adopted the use of larger pieces of skin, the Thiersch grafts, which
were much more satisfactory, and enjoy the greatest popularity
today. There has never been serious difficulty in getting the graft to
live, but to preserve the cul-de-sac from obliteration by shrinking
has been a well-nigh hopeless task until within the last few years. In
order to accomplish this surgeons have gone to every extreme, the
work of Continental surgeons having been especially heroic. These
have, for the most part, taken some form of making a temporary flap
of the lid, restoring it to position after healing was complete.

_Czermak's operation in extensive symblepharon_ is a fair example of
the class just mentioned and is performed as follows: A free canthot-
omy is done and from the end of this cut an incision is made which in-
cludes the entire thickness of the lid, down along the orbito-palpebral
row to a point below the inner canthus. This flap is dissected from
its adhesions to the globe and turned back over the nose. The raw surface on the globe is now covered with the Thiersch graft and protected by a layer of gutta percha tissue smeared with vaseline. The denuded surface of the flap is likewise covered and the lid turned back into place. The gutta percha, extending beyond the borders of the wound in all directions, insures the avoidance of adhesions and a consequent epidermization clear to the bottom of the cul-de-sac. When the new skin has become firmly united the edges of the flap and adjacent side of the cheek are freshened and the lid sutured into position. This operation is claimed to provide a deep and enduring cul-de-sac and to be especially useful in providing a socket for a prosthesis.

These mutilating operations have seldom been resorted to in the United States, but a gratifying degree of success has been attained by using the same form of graft in a more conservative way.

The Hotz operation for the restoration of the cul-de-sacs. Hotz, of Chicago, and May, of New York, were pioneers in this branch of surgery in this country, and their first successful work was reported about 1897. Since that time there has been little change in either methods or results. With slight variation of technique, but without change of principle, these operations are performed as follows: The lid is thoroughly dissected free from its attachment to the globe and the cul-de-sac is made large in all dimensions, all cicatricial bands being severed. The plate which is to hold the graft in place is now fitted. This plate is the keystone of the operation. It may be made of porcelain (May), sheet lead (Hotz), block tin (Woodruff), hard rubber (Weeks), celluloid (Haitz), or of some soft metal covered with paraffin (Wilder), but it should always be large enough to entirely fill the new socket. After the size and the shape of the plate have been satisfactorily arranged, the graft is taken from the inner side of the arm and transferred directly to the plate, where it is folded over the edges with the raw surfaces out. The plate and graft are then placed in the newly prepared socket and the lids closed over them and held in that position either by sutures or strips of adhesive, over which is put the usual dressing and bandages. It is essential to keep the lids as quiet as possible and to this end both eyes are kept bandaged until the grafts have become firmly adherent, which requires from 4 to 6 days. At the end of that time the plate is removed but the eye is kept bandaged for a few days longer. It is well to cut an opening in the center of the plate for purposes of observation and cleansing. When the globe is present this opening should correspond in size to that of the cornea, thus obviating pressure of the metal upon it and permitting its condition to be seen.
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When the globe is absent some operators make two holes, about 5 mm. in diameter and 15 mm. apart, to furnish drainage and means of irrigation before the plate is removed. The author has found that a single opening answers all these purposes, and is preferable in extensive restoration because it does not occupy space needed for the grafts.

Weeks' operation for cicatricial orbit. Weeks, in 1904, reported an elaboration of the ordinary plate method of grafting, whose good results he attributes to the fact that the graft is attached to the periosteum at the rim of the orbit.

The case then reported was one of anophthalmos with obliteration of the socket. A free canthotomy was made and the lid detached almost to the rim of the orbit. Into this new cul-de-sac was placed a large Wolfe graft folded upon itself so that the raw surface covered the wounds on the stump and lid. Sutures passed through the bottom of this crease were also put through the periosteum of the orbital rim and out on the cheek. This draws the graft down into the bottom of the fornix where it is further maintained by the plate which is inserted after the edges of the graft have been sutured to the stump and conjunctiva of the lid. The last step is the closure of the canthotomy. The deep sutures are left in for fourteen days, those of the conjunctiva and stump one week. The plate is left in position until all shrinkage of the flap ceases.

There seem to be many advantages gained by using the plate, and no dangers. For it is claimed that (1) it enables one to accurately place the graft in position; (2) it holds it in position at the very bottom of the cul-de-sac; (3) it secures accurate and firm approximation of the whole extent of the graft; (4) it secures a greater degree of immobility and rest for the parts during the process of repair than any other method.

In addition to these merits, common to all plates, the following are claimed for that of metal coated with paraffin. It possesses greater smoothness and is less irritating to the cornea, may be easily built up to appropriate form and thickness and furnishes a bed upon which the graft is more easily spread out than upon naked metal, rubber or porcelain, and is unaffected by the secretions of the eye. Large metal plates may be cut in two to facilitate removal. Wilder, the originator of the paraffin-coated plates, advises the use of paraffin of a melting point not lower than 130° F.

When the restoration is extensive, as in obliteration of the socket with anophthalmos, in view of the inevitable shrinkage of the newly formed cavities, it is important that the fashioning of the cul-de-sacs
BLEPHAROPLASTY, ARLT'S METHOD OF

and of the paraffined plate, be done on a large scale. To this end it is essential to make provisional canthotomy the first step. This act serves two purposes, (1) it opens up the field of operation and (2) it permits the insertion of a much larger plate than could otherwise be employed. When the time comes to remove the plate either the canthus is again divided and subsequently resutured or else the plate is cut in two by means of strong, blunt-ended scissors.—(C. H. B.)

Blepharoplasty, ARLT's method of. See the major heading.

Blepharoplasty, Blasius's method of. See the major heading.

Blepharoplasty, de Wecker's method of. After the removal of skin in operations about the lids, or when these have been removed as the result of a trauma, de Wecker was in the habit of covering the whole granular surface (Norris and Oliver's System, III, p. 120) "with a 'mosaic' of small dermic grafts taken from the forearm. He pinched up a little fold of skin with the finger and thumb, transfixed it with a small bistoury, and freed it with a pair of curved scissors, forming a flap which after contraction measured six or eight millimetres in diameter. When a sufficient number of such grafts had been transplanted they were covered with gold-heater's skin, and over this a retaining compress and bandage were placed. In cases of ectropion, after freeing the lid-margin and uniting it with the other lid by tarsorrhaphy, the gaping wound was left for seven days to form a granulating surface before the grafts were transplanted. The lid-margins were allowed to remain united for several months. Later, he advised the immediate transplantation of the grafts upon the fresh wound; if they do not live they can still be replaced by others after granulations have formed."

Blepharoplasty, Dieffenbach's method of. See the major heading.

Blepharoplasty, Fricke's method of. See the major heading.

Blepharoplasty, Harlan's method of. See the major heading.

Blepharoplasty, Hasner's method of. See the major heading.

Blepharoplasty, Hysern y Molleras's method of. According to Norris and Oliver's System (III, p. 111) this operator in a "publication entitled Tratado de la blefaroplastia temporofacial, ó del método de restaurar las destrucciones de las párpadas, which appeared in 1834, described an operation for restoring the upper lid, performed by him in 1829. The original is not accessible, but from reference to it by Serre the plan of operation seems to have been much the same as that followed by Fricke (q. v.). Hysern y Molleras made a point of including muscle in the flap."

Blepharoplasty, Indian method of. See the major heading.

Blepharoplasty, Landolt's method of. See the major heading.
Blepharoplasty, Lawson’s method of. The first one to make use of grafting for the purpose of restoring the eyelid in ectropion of the upper lid was Lawson (London Lancet, Nov. 19, 1870). He first dissected the lid margin free and united it by a tarsorrhaphy to the edge of the lower lid. He then left the resulting wound until the fourth day and when it had been well covered with healthy granulations, transplanted a piece of skin the size of a three-penny bit, and two days later grafted another portion still larger. Both pieces of skin united to the granulating surface, the space between being rapidly filled up with new cicatricial tissue.

Blepharoplasty, Le Fort’s method of. This surgeon was probably the first to make use of transplantations from the distance of a flap without pedicle—a procedure now frequently employed. He stated (Gaz. Hebdom., Mar. 1872, p. 140) that he had read an account in the Indian Annals of Medicine of operations performed by natives for restoring the nose by flaps taken from skin of the patient or from some subject willing to supply the necessary graft. He preferred an arm-flap large enough to cover the entire denuded surface. The transplanted skin was retained in place by seven or eight sutures and a light bandage.

Blepharoplasty, Pancoast’s method of. Harlan describes (in Norris and Oliver’s System of Diseases of the Eye, III, p. 115.) this operation. The skin of the upper lid had been destroyed and its margin was adherent to the edge of the orbit; there was an extensive cicatrix of the forehead, and the eyebrow had entirely disappeared. Pancoast transplanted a flap taken from the skin far back in the temporal region, including a narrow strip of the scalp in its outer edge. When the flap was in place the hair on its upper margin was made to take the position of the eyebrow.

Blepharoplasty, St. John’s method of. This method is described in Trans. Annals. Ophth. Soc., 1893, p. 597. The patient had had her entire scalp torn off by the revolving shaft of a mill, leaving a most extensive granulating surface which was cicatrized by skin-grafting. The resulting contraction of the enormous scar produced an extensive ectropion. St John took a large flap from below the lower lid and placed the incisions so that the scar should fall in the natural furrow at the margin of the orbicularis muscle. The margin of the eyelid was freed by an incision about two millimetres above the ciliary border, dissected loose, brought down and united by sutures to the edge of the lower lid. The incision by which the lid-edge was freed was extended outwardly to a point about three centimetres from the external canthus, and from this point a curvilinear incision was carried, following the natural fold and keeping about two centimetres from the edge of the
lid. This incision extended to the side of the nose, and then, turning sharply upon itself, ran in a slightly crescentic curve (concavity upward) below its former course, and distant from it, at a point exactly below the centre of the lid, two or three centimetres, corresponding to the width of the gap to be filled. This incision was prolonged in the direction of the ear at least one and one-half inches beyond the external canthus, and an incision from the upper edge of the gap left when the lid was dissected free was also carried outwardly parallel to the one just described. The tongue-like flap below the eye was then dissected up, and the dissection carried at least one inch beyond the canthus. The flap was then laid in the gap to be filled and secured by fine sutures. The large gaping wound upon the cheek was filled by undermining with scissors the lower edge only, and this undermining had to be very extensive—at least two inches—in order to have as little tension as possible.

**Blepharoplasty, Tagliacotian method of.** See major heading.

**Blepharoplasty, Velpeau's method of.** For the purpose of covering the defect in some of the blepharoplastic methods, Velpeau took the flap from the malar region for the upper lid, and from the temporal region for the lower lid, to obviate the tendency to ectropion as the result of subsequent contraction. This procedure was also the favorite practice of Herman Knapp.

**Blepharoplasty, Wolfe's method of.** See the major heading.

**Blepharoplegia.** (L.) Paralysis of the eyelids.

**Blepharopsalis.** (L.) A name proposed by Kraus for the *blepharome-trum* of Buzzi (q. v.).

**Blepharoptosis.** (L.) Drooping of the upper eyelid. See *Ptosis*.

**Blepharopyorrhea.** (L.) f. n. A flow of pus from the conjunctival sac or inner surface of the eyelids.
Blepharorrhaphia lateralis. (L.) Partial closure of the interpalpebral aperture at either canthus by surgical means.

Blepharorrhaphia medialis. (L.) Partial closure of the interpalpebral slit by stitching together the eyelids at their centre.

Blepharorrhaphia totalis. (L.) Complete closure of the interpalpebral slit by operative measures.

Blepharorrhaphie. (G.) The stitching together of a part or the whole of the interblepharal slit.

Blepharorrhaphy. This is another name for tarsorrhaphy—an operative procedure whose purpose it is to procure adhesion of the lid margins and so to close, more or less completely the palpebral fissure. See Blepharoplasty.

Blepharorrhea. (L.) f. n. A discharge from the eyelids.

Blepharospasm. This is a spasm, either tonic or clonic, of the orbicular muscles. It shows itself by firm closure of the patient’s lids, and is a common symptom of several conjunctival and corneal diseases.

It not infrequently occurs without known pathologic condition (“essential” blepharospasm). In the tonic form the lids close spasmodically and remain closed for a time; in the clonic form the spasm is of short duration, is immediately followed by relaxation, and this in turn is followed by another spasm. A common form of blepharospasm is the fibrillar contractions, which are often alarming to the patient. The twitching of the fibres can be seen near the lid-margin. It indicates a local irritation, such as often is found in mild conjunctivitis or in errors of refraction, but is without significance. It is frequent in habit chorea and hysteria. These clonic conditions are of momentary duration. In some cases clonic blepharospasm is a distressing affection, particularly in aged subjects. The contractions are frequent and violent, involving not only the orbicularis, but also the adjacent facial and temporal muscles. This form is often rebellious to treatment. Hysterical blepharospasm is often seen in neurotic females up to the middle period of life. Von Graefe described cases of spasm of the orbicularis occurring in persons who had been subject to trigeminal neuralgia, the supraorbital and supramaxillary branches being often involved. The tonic contraction in these cases can be controlled temporarily by pressure over the nerve-branches or permanently by subcutaneous section of the trunk. Similar cases and results are seen in persons who have never been subject to neuralgia. By far the most frequent class of cases is that in which the spasmodic action follows irritation or inflammation of the conjunctiva, lid-margin, or cornea (reflex blepharospasm). It is present in practically all cases of phlyctenular conjunctivitis and keratitis and often persists long after the subsidence
of the acute conjunctival or corneal symptoms. In such cases careful examination will show the presence of a minute fissure located more often at the outer than at the inner canthus. The patient with reflex blepharospasm shuts the eyelids tightly, strenuously resists efforts to open them, hides the head in a handkerchief or pillow, and dreads exposure to light. A rare and obscure form of disease is that in which persistent tonic blepharospasm occurs. When finally the eyes are opened, there may be temporary loss of vision without fundus changes, or great reduction in visual acuity with marked retinal, chorioidal, or optic-nerve lesions.—(J. M. B.)

Its treatment naturally varies with the cause of the complaint. In children effective, but harsh treatment of persistent spasm is in holding the head beneath an irrigator or water tap, allowing ice water to flow with slight force over the closed eye-lids. In addition stretching the lids with elevators or other instruments is effective.

R. D. Gibson instills a single drop of four per cent. solution of cocaine into the eye, to prevent undue irritation of the parts, and follows this with the introduction of an eye speculum to expose the eye to the light and air for a period varying from three to ten minutes once per day. The setscrew of the speculum may be advanced a little at a time until the full tension of the spring is exerted in stretching the lids wide open.

Speville (Clinique Ophthalmologique, May, 1906) reports a case cured by hypodermic injection of 1 cc. of 80 per cent. alcohol.

Valude (Weiner Medizinische Wochenschrift, July 28, 1906) also injected 80 per cent. alcohol in the region of the facial nerve (where it emerges from the stylomastoid foramen) in two cases of blepharospasm in which no local cause could be detected. The site of injection was behind the ear close to the anterior wall of the auditory canal; the needle was directed obliquely downward, and was made to enter deeply into the structures for about 2 cm. until it reached the styloid process and then was drawn backward along the temporal bone up to the opening of the mastoid canal where the facial nerve emerges. It is of advantage to add cocaine to the alcohol, 1 c. c. water, \( \frac{1}{2} \) c. c. alcohol, and 1 centigram of cocaine. The immediate result of the injection is a paralysis of the facial nerve; this paralysis, however, disappears quite rapidly and with it the blepharospasm.

Valude reports three more cases successfully treated by this method, one to which attention has been several times called in these pages. He infers from the result in one of these cases that the injection of alcohol is applicable not only to simple blepharospasm, but to so-called tic douloureux.

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BLEPHAROSPAT

Blepharospat. (G.) Artery forceps or clamp for use in operations on the lids—the upper lid in particular.

Blepharospath. A hæmostatic forceps for taking up or holding an artery; for use in operations on the eyelid.

Blepharosphincterectomy. An operative procedure intended to lessen the pressure of the upper lid upon the cornea. An incision is made along the entire length of the lid about 2 mm. above its border. Another incision removes a small oval skin flap 2 to 4 mm. broad together with all the underlying muscle fibres. The wound thus made is closed by two or three sutures.

Blepharostat. An instrument for fixing the lids in operations on the eye.

It was Sharp who first (in 1753) pointed out the probable value of the blepharostat. "I should not be surprised," he said, "if the use of a speculum oculi should hereafter be esteemed an improvement. But, then, it must be contrived so that it shall not compress the globe of the eye; or, if it does, the operator must be careful to remove it in the instant the incision is making, lest by continuing the pressure after the wound is made, all the humors should suddenly gush out."

Blepharostenosis. (L.) f. n. Narrowing of the interpalpebral aperture.

Blepharosymphysis. Blepharosynechia; adhesion of the eyelids.

Blepharosyndesmitis. (L.) f. n. Palpebral conjunctivitis.

Blepharosynechia. The adhesion or growing together of the eyelids.

Blepharotis, BLEPHAROTITIS. (L.) Obsolete names for blepharitis.

Blepharotomy. This term is generally used as a synonym for canthoplasty (q. v.), an operation intended to enlarge an abnormally short or small palpebral fissure.

Blepharoxysis. An operation employed by ancient ophthalmologists in the treatment of trachoma. The procedure consisted in rubbing the inner surface of the lid with a spindle-shaped piece of wood, on which had been closely wound a quantity of Milesian wool. The rubbing was continued until it was followed no longer by blood, but by a thin, watery fluid. The abraded surface was then subjected to the actual cautery (care being taken not to cauterize the margin of the lid) and this was followed (all being done at the same sitting) by the application of a salve containing scales of the peroxide of copper.

When the scab produced by the blepharoxysis had fallen from the lid, incisions were made in various portions of the scalp.—(T. H. S.)

Blépharoxyste. (F.) Instrument for removing vegetations from the inner surface of the eyelids.
BLEPHAROXYSTON

Blepharoxyston. Lid-shaver. An instrument with which, according to Paul of Aegina (625 to 690 A.D.) trachoma granules were removed from the conjunctiva. The exact nature of this instrument is not known. No exact description of it has been preserved to us, and no examples of it have been recovered.—(T. H. S.)

Blepharoxystum. Any instrument whereby the operation of blepharoxysis might be performed, blepharoxysis having been a favorite operation for the treatment of trachoma in ancient and mediæval times. See Blepharoxysis.—(T. H. S.)

Blepharydatis. A bullous disease or hydatid affecting the eyelid.

Blessé, -ée. (F.) Wounded; hurt.

Blessig, Robert. A celebrated Russian ophthalmologist, renowned especially as an operator and teacher. Born at St. Petersburg, Russia, Oct. 8, 1830, he attended the University of Dorpat, receiving at that institution the degree of doctor of medicine in 1855. His dissertation was entitled, "De Retina Textura Disquisitiones Microscopice." In 1863 he became physician in chief to the Ophthalmic Hospital of St. Petersburg. Under his ceaseless care and brilliant management this institution soon acquired an international reputation.

His most important compositions are:
1.—A Case of Embolism of the Central Artery of the Retina. (v. Graefe's Archiv., bd. VIII, 1861.)
2.—Cases of Disease of the Vitreous Humor in Constitutional Syphilis. (1861.)
3.—On Retinal Hemorrhage. (1863.)
4.—Clinical Contributions to Our Knowledge of the Inflammation of the Optic Nerve. (1866.)
5.—On Xerosis of the Conjunctival Epithelium and its Relation to Hemeralopia. (1866.)
6.—A Cavernous Tumor in the Sceral Conjunctiva, cured by Injection of Liquor Ferri, Sesquichlor. (1867.)
7.—Report of the Cataract Operations Performed at the St. Petersburg Ophthalmic Institute from 1864 to 1868. (1868.)

Blessig was a man of warm heart and many friends. He is said to have worked almost continually, allowing but little time for meals and sleep. Thus he undermined his constitution, and when, in 1878, an epidemic of typhus fever broke out in the institution in which he worked, he became an early victim.—(T. H. S.)

Blessure. (F.) Wound; injury.

Bleu. (F.) Blue colour; blue.

Bleu d'azur. (F.) Smalt.

Bleu de montagne. (F.) Carbonate of copper.
Bleu de Prusse. (F.) Prussian blue.

Blézin, Jean. A 16th century oculist and general practitioner, the date of whose birth is not known. In 1584 he became Dean of the Faculty at the University of Montpellier. He published the works of his uncle, Jean Blézin Schyron, who taught at the same university from 1520 to 1566. He himself is known to have written in 1574 an unsuccessful competitive thesis, entitled, "L’Usage du Vin Guérit-il la Faim et l’Ophtalmie?" He died in 1609.—(T. H. S.)


Blickfeld. (G.) Field of vision.

Blicklähmung. (G.) Paralysis of the visual apparatus that takes part in the direction of vision.

Blicklinie. (G.) Visual line, or direction.

Blicklinie, Binoculär. (G.) Binocular line, or direction, of vision.

Blickpunkt. (G.) Fixation point.

Blight in the eye. An obsolete term for a catarrhal inflammation of the eyelids associated with spots on the cornea.

Blind, Accessory sense of the. See Blind, Sixth sense of.

Blind, Alphabet for. See Alphabet for the blind.

Blind, Amusements and recreations of the. As a general proposition blind persons choose their amusements much as do the seeing. Their recreations and pleasures are also of the same kind and while, naturally, a blind individual (however intelligent and sociable) has limitations put upon his recreations by his lack of visual capacity, yet when one remembers that climbing Mont Blanc (Sir Francis Campbell) and archery (with a small electrically-moved bell constantly ringing just behind the bull’s eye of the target) have been indulged in by blind people, one recognizes the possibilities of the subject. Of course individuals who have become blind after youth has passed and have, in consequence, received an early education, in this matter, as in most others, possess a great advantage over the congenitally blind and over those who have lost their sight in childhood.

Among the recreations that the average blind person may readily indulge in are walking in the country, music, tandem-tricycling, typewriting personal letters, as well as all sorts of games. Javal (On Becoming Blind, p. 131), speaking of the last named, says: "There is nothing to hinder a blind person from playing dominoes, chess, checkers or cards, if he is gifted with a fair memory. If his memory is excellent there is no trouble at all, since the great chess players play without seeing the board, their adversary alone being with the board and making alternately his moves and those of the great player. Being endowed with a wretched memory, I cannot even play at dom-
BLIND ANIMALS

inoes, being unable to remember either what has been played or what dominoes I have in my hand. I have not even tried to play checkers or chess, for I am utterly unable to picture to myself the position of the pieces. For the majority of blind players the game of checkers or chess is made very easy by means of boards on which each square has a little hole to receive the peg with which the checkers or chessmen are provided. These sets with holes and pegs are to be bought, for they were invented for playing on railway trains. It is easy to imagine the slight change necessary to make the black pieces recognizable from the white. For those who do not like the pegs there are special checkerboards made with the squares of one color set deeper than the others. At the municipal school for the blind in Berlin, besides chess and checkers, there are loto, halma, etc. Since the blind person who plays draughts or chess is constantly passing his hands over the game, it is better for his opponent to have a separate board. There are playing cards recognizable by almost invisible needle pricks which give the blind the ability to play with those who see. One can get at the National Institute a little instrument for marking playing cards. A blind person can amuse himself without any modification with the games of solitaire, ring puzzles and billiards."

Blind animals. There are no blind bird species for the simple reason that avian eyesight is a sine qua non of avian life. A wild blind bird would very soon be killed by enemies or would starve to death because of its inability to avoid danger and procure food. This law does not, however, hold true of mammals and other animal classes, a few species being able, in spite of blindness, to live and reproduce their kind. Darwin, as long ago as 1860 (Origin of Species, p. 149, Harvard Classics), gave a philosophical account of blindness in species: "The eyes of moles and of some burrowing rodents are rudimentary in size, and in some cases are quite covered by skin and fur. This state of the eyes is probably due to gradual reduction from disuse, but aided perhaps by natural selection. In South America a burrowing rodent, the tuco-tuco (q. v.), or Ctenomys, is even more subterranean in its habits than the mole; and I was assured by a Spaniard, who had often caught them, that they were frequently blind. One which I kept alive was certainly in this condition, the cause, as appeared on dissection, having been inflammation of the nictitating membrane. As frequent inflammations of the eyes must be injurious to any animal, and as eyes are certainly not necessary to animals having subterranean habits, a reduction in their size, with the adhesion of the eyelids and growth of fur over them, might in such case be an advantage; and if so, natural selection would aid the effects of disuse. It is well known
that several animals, belonging to the most different classes, which
inhabit the caves of Carniola and of Kentucky are blind. In some
of the crabs the foot-stalk for the eye remains, though the eye is gone —the stand for the telescope is there, though the telescope with its
glasses has been lost. As it is difficult to imagine that eyes, though
useless, could be in any way injurious to animals living in darkness,
their loss may be attributed to disuse. In one of the blind animals,
namely, the cave-rat (Neotoma), two of which were captured by Pro-
fessor Silliman at above half a mile distance from the mouth of the
cave, and therefore not in the profoundest depths, the eyes were
lustrous and of large size; and these animals, as I am informed by Pro-
fessor Silliman, after having been exposed for about a month to a
graduated light, acquired a dim perception of objects. It is difficult
to imagine conditions of life more similar than deep limestone caverns
under a nearly similar climate, so that, in accordance with the old
view of the blind animals having been separately created for the
American and European caverns, very close similarity in their organi-
zation and affinities might have been expected. This is certainly not
the case if we look at the two whole faunas; and with respect to the
insects alone, Schiödte has remarked: ‘We are accordingly prevented
from considering the entire phenomenon in any other light than
something purely local, and the similarity which is exhibited in a
few forms between the Mammoth cave (in Kentucky) and the caves
in Carniola, otherwise than as a very plain expression of that analogy
which subsists generally between the fauna of Europe and of North
America.’ On my view we must suppose that American animals,
having in most cases ordinary powers of vision, slowly migrated by
successive generations from the outer world into the deeper and
deepener recesses of the Kentucky caves, as did European animals into
the caves of Europe. We have some evidence of this graduation of
habit for, as Schiödte remarks: ‘We accordingly look upon the sub-
terranean faunas as small ramifications which have penetrated into
the earth from the geographically limited faunas of the adjacent
tracts, and which, as they extended themselves into darkness, have
been accommodated to surrounding circumstances. Animals not far
remote from ordinary forms, prepare the transition from light to
darkness. Next follow those that are constructed for twilight; and,
last of all, those destined for total darkness, and whose formation is
quite peculiar.’ These remarks of Schiödte’s, it should be under-
stood, apply not to the same, but to distinct species. By the time that
an animal had reached, after numberless generations, the deepest
recesses, disuse will on this view have more or less perfectly obliterated
its eyes, and natural selection will often have effected other changes, such as an increase in the length of the antennæ or palpi, as a compensation for blindness. Notwithstanding such modifications, we might expect still to see in the cave-animals of America, affinities to the other inhabitants of that continent, and in those of Europe to the inhabitants of the European continent. And this is the case with some of the American cave-animals, as I hear from Professor Dana; and some of the European cave-insects are very closely allied to those of the surrounding country. It would be difficult to give any rational explanation of the affinities of the blind cave-animals to the other inhabitants of the two continents on the ordinary view of their independent creation. That several of the inhabitants of the caves of the Old and New Worlds should be closely related, we might expect from the well-known relationship of most of their other productions. As a blind species of Bathyscia is found in abundance on shady rocks far from caves, the loss of vision in the cave-species of this one genus has probably had no relation to its dark habitation; for it is natural that an insect already deprived of vision should readily become adapted to dark caverns. Another blind genus (Anephthalmus) offers this remarkable peculiarity, that the species, as Mr. Murray observes, has not as yet been found anywhere except in caves, yet those which inhabit the several caves of Europe and America are distinct; but it is possible that the progenitors of these several species, whilst they were furnished with eyes, may formerly have ranged over both continents, and then have become extinct, excepting in their present secluded abodes. Far from feeling surprise that some of the cave-animals should be very anomalous, as Agassiz has remarked in regard to the blind fish, the Amblyopsis, and as is the case with the blind Proteus with reference to the reptiles of Europe, I am only surprised that more wrecks of ancient life have not been preserved, owing to the less severe competition to which the scanty inhabitants of these dark abodes will have been exposed.”

Blind, Distance sense of the. Distance sense is defined by Wolflein (Zeitschr. f. Sinnesphysiologie, 43, 1908) to be the faculty of the blind to perceive larger objects at a certain distance, whereas orientation means the sum of distance sense, the sense of hearing, pressure, temperature, smell, etc. For testing the distance sense the writer recommends an empty hall at least 8 x 14 m. and a uniform size of the test objects, viz., a board of pine wood, 1 m. square.

He divides the blind into three groups: 1, with well developed distance sense; 2, with weak distance sense; 3, without distance sense. He selected only the blind with well developed distance sense for his
examinations, which gave the following results: The distance sense is not only dependent upon the quality of the object (wood, metal, felt, etc.), but also upon its size. By covering different parts of the face he found that the forehead is the most sensitive part of the distance sense, then the sides of the face, and the least the back of the head. An object is felt, when approached to the patient, later than if the patient moves toward it, and later if the object is rapidly approached than if the patient walks slowly towards it. It seemed important that the reflected air-waves impinge upon the forehead vertically; oblique reflection lessens the perception. If a blind person is arrested in his walk at the moment in which he perceives the object by his distance sense, the perception grows stronger for a few seconds, remains for about a minute in its former strength and then sinks rapidly to a minimum. The distance sense may be cultivated by practice, but patients lacking distance sense cannot acquire it by exercise. In all tests the ears must be tightly closed by the moistened index fingers.

That the distance sense is independent of hearing is shown by the well-developed distance sense of blind and deaf persons. Nor could the writer ascertain an increased sense of temperature in the blind. Uhthoff, Greisbach and others have found that the sensibility of the skin of the blind with regard to topography and pressure is not increased.

It seems most probable that the distance sense is a function of the sensitive nerves of the face, particularly the 5th nerve. Whether special nerve fibres conduct this sensation, or whether this occurs in the paths reserved for the senses of pressure and topography, is still an open question.

Blind, Education of the. See Institutions and resources of the blind; Blind, Occupations and trades for the.
Blindenfürsorge. (G.) The care of the blind.
Blindenwesen. (G.) Condition of the blind.
Blinder. A shield worn before an eye, to temporarily throw it out of function.

Blind, Facial perception of the. See Facial perception of the blind.

Blind fish. In situations where light is absent, blind animals are commonly found. The absence of the normal stimulus has necessitated cessation of function and various degrees of degeneration in structure. In most cases rudimentary traces of eyes prove the fact of degeneration; and that the latter is largely the direct effect of the absence of the stimulus preserving the health of the eye is allowed by most. The blind fish of the Kentucky caves (Amblyopsis) has degenerate hidden remnants of eyes; Lucifuga dentata, a very different form, found in the subterranean caves of Cuba (the member of a marine
family), is also blind; the hagfish (*Myxine glutinosa*), though perhaps hardly a fish in the technical sense, has also virtually lost its eyes in association with its habit of spending much of its life buried in the mud, or parasitically within eods and haddocks. That primitive vertebrate, the lancelet (*Amphioxus*), is in the same state. (Standard Encyclopedia, p. 172.)

After pointing out the discrepancies and contradictions in the description of the eyes of this blind salamander given by Carl H. Eigenmann in a paper published in the Biological Bulletin, II, 1, 1900, with W. A. Denny in the same periodical (Vol. 2, pt. 1, 1900) and in a monograph on The Cave Vertebrates of America, issued by the Carnegie Institution, Washington, in June, 1909, Adolt Alt, on The Histology of the Eye of Typhlotriton Spelaeus from Marble Cave, Mo. (Trans. Academy of Science, St. Louis, Vol. XIX, No. 6, 1910, p. 83), believes that in the former paper Eigenmann, when speaking of Typhlotriton, really refers to Typhlomolge Rathbuni. In the third mentioned publication the following general description of Typhlotriton Spelaeus and its ocular apparatus is given by Eigenmann: "It is an incipient blind salamander living in the caves of southwestern Missouri. It detects its food by the sense of touch without the use of its eyes. It is stereotrope. The eyes show the early stages in the steps of degeneration from those of salamanders living in the open to those of the *Typhlomoge* from the caves of Texas. The lids are in process of obliteration, the upper overlapping the lower so that the eye is always covered in the adult. The sclera possesses a cartilaginous band in the larval stage but not in the adult. The disappearance of the cartilage is probably an incident of metamorphosis, not of the degeneration the eye is undergoing. The lens is normal. The retina is normal in the larva with a proportionately thicker ganglionic layer than in the related epigean forms. Marked ontogenetic degenerations take place during and shortly after the metamorphosis. (a) The outer reticular layer disappears. (b) The rods and cones lose their complexity of structure, such as differentiation into inner and outer segments and finally are lost altogether."

Alt was able to examine six specimens of Typhlotriton spelaeus from Marble Cave, Mo., of which the smallest was a larva 90 mm. long, while the largest measured 115 mm. Of the two smallest one still had gills and no eyelids, the other no longer showed a sign of gills, but, also, had no eyelids. The next two in size had eyelids and a small palpebral fissure, the upper eyelid, however, overlapped the lower one. In the two largest specimens he could not find the smallest palpebral opening. It seemed that no light whatever could enter their
eyes except after having passed through the semi-transparent lids covering them. In the two specimens which had as yet no eyelids the outer skin appeared to pass over the eyes. But it showed decided structural changes in this ocular part, so as to be easily recognized as the cornea. While the epithelium of the skin in the neighborhood of the eye consists chiefly of cylindrical and goblet-shaped cells, it is suddenly changed into a stratified epithelium where it covers the eye. While in the four eyes without lids he could find no section in which the whole of this corneal epithelium was intact, on account of the lack of protection, yet larger portions, and especially the peripheral parts, were in a larger number of the sections well enough preserved to show that there are usually three layers of epithelial cells. The cells of the basal layer were more or less cuboid, the next layer consisting of flatter cells, and in the outer layer they were still more flattened. In the eyes of the adult specimens where the corneal surface was well protected the corneal epithelium was preserved intact and showed the same arrangement.

The corneal tissue proper showed a lamellated structure with fixed corneal cells. Alt was not able to find any interior uniform layer corresponding to Bowman's layer, nor a posterior membrane corresponding to that of Descemet in the human eye. On account of the extreme shallowness of the anterior chamber in most of the sections, in consequence of which the anterior surface of the iris and the anterior pole of the crystalline lens seemed fairly agglutinated to the posterior surface of the cornea, it was only with difficulty that he could convince himself that the posterior surface of the cornea is lined with a layer of endothelial cells. These cells appeared large and flat and had a large oval nucleus. They resemble so much the capsular epithelial cells of the adjacent crystalline lens that this, also, helps to render it more difficult to differentiate them.

The sclerotic was quite thin and showed nothing particular aside from a small amount of cartilage tissue.

Alt found no trace of blood vessel in what in the human eye is the vascular coat. The ciliary body appeared like a few folds and corrugations of darkly pigmented tissue in which there were muscular fibers. It was, also, impossible to demonstrate any muscular tissue in the iris.

The cells of the pigment epithelium are comparatively well preserved in a good many of my sections, although their continuity is frequently interrupted. They are large flat cuboid cells, the protoplasm of which is filled with fuscine needles. Their nucleus is quite large. In most sections they adhere to the outer surface of the retina,
a fact of importance for the understanding of the outer structures of the retina.

In all the sections next to the crystalline lens the retina is really the most conspicuous part of the eye. Even where it is well preserved and lies approximately in its normal position, its great thickness is obvious. When viewed from within outward under a higher power, the first striking fact is an absence of a plainly visible nerve fibre layer. In sections of the larval eye the ganglionic layer seems to be composed of three more or less well defined rows of cells, and, on the other hand, in sections of the adult eye six or seven rows of cells may be counted.

The inner plexiform (reticular) layer forms in all the sections, whether they are from the eyes of the larvae or of the adult, a comparatively broad band. No details can be made out in his sections of this layer; it appears as a uniformly stained homogeneous tissue. Outside of this layer lies apparently a single very broad nuclear layer, where in the human retina we have the two nuclear layers, separated by the external plexiform layer. This thick nuclear layer shows, sometimes very indistinctly, sometimes more plainly, a separation between the large inner mass of nuclei and the outermost layers; that is, what in the human eye would correspond to the layer of rods and cones and their nuclei.

The outermost layer of the retina corresponding to the rods and cones, consists of cells which are arranged pallisade-like and markedly differ in their shape and nature from the others. While in the larval eyes they often appear broader at the base and thinner at their outer end, in the adult eyes their shape is more rounded at the outer end. It is impossible to distinguish between rods and cones, the cells appearing all of the same ovoid shape.

Like Eigenmann, Alt did not find any network of blood vessels in the retina proper, though in a number of cross sections he saw one large blood vessel near where the optic disc should be.

He was never able to see a nerve fibre layer in the retina. The optic nerve is small and consists of very few fibres only. It appears from a number of sections that each optic nerve separately enters the cerebral hemisphere on its side, at least in a number of sections this seems to be the only explanation. In these Alt found a strand of fibres with spindle-shaped nuclei going from the back of the eye towards the brain and entering it through an opening in the cranial bones.

The crystalline lens is very large and in most sections is perfectly spherical and fills almost the whole space between the cornea and
posterior surface of the iris, and the retina, except at its posterior pole where the retina has a funnel-like depression (corresponding to the optic papilla in man) in front of the optic nerve. The capsular epithelium in Typhlotriton lines the whole of the lens capsule.

Alt discovered a small amount of amorphous tissue, stained slightly by eosin, in the funnel back of the lens; but he believes it is impossible to state whether this is derived from a vitreous body or not.

In the examination of the parts thus far conducted Alt can find no material difference between larvae and adults; and the only real difference is that the adults have eyelids and a conjunctival sac. Two adult specimens had a small palpebral fissure which is centrally located. Towards what might be termed the outer and inner canthus the eyelids are united. In these specimens the upper lid overlaps the lower one in the palpebral fissure to quite an extent and both lids contain the same small amount of subcutaneous pigment. To both sides of the palpebral fissure the union of the two eyelids is for a certain distance an epithelial union only but still further outward this gives place to firm tissue union. The palpebral opening can be of little use as far as the admission of form impressions from the outer world goes, especially since there does not even seem to be any muscular tissue in the upper lid which might serve as a levator. Yet, the eyelids are evidently transparent enough to transmit a considerable amount of light.

**Blinder Fleck.** (G.) Blind spot of Mariotte.

**Blind headache.** A popular name for migraine; referring to the (often scintillating) scotoma that as a hemiopia or total obscuration of the visual field is seen in many cases.

**Blindheit, Angeborene.** (G.) Congenital blindness.

**Blindheit, Erworbene.** (G.) Acquired blindness.

**Blindheitsursachen.** (G.) Causes of blindness.

**Blind, Institutions and occupations for.** See **Institutions and occupations for the blind.**

**Blind, Legal status of the.** See **Legal ophthalmology.**

**Blind, Literature for the.** See **Alphabets and literature for the blind.**

**Blind, Magazine for the.** A description of the Ziegler Magazine for the Blind is given in the Scientific American for May 16, 1908. The former periodical has a circulation of about 8,000. The scope of the magazine is very broad. It gives a monthly review of current events, some standard literature, both prose and verse, short stories, a page of music, and a page of conundrums and jokes. Two editions are printed, one in New York point, the other in American Braille. The back cover page of each number of the magazine is illustrated.
BLINDNESS, BINOCULAR, FEIGNED

Usually a map is shown and an illustration of some prominent structure, such as the Brooklyn bridge, or the Statue of Liberty. Blind operatives are employed as far as possible. There are several engravings illustrating various phases of this work for the blind. See also, Alphabets for the blind.

Blindness, binocular, Feigned. See Blindness, Simulation of.

Blindness, Bisulphide of carbon. See Toxic amblyopia.

Blindness, Causes and distribution of. Statistics of blindness. In practice many persons are considered blind who still possess some power of vision, namely, when the visual power is reduced by an incurable condition to such an extent that every demand put upon the eye cannot be fulfilled. Schmidt-Rimpler and Magnus consider such individuals blind as can count fingers at a maximum distance of 1/3 meter only. Fuchs places the limit at finger counting at 1 meter. One must consider the ability (or its lack) to orientate; also that people with more acute central vision than the foregoing but with marked contraction of the field of vision should be considered blind.

Fuchs estimates that there is one blind persons to every 1,000 inhabitants in Europe. The percentage of the blind varies greatly in different lands, as shown by the following table, in which the proportion per 100,000 of the population is as follows:

<table>
<thead>
<tr>
<th>Country</th>
<th>Proportion per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holland</td>
<td>44</td>
</tr>
<tr>
<td>Canada</td>
<td>62</td>
</tr>
<tr>
<td>Poland</td>
<td>70</td>
</tr>
<tr>
<td>Italy</td>
<td>75</td>
</tr>
<tr>
<td>Switzerland</td>
<td>76</td>
</tr>
<tr>
<td>Denmark</td>
<td>79</td>
</tr>
<tr>
<td>Sweden</td>
<td>80</td>
</tr>
<tr>
<td>Belgium</td>
<td>81</td>
</tr>
<tr>
<td>Prussia</td>
<td>83</td>
</tr>
<tr>
<td>France</td>
<td>84</td>
</tr>
<tr>
<td>Germany</td>
<td>85</td>
</tr>
<tr>
<td>England</td>
<td>88</td>
</tr>
<tr>
<td>Austria</td>
<td>94</td>
</tr>
<tr>
<td>United States</td>
<td>97</td>
</tr>
<tr>
<td>Ireland</td>
<td>120</td>
</tr>
<tr>
<td>Hungary</td>
<td>128</td>
</tr>
<tr>
<td>Norway</td>
<td>136</td>
</tr>
<tr>
<td>Spain</td>
<td>148</td>
</tr>
<tr>
<td>Caucasia</td>
<td>150</td>
</tr>
<tr>
<td>Argentina</td>
<td>202</td>
</tr>
<tr>
<td>Russian</td>
<td>210</td>
</tr>
<tr>
<td>Finland</td>
<td>219</td>
</tr>
<tr>
<td>Portugal</td>
<td>219</td>
</tr>
<tr>
<td>Ireland</td>
<td>340</td>
</tr>
</tbody>
</table>

The most important cause of blindness is in most lands blennorrhea neonatorum, a fact which is of importance because this disease can be cured with few exceptions by early treatment. Second is trachoma, a disease which does not lead to blindness if treated regularly and carefully. The statistics on blindness give evidence of possible hygienic improvements.
The following tables of Magnus, our chief authority, give the causes of the visual loss (percentages) in 2,528 cases of bilateral blindness.

### Congenital amaurosis

<table>
<thead>
<tr>
<th>Cause</th>
<th>Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anophthalmos and microphthalmos</td>
<td>1.068</td>
</tr>
<tr>
<td>Megalophthalmos</td>
<td>0.435</td>
</tr>
<tr>
<td>Cataracta accreta congenita complicata</td>
<td>0.119</td>
</tr>
<tr>
<td>Choroiditis congenita</td>
<td>0.158</td>
</tr>
<tr>
<td>Atrophy of the optic nerve (congenital)</td>
<td>0.751</td>
</tr>
<tr>
<td>Retinitis pigmentosa congenita</td>
<td>0.751</td>
</tr>
<tr>
<td>Anomalies of the cornea</td>
<td>0.198</td>
</tr>
<tr>
<td>Tumors (congenital)</td>
<td>0.039</td>
</tr>
<tr>
<td>Undetermined forms of congenital amaurosis</td>
<td>0.939</td>
</tr>
</tbody>
</table>

### Acquired amaurosis

#### I. Acquired through idiopathic eye diseases.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blennorrhea neonatorum</td>
<td>10.876</td>
</tr>
<tr>
<td>Trachoma and blennorrhea adultorum</td>
<td>9.402</td>
</tr>
<tr>
<td>Conjunctivitis diphtheritica</td>
<td>0.356</td>
</tr>
<tr>
<td>Diseases of the cornea</td>
<td>8.068</td>
</tr>
<tr>
<td>Iridochoroiditis myopia</td>
<td>0.949</td>
</tr>
<tr>
<td>Choroiditis and chorioretinitis</td>
<td>1.107</td>
</tr>
<tr>
<td>Retinitis pigmentosa acquisita (syphilitic)</td>
<td>1.266</td>
</tr>
<tr>
<td>Retinitis apoplectica</td>
<td>0.199</td>
</tr>
<tr>
<td>Neuroretinitis</td>
<td>0.791</td>
</tr>
<tr>
<td>Sublation retinæ</td>
<td>4.746</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>8.978</td>
</tr>
<tr>
<td>Atrophy of the optic nerve</td>
<td>7.751</td>
</tr>
<tr>
<td>Tumors</td>
<td>0.356</td>
</tr>
<tr>
<td>Undetermined forms of acquired amaurosis</td>
<td>3.367</td>
</tr>
</tbody>
</table>

#### II. Acquired through trauma.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct traumas of the eyes</td>
<td>4.034</td>
</tr>
<tr>
<td>Unfortunate operations</td>
<td>1.938</td>
</tr>
<tr>
<td>Trauma of the head</td>
<td>0.277</td>
</tr>
<tr>
<td>Ophthalmia sympathetica traumatica</td>
<td>4.509</td>
</tr>
</tbody>
</table>

#### III. Acquired through bodily diseases.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syphilis</td>
<td>0.470</td>
</tr>
<tr>
<td>Blennorrhea gonorrheica</td>
<td>0.910</td>
</tr>
<tr>
<td>Scrofulosis</td>
<td>0.039</td>
</tr>
<tr>
<td>Brain diseases</td>
<td>8.385</td>
</tr>
<tr>
<td>Diseases of the spinal cord</td>
<td>2.333</td>
</tr>
<tr>
<td>Hemorrhage (atrophia nervi optici)</td>
<td>0.079</td>
</tr>
</tbody>
</table>
The above tables give the various causes of blindness without regard to the age at which they occurred. This factor deserves a separate consideration, because it is just this information that teaches us the danger of blindness at various ages; and from such figures it is possible to deduce a rational prophylaxis against blindness. The tables of Magnus also furnish these important figures:

*First age-group (1-15 yrs.)*

<table>
<thead>
<tr>
<th>Condition</th>
<th>Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glioma retinae</td>
<td>1.52</td>
</tr>
<tr>
<td>Measles</td>
<td>2.66</td>
</tr>
<tr>
<td>Scarlet fever</td>
<td>2.66</td>
</tr>
<tr>
<td>Smallpox</td>
<td>4.18</td>
</tr>
<tr>
<td>Typhoid fever</td>
<td>2.28</td>
</tr>
<tr>
<td>Acute exanthemata (undetermined)</td>
<td>1.90</td>
</tr>
<tr>
<td>Atrophy of the optic nerve</td>
<td>15.58</td>
</tr>
<tr>
<td>Sublatio retinae</td>
<td>2.28</td>
</tr>
<tr>
<td>Various retinal diseases</td>
<td>2.66</td>
</tr>
<tr>
<td>Diseases of the uveal tract</td>
<td>7.22</td>
</tr>
<tr>
<td>Diseases of the cornea</td>
<td>8.36</td>
</tr>
<tr>
<td>Sympathetic ophthalmia</td>
<td>6.08</td>
</tr>
<tr>
<td>Traumas</td>
<td>1.52</td>
</tr>
<tr>
<td>Conjunctivitis diphtheritica</td>
<td>0.38</td>
</tr>
<tr>
<td>Trachoma</td>
<td>0.76</td>
</tr>
<tr>
<td>Blennorrhea neonatorum</td>
<td>38.78</td>
</tr>
</tbody>
</table>
Second age-group (15-30 years)
Conjunctivitis gonorrheica and blennorrheica .................................. 2.86
Typhoid fever ................................................................. 7.62
Small pox ................................................................. 0.95
Atrophy of the optic nerve ........................................... 25.71
Sublatio retinae .............................................................. 15.24
Various retinal diseases ................................................. 3.81
Diseases of the uveal tract .................................................. 16.19
Diseases of the cornea ...................................................... 8.57
Sympathetic ophthalmia .................................................... 5.72
Traumas ................................................................. 11.43

Third age-group (30-45 years)
Conjunctivitis gonorrheica and blennorrheica .................................. 1.78
Syphilis ................................................................. 0.89
Atrophy of the optic nerve ........................................... 44.64
Glaucoma ................................................................. 11.61
Sublatio retinae .............................................................. 6.25
Various retinal diseases ................................................. 2.68
Diseases of the uveal tract .................................................. 14.26
Diseases of the cornea ...................................................... 3.57
Trachoma ................................................................. 1.78
Sympathetic ophthalmia .................................................... 6.25
Traumas ................................................................. 6.25

Fourth age-group (45-60 years)
Typhoid fever ................................................................. 0.91
Smallpox ................................................................. 0.91
Atrophy of the optic nerve ........................................... 23.63
Glaucoma ................................................................. 27.27
Sublatio retinae .............................................................. 13.64
Various retinal diseases ................................................. 2.73
Diseases of the uveal tract .................................................. 15.45
Diseases of the cornea ...................................................... 5.45
Trachoma ................................................................. 1.82
Sympathetic ophthalmia .................................................... 0.91
Operations ................................................................. 1.82
Traumas ................................................................. 3.64

Fifth age-group (60-75 years)
Atrophy of the nerve ...................................................... 5.40
Glaucoma ................................................................. 58.11
Sublatio retinae .............................................................. 2.70
Blindness, Color. See Color-sense and Color-blindness.

Blindness, Congenital, occurs as a result of defects in development, or of intra-uterine inflammation. Among these anomalies are: corneal and lens opacities, closure of the pupil, atrophy or arrested development of the intraocular membranes or of the optic nerve, enlargement or reduction in size of the eyeball, or its complete absence—anophthalmos.

Those patients with congenital cataract, who in later years have been relieved by operation, have been well studied, especially as regards the facts concerned with their learning to see. See Congenital anomalies.

Blindness, Cortical. UREMIC AMAUROSIS. In this form of cerebral disease there is loss of the ocular movements insofar as these result from conscious visual impressions. Swanzy (Norris and Oliver’s System, IV, 583) believes that "in such cases the eyes can be voluntarily moved by stimuli received from other senses, especially hearing or touch, but these motions are merely approximate fixation motions; fine binocular fixation cannot be effected. In cases of hemianopsia, loss of motion is not so easily demonstrated; yet, as Knies believes, it is to some extent present. The eyes can follow an object towards the hemianopic side of the field, but the motions are awkward as compared with those towards the seeing side of the field. Knies thinks, too, that the difficulty in reading in right homonymous hemianopsia is mainly due to some impairment of the voluntary conjugate motion of the eyes towards the right." See Neurology of the eye.

Blindness, Desert. This condition is comparable or analogous to snow-blindness (q. v.). The excessive brilliancy of the sun-illumined white or yellow sand of the desert affects the anterior structures of the eye as well as the retina. The excessive heat of the day combined with the often intense cold at night are also contributing causes.

Blindness during ocular movements. That during the ordinary normal excursions of the eyes they do not perceive objects, in other words are blind, for a fraction of a second has been demonstrated by Dodge, who pointed out that one does not see the movements of one's own eyes in a mirror.

Blindness, Education of. See Education of the blind.
Blindness, Feigned. See Blindness, Simulation of.

Blindness, feigned, Rosanow's test for. This is a test for pretended monocular blindness and is practically that of Delay or Herter. Light is reflected with the ophthalmoscopic mirror into both eyes repeatedly and rapidly. The patient does not always know (owing to the intersecting of the optic fibres at the chiasm) which eye is being illuminated and on being asked is likely to name the blind eye. It is not a very satisfactory test.

Blindness, Fridenberg's test for simulation of. See Blindness, Simulated.

Blindness from arsacetin. Hitherto, recorded observations of ocular disease following injections of arsacetin have been clinical only. Sattler (Graefe's Archiv f. Ophthalm., LXXXI, p. 510) is now able to report the post-mortem findings in a case of arsacetin amaurosis. The patient, a woman of 49 years, was given in the course of thirty-one days a total of 4.8 gm. of the drug, in eight intramuscular injections of 0.6 gm. each. She was suffering from pernicious anemia, and was thoroughly acquainted with the risk to her eyes before the treatment was commenced. Visual disturbances began six weeks after the first arsacetin injection. A week later, although the sight was decidedly obscured, there was no central scotoma. Two months after the first injection both eyes were absolutely blind, and the ophthalmoscopic picture was that of typical optic atrophy. The patient died five weeks later. Microscopic examination showed a simple degeneration of the nerve elements, without any indication of an inflammatory process. In the first neuron, the external granular layer and the layer of rods and cones, no changes could be recognized. In the second neuron, moderate degenerative changes were found in individual nuclei of the inner granular layer. In the third neuron there were extensive alterations. These were more marked in the peripheral part of the neuron; that is, the ganglion cells and optic nerve, than in the central part—the optic tract. The ganglion cells had undergone chromatolysis and vacuolization, their nerve fibers had disappeared, and there was slight increase of glial tissue. The papillomacular bundle was less affected than the other fiber bundles. (Jour. A. M. A. abstract).

Blindness from aryolarsenates. The subject of arsenical amblyopia has been discussed under Atoxyl, Amblyopia, Arsenical Blindness from arsacetin and similar captions but it may in addition be said here that almost all organic or other compounds with arsenic used as therapeutic agents (such as orsudan and soamin) have been held responsible—probably with reason—for blindness, although when combined with anilin the loss of vision is due to the latter poi-
BLINDNESS, GOLD

son and not to the arsenic. The aryl arsenates, from their action on the nutrient blood-vessels, cause progressive optic atrophy. The poisonous dose varies greatly in individuals; probably the amblyopia is due to an idiosyncrasy, as with wood alcohol. See Toxic amblyopia; Salvarsan.

Blindness, Gold. A variety of asthenopia occasionally affecting dentists, not always due to the same cause but sometimes the first indication of a toxic amblyopia (q. v.), owing to which there is inability to distinguish the filling from the tooth.

Blindness, Hen. Hemeralopia.

Blindness, Hysterical. The diagnosis of hysterical amblyopia and amaurosis from other forms of blindness is not always easy. See Amblyopia, Hysterical. Hansell is, however, of the opinion that it may be made when accompanied by certain hysterical stigmata, such as ciliary spasm or paresis; amblyopia due to anesthesia of the retina, corresponding in kind to the anesthesia of the skin; contraction of the visual field; relatively greater for white than for colors, and reversal of the fields for blue and red; the tubular field, blepharospasm, monocular diplopia, anesthesia of the conjunctiva and ring scotoma. Simulated blindness (see Blindness, Simulation of) is usually not difficult to recognize, and is to be detected by testing the pupillary reaction, by the stereoscopic tests, the use of red and green letters, etc. These patients always have some very good reason for malingering.

Blindness, Letter. See Visual aphasia; Neurology of the eye.

Blindness, Mind. Visual aphasia. Object blindness. There is in the occipital region not only a centre for vision, but one for visual memory. As Swanzy pointed out (Norris and Oliver's System, IV, 556), in the cells of this latter centre are stored the memory-pictures of objects and scenes that have from time to time been formed in the retina and impressed on the brain. "When an object is looked at which, or the like of which, the individual has seen before, the impression conveyed to the centre for vision is carried on to the visual memory-centre, is there compared with the corresponding visual memory-picture, and recognition takes place. Or if the object be one which the individual has never before seen, its memory-picture is stored up for future use in his visual memory-centre. The faculty of visual memory varies a good deal in different persons, according as they are specially endowed or as education and use develop the power, and it is present more for certain classes of objects than for others in some persons, and more than in other people. The vividness, and even the existence, of a visual memory-picture depend largely on the degree
of desire to retain such an impression of it which accompanies the reception of its image on the retina and in the centre for vision.'

When through a destructive lesion of the visual memory cells the power of visualizing memory is lost we have a true mind-blindness. 'Two kinds of mind-blindness are recognized,—the cortical and the transcortical. In the former the lesion is in the centre for visual memory, while in the latter only the path connecting the centre for vision with the visual memory-centre is interrupted.

'In cortical mind-blindness the memory-pictures themselves are lost. Here the patient is unable to either tell what an object is which he only sees, or to describe an object he is not looking at; visual memory-pictures can no longer be called up in his imagination. He cannot describe the appearance of his nearest relations, the arrangement of the furniture in his rooms, the well-known way from one part of the town to another, and so on; while, too, his relations and friends, when he actually sees them, are like strangers, he does not know his own face in the glass, he does not feel at home in his own house, he cannot find his way through his own town, nor tell the use of the most common objects which he only looks at.

'In transcortical mind-blindness the patient is perfectly able to describe a well-known face, object, or place when he is not looking at them, but immediately afterwards, if shown any of these, he fails to know that they are what he has been describing.' See Neurology of the eye.


Blindness, Preparations for the oncoming of. It not infrequently happens in the practice of physicians skilled in the treatment of diseases of the eye that cases occur in which it is evident that within a few weeks or months, blindness must result. In certain of these cases as in the ripening of an uncomplicated cataract, the loss of sight, while it may be so complete as to shut out all recognition of form leaving only a perception of light, is still hopeful in that the removal of the opaque lens by a surgical operation will, in a large proportion of cases, be followed by a restoration of useful vision. In certain conditions, however, such as chronic glaucoma in which operative measures have not stayed the progress of the disease, or sympathetic ophthalmia, or progressive atrophy of the optic nerve or other steadily progressive diseases of the eyes the waning of sight will continue until eventually like a guttering candle it will flicker and go out.

Those who are born blind, or to whom blindness comes early in life, adjust themselves, after a manner, to their limitations, but when
the blow falls upon the mature man or woman who has been busy with all of the activities of life, it is quite another matter and it frequently requires, on the part of the surgeon by whom the sentence must be passed, both delicacy and diplomacy as well as honesty in dealing with this difficult situation.

In dealing with a patient one should always tell the truth, but bluntly state the facts would be brutal. To fail to tell the real truth would be unworthy and futile, but every statement made by a physician to the anxious patient assumes an exaggerated importance. If the name of the disease is mentioned it conveys the impression which the sufferer has of the disease rather than the real facts concerning it; so it is often necessary with high-strung, imaginative people to tell the facts in the terms of conditions rather than by the use of the scientific name of the disease which exists. Nor is it necessary always that the whole truth should be told to the patient. Pandora left her best gift in the box, when the others flew away; but it is imperative that the relatives or near friends should know the exact facts. When blindness is inevitable the patient must be told then, in as kindly and sympathetic a way as one would break the news of any other great calamity, that this is a loss that he must suffer and that he must gradually learn to do without that one of his special senses on which, in the past, he has chiefly relied. Lack of frankness causes loss of confidence, and in desperation the poor man who feels the night settling about him flies from one suggestion to another in the vain hope of finding a way of escape. If the reputable and dependable oculist fails to enlighten him as to his future he seizes upon the unwarrantable encouragement offered by unscrupulous and ignorant quacks, immensely increasing his disappointment and unhappiness when the inevitable blindness comes. He should have a reasonable time to prepare himself to meet the new conditions under which he must live, and then, more than ever in his life, he needs the encouragement and support of those who can make him realize that all is not necessarily lost,—because he must use other means than those to which he has been accustomed to bring him in touch with the world. During the oncoming of blindness, and finally when blindness has actually come, the aid of judicious friends is of inestimable value.

A word of courage and cheer may still be given him. The loss of sight, bad as it is, is not the worst misfortune that could come to him. Others have gravely met this same affliction and risen superior to it, sometimes the better for it. The manner in which he meets it will show the stuff that he is made of. At first the shock of the dis-
covery dazes him, knocks his foundation from under him. Death seems preferable. For him there is no future; all is blackness and despair. With certain temperaments relief is sought in death.

Usually the man upon whom blindness is imminent knows nothing of the blind, their possibilities, or their achievements. He very naturally thinks that when his eyes are shut all avenues are closed. Let those who know what can be done without sight be his good angels during this period of discouragement and dismay. Let them bring to his knowledge the biographies of successful blind men and women, not alone those who were eminent and gifted like Milton or Fawcett, Senator Gore or Dr. Campbell, but those like himself, if he is of ordinary ability and intelligence, who have fought their way cheerfully through life, in the dark, and have achieved contentment at least, if not happiness, which is the gift of the gods reserved for few. Let him be buoyed up over the danger period and he will have the courage to face life under the new conditions and not weakly to throw it away like a child terrified by present limitations, as Dick did in the "Light that Failed."

If he can no longer busy himself as he has formerly done he must learn some new occupation. His work must be measured by his possibilities, but work he must do,—there is nothing that will so divert his mind from the thought of his own misfortunes. Has he been a writer? Then let him dictate still. A laborer, he must work at such things as he can do, and these are many. He must be told of the successful blind men of all grades of life and how they have succeeded. Above all he needs friends, for who of us who see can know the solitude of sitting in an endless night?

When blindness threatens we are forced to realize that we have all our life used our eyes to the disadvantage of our other senses. From the time that we wake in the morning until we go to bed at night, wherever we go or wherever we look, there is passing before our eyes a series of rapidly changing pictures. As we move about the house or walk down the street our glance rests for a fleeting instant now on this thing and now on that, but so rapidly do the various objects pass before us that the memory of the one picture obliterates the other, and if we attempt to recall the things that we have seen we retain only a blurred and indistinct impression. However unconscious has been our realization of these rapidly changing views we have automatically adjusted ourselves through them to the position that we occupy in relation to them. Without thinking of its details we stop when a touring car comes towards us and we turn aside to avoid a pedestrian who
croses our path without knowing a minute later why we have done so. But, while these impressions are so slight as not to be recalled it is upon them, nevertheless, that we depend in placing ourselves in relation to our surroundings. We ignore thereby to a very large degree the impressions brought to us by our other senses, and only when they are of a startling nature do they succeed in attracting our notice.

We are almost totally unconscious of small, unobtrusive sounds which differentiate themselves only as we listen, of the differences in the feeling of the fabrics as we touch them, or of the smell of the books or of the hangings about us, although all are distinctive and individual, because the eyes have already told us their story. But when we have no longer eyes to see, this lack of training of the remaining senses leaves us peculiarly helpless.

When one is born blind the necessity is forced upon him to cultivate these auxiliary senses if he would to any degree live an independent existence. He cannot see the approaching wagon so he learns to listen for it. The foot-steps of his friends have a distinguishing rhythm and expression, and upon the tone of the voice he depends to a very much greater degree than do those of us who see, the varying shades of difference indicating to him at once the degree of friendliness which the voice conveys. Living in a world of four senses instead of five he learns to use these four as those of us who see do not. Curiously enough the importance of this development of the special senses remaining to those without sight has not been emphasized to anything like the degree which it merits, either in the schools for the seeing or those devoted to the training of the young blind. A blind physician, living in Chicago, is said to be able to tell the temperature of the body to a fraction of a degree by the sense of touch, and a blind girl, by running her finger tip over a coin is able to recognize details that to the average crude touch are totally indistinguishable. If these neglected senses were trained in the schools for the seeing the helplessness of the adult who loses his sight would not be so pathetic. He has depended so constantly upon his eyes that he is no longer able to place himself when the curtain drops. He has not learned to analyze the impressions conveyed by sound, and he does not make nice discriminations in the feeling of the different substances under his feet. He is not conscious of the slight elevation which marks the door-sill, nor of the sense of openness when he has passed through the doorway into the larger room. The meaning of things have come to him wholly through his eyes and now his eyes are shut. He has dressed himself in the morning by sight, he has
eaten his food by sight, he has lived in the world by sight, and so having neglected the education of his sense of hearing, of his sense of touch, and of his sense of smell, they all must be trained at a period in life when training is difficult. He must learn to walk, not because he sees the floor, but because he feels the floor, and the co-ordination of the muscles unused to such responsibilities comes slowly and imperfectly. He must readjust himself to a new world through a new use of the hitherto untried and untrained senses. If he is reasonably intelligent, mentally alert and ambitious, and he immediately begins his new schooling this can be done. Delay is fatal, timidity and fear gain the mastery and he loses his courage and confidence in himself. If he allows himself to sit for a year or more in helpless inactivity his struggle to get back in the active useful world will be difficult. He must at once begin to readjust his life. If the work with which he has heretofore been occupied is not longer possible he must take up something new. He may need special training for this and if so there must be no delay in beginning. When blindness is inevitable it is unkind and unfair that he should not receive previous warning. While he has yet some sight he can do much in adjusting himself to his new condition, but blindness having come, his life must be definitely planned as it never was before.

If the blind man has not up to the present time acquired the habit of order he must begin to do so at once. Each article must have its place and be kept in its place, or he is lost. He must be independent, not dependent. Everything that he can possibly do for himself, and some things that he cannot, he must at least attempt. Let him first acquire topography of the room in which he sleeps. He must know where his dressing case stands in relation to his bed. There must be no indiscriminate placing of his clothes in the wardrobe, each garment must have its exact place. He must know where his shoes and his slippers are kept. His collars must be collected in a neat box, and not scattered about in a drawer. His cravats should be easily accessible, they should be kept in definite order and he should know their color and form. Indiscriminate arrangements that are perfectly proper with those who see are confusing to one who is blind. When his clothes are taken off, each garment should be put in its special place. There will be a certain amount of interest and excitement in his voyage of discovery in studying the room where he is to live, as one would study a new country. He must learn to do things for himself. To be happy he must constantly have something to overcome. His greater difficulties will prove to be his salvation because they will keep him occupied
and give him the keen mental exercise which he would otherwise lack. He must practice such athletics as are within his possibilities in order that his muscles do not become stiff, and these possibilities are much greater than one could imagine. The young blind run footraces by following a wire guard, and they have taken prizes from the boys who see by excelling in the high jump. He must progress from day to day or his retrogression is rapid. He must learn to see with his fingers. The neatness of his dress which was satisfactory before must be exaggerated now; where a superficial dusting with a whisk broom was all that was formerly required to keep his clothes presentable they now must be brushed with a stiff clothes brush in order that no possible spot may escape his care. He must acquire extraordinary habits of neatness because the things that were formerly obvious to him will go unnoticed unless this extreme care is emphasized. His teeth must be kept immaculately clean and his hair properly cared for. He does not wish to excite the pity or sympathy of his friends; let him rather excite their admiration. He must not assume the manner or gait of the man who is blind; he must walk erect and hold his head high, and his very effort to do this will rob his affliction of half its poignancy. His greatest difficulty will be at the table, but here again he must think with his fingers. He must carefully locate his water glass or his coffee cup. He will learn what articles of food are upon his plate and he will have them so arranged that with the end of his fork they are perfectly located, and then with a piece of bread, to aid in its manipulation, he will be able to feed himself almost as daintily, and perhaps in some cases even more so, than do some of his friends who see. He must avoid stooping suddenly without protecting himself from possible chair backs that may be in his way. The blind man must think out and solve his own problems; his greatest danger is in apathy and indifference. The loss of sight, dreadful as it is, is by no means the most serious calamity that could come to one. (A business man who became blind at 50 has doubled his fortune at 50, and a stranger seeing him walking with his valet, in his office or on the street, would never suspect that he was unconscious of a ray of light.) His interest in life must be continuously maintained. To those of mature years each day’s new experience will have all of the fascination of a game. He must learn to utilize the multitude of sounds that come to his ears and the odors that float upon the air and which enable him to determine—whether he is passing a shoe store, a bakery, a grocery, or what not, and by utilizing all of his remaining faculties he will have the keen satisfaction not only of continued
mental occupation, where inactivity is misery, but, as well, progressive development and the joy of adjusting himself to the new conditions in which he must be placed for the remainder of his life.—(F. P. L.)

Heller emphasizes, from his 37 years' experience as teacher of the blind, the importance of sending patients, who are losing their sight, in the preliminary stage of blindness, to schools for the blind, lest the most valuable and effectual starting points for pedagogic measures be greatly reduced or entirely lost. By systematic and rational methods the involuntary tendency of persons affected with progressive blindness to control the defective visual perceptions by the sense of touch, can be much better developed, and scarcely definable psychic conditions can be produced, in which the problematic value of tactile perceptions are considerably and constantly increased by new acquisitions. The transmission of qualities necessary for visual perceptions to tactile perceptions require that persons, becoming blind later on, revive and retain the various visual remembrances and utilize them. The neglect, even the retardation, of this important and effectual transmission obscures and confuses the pictures of remembrance, and produces the sad aspect of dullness, resignation and apathy, equivalent, as it were, to a second psychic blindness.

Among the precautionary measures thus indicated is the perusal by the patient (or the reading of it to him) of "On Becoming Blind." This text-book (if one may so designate it) for those threatened with blindness is one of the most admirable works on the subject yet published and has been a source of great comfort and help to not a few patients. A useful adjunct to treatment of cases at this stage of their defective sight is practice on the typewriter. The ability to use this instrument after the incidence of blindness is a decided solace to these unfortunate.—(Ed.)

Blindness, Prevention of. One of the most important movements during the last decade which has occupied the attention of physicians, political economists, social workers, and others interested in the public welfare is that which concerns itself with the prevention of disease. It has been recognized that none of the movements looking toward the conservation of valuable utilities compares in importance with the saving of human life and the preservation of human efficiency, and among these the preservation of useful sight is one of the most important. While through preventable causes resulting in death the individual is removed from the sphere of social activities, should he lose his sight in a majority of instances he is not only no longer able to maintain himself independently but as this may be associated with
normal health he may live for many years as a dependent upon the efforts of others. Moreover there is no calamity that is more deplorable than that resulting in blindness.

More than a quarter of a century ago it was shown that nearly half of the existing blindness was due to conditions which might have been avoided, and careful investigations in more recent years have shown that this estimate has not been exaggerated. It is therefore of very great importance both from an economic and a humane standpoint that measures should be instituted wherever possible to prevent such destruction of human eyes as will result in blindness, or in a diminution of sight so material as to seriously interfere with the occupation and comfort of one so affected.

Definition and statistics.—According to the United States census of 1910 the number of blind people recorded in the United States was 65,000. From private investigations that have been subsequently made, however, it has been shown that these figures are absolutely undependable. Many have been recorded as blind who had simply weak sight, others who had lost one eye having still a remaining eye which was good, while large numbers who were actually blind were not recorded at all. According to Henry Copley Greene, field agent for the Massachusetts Commission for the Blind, it was said that in Massachusetts only about 53 per cent of the actual cases had been recorded, and in Delaware only about 48 per cent. Assuming that like conditions existed in other parts of the country he estimates that the total number of blind in the United States is not less than 118,000. The difficulty of obtaining accurate statistics lies in the absence of any authoritative definition of blindness and consequently in various inquiries that have been conducted differing standards have been adopted.

Blindness has been defined as an incurable total loss of sight. It is understood as that condition in which sight is so diminished that any occupation requiring the use of the eyes is impracticable. It will be evident that either definition falls far short of meeting all requirements.

That which constitutes blindness may depend upon a variety of circumstances and may be variously interpreted. A watch-maker or a surgeon would be blind, because of the accuracy of sight necessitated for the work of each, long before a laborer or a housemaid would feel obliged from failing sight to give up work. A person with a keen mind would so supplement his failing sight by the use of his other senses, that an acknowledgment, even to himself of actual blindness might be much longer delayed, than in the case of a more dependent
character. When we are considering blindness, moreover, from the standpoint of prevention, it should be borne in mind that there exists a sliding scale in which impairments of sight run the entire gamut, from a slight lessening of normal vision to the darkness of absolute night—from the cloud before the eye, which prevents only the finest work, to the blackness, which is penetrated by no ray of light, or when the eyes themselves are gone, or exist only in rudimentary development.

It soon becomes evident therefore, that this lack of exactitude in our understanding of blindness itself causes widespread confusion in every relationship having to do with the subject.

In its medico-legal aspect its importance was shown in the refusal of a fraternal insurance company to pay a claim for indemnity because the blindness was not total, although the claimant was able only to discriminate between light and darkness.

The chief value, however, of a precise understanding of the meaning of blindness is in obtaining statistics upon the accuracy of which help for the blind themselves, as well as all future preventive procedures, must largely depend.

The instructions given the enumerators for securing the data for the twelfth census of the United States, that for the year 1900, was to obtain answers to the question "Whether all persons enumerated have good sight and good hearing, i. e., can see and hear well" and "should it appear that the sight is so seriously impaired that it is impossible for the persons to read a book, even with the aid of glasses," the enumerator was directed to note such person as "blind" even though he or she may have some slight power of sight. In most schools for the blind the candidate for admission is considered blind who does not possess sufficient sight to be educated in a school for the seeing. The Massachusetts Bureau of Statistics and Labor provided the following definition of blindness for the guidance of enumerators in taking the decennial census, and this was also adopted by the New York Commission for 1906. It included persons "who with the aid of glasses are yet unable to distinguish form and color, to count the fingers of the hand at one foot, or to read writing or ordinary print."

It is at once evident that all of these definitions lack exactitude because of the elasticity of the term blindness itself. The fairest and most just and discriminating definition of blindness is that of Dr. Lewis Sticker, given in the article read before the Ohio State Medical Association on Blindness in Hamilton County.

He proposed a standard definition of three degrees. The first, total
or *absolute blindness* in which the light sense is completely abolished. The second, which might be termed *relative blindness*, is that in which the vision with either eye, with proper corrective glasses adjusted, is so low that fingers can no longer be counted at one meter or three feet, but movements of the hand or moving objects may still be discerned. The third, *practical* blindness, is that in which moving objects may still be discerned at three meters, or nine feet, but in which the field of vision has become so impaired (either by contraction of the field down to five degrees or less, or is entirely abolished and a small area of eccentric vision remains) or in which disseminated scotomata exist, or in which is found only a sector of eccentric vision, that no useful vision remains and the individual gets about with great difficulty. Fourth, only those are to be considered as blind who are helplessly and incurably so. As a basis for any statistical data that may be secured, it would seem necessary that this or some other equally precise definition should be officially adopted so that all records taken may be based upon at least a reasonably similar standard.

The absence of any accurate definition of blindness has been followed as a natural consequence by the greatest inaccuracy as to its extent as indicated by our national and state census reports.

Many individuals with uncomplicated cataracts have been placed among the ranks of the blind, to be practically but not technically taken from this list after the eye or eyes have been successfully operated upon. Many persons were recorded as blind who had one defective eye or who had had one eye removed. The enumerators who took the census for the New York State Commission for the Blind found that many persons had been recorded as blind who were not blind at all, having some weakness of the eyes simply, while others back in the country from the trunk railroad lines who were actually blind, were in many instances entirely overlooked.

It is evident that for scientific purposes the only records that are of any value are those which are made by trained and experienced ophthalmologists, but these are conspicuous by their absence where we would reasonably expect to find them.

The lack of accurate study on this subject is evinced in the almost total absence of any large amount of reliable data and in the inexactness of those which are obtainable.

There are four sources to which we might look for statistics concerning the relative incidence of blindness and the causes which produce it; the federal and state census reports, the unreliability of which has been already noted, the records of public institutions devoted to
the treatment of diseases of the eye, or having an eye department, the reports of ophthalmic examiners of schools or pension bureaus for the blind, and the private records of ophthalmologists.

The records of most of our public institutions as a basis for the study of statistical data concerning the amount of blindness which exists seem to be absolutely worthless. The annual reports of ten of the largest institutions in the United States for the treatment of diseases of the eye were carefully examined and none of them appear to contain other than the most superficial notes on the character of the cases presented. It is of very little value to the public or to any one else to know that there were so many cases treated involving this or that tissue of the eye, and that the cost of maintaining the institutions was so much. Yet in none of them, except possibly the Eye, Ear, Nose and Throat Hospital of New Orleans, was anything more than this attempted.

The possibility of utilizing statistically and for purposes of general study the vast amount of material which passes annually under the observation of the skilled men connected with these various institutions seems to be neglected. The individual is well treated but the completed report is so deeply buried in a mass of records that it is of little value to any one. A careful study of each case, or group of cases, with the method of treatment employed, in their relation to the disease of which they are representative instances, together with the average number of days which the patients were under treatment and the final results obtained, would be of great value and would add but little to the clerical labor involved.

When an iridectomy or sclerotomy or some of the newer trephining operations is made for glaucoma it is important to know what the vision was before the operation and what it was six months or a year later. When vision for any reason has been reduced, as from a result-
ant scar after a patient has been treated for corneal ulcer or other cause, it is a matter if definite value to know how long the patient was under treatment, what medical measures were employed and exactly what amount of sight was saved in each eye.

If such records were made in all public institutions, at least two beneficial results would follow; first, the aggregation of a number of facts from which definite, helpful conclusions might be drawn as to the relative value of different methods of treatment; second, the greater care which would be used if it were known that all of the work done would be open to public inspection. There is no one whose work is
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not done with greater attention to detail when it is understood that the results are to be published.

In several important schools for the blind no ophthalmic examiner is employed and no records whatever are made as to the causes of blindness. In a statement from one of the largest schools in the United States among the given causes of blindness in one case is "meningitis," which probably means "optic atrophy," but it does not say so. The next is exophthalmic goiter, without any statement as to the condition of the eyes which resulted in blindness. A third is "accident," another "disease of the blood," but this is starred as not the oculist's statement, which by inference would mean that the others were. Still another is "glaucoma," which is said to have occurred in a child of two years of age, which is not the term usually employed for this condition, another "measles," another "congenital," simply, still another is "consanguinity," with an interrogation point, whatever that may mean. "Neuritis, whooping cough, uremia," etc., are also other assigned causes. Certainly none of these were obtained as the result of an accurate physical examination made by a competent examiner and, for scientific purposes, they have practically no value whatever. In some cases, however, the most exact and detailed pathologic statements are given and the record obtained is of corresponding value.

There should be no doubt be a uniform record blank in every institution for the blind, on which the condition of each eye should be accurately specified, the age at which blindness occurred and the cause, so far as can be ascertained, on which the loss of sight was dependent. If this were carefully noted in all institutions, it would add another source of exact and practical, available knowledge.

But the most useful and easily accessible source of data of this character would be the ophthalmologist's daily records. It would be a simple matter if each man had on his desk a printed blank on which an exact record could be made, taken from his case book, of the age and of the sex of the patient, the eye involved, the degree of blindness, and, when ascertainable, the cause of the loss of sight. On this could be briefly included those cases presenting the day's work which come under the accepted definition of blindness, with an opinion as to whether or not it might have been prevented, and a suggestion as to how that could have been done. Such reports, especially in regard to accidents, ophthalmia neonatorum, and trachoma at least should be exacted from the clinics of all eye hospitals. In a year the aggregated records would be invaluable.
It is astonishing how relatively frequent are the cases in which but one eye is blind. But they probably would not number more than a dozen during the course of the week, and in the experience of the busiest observer, the accumulated observations made by a number of carefully trained men, while taking but a minimum of effort, would when aggregated give exceedingly valuable results. Such data must be secured before we shall have any absolutely dependable basis on which to establish our future work in prevention.

*Hereditary blindness and its prevention.*—It is important in considering congenital blindness to know as far as possible what factors enter into its production and whether by any possibility these can be anticipated and avoided. Infants are brought into the world blind at birth, and others having the potential elements of blindness which will develop later. The proportion of cases of congenital blindness seems to be much the same when carefully taken in different parts of the world. Magnus in Germany, Trousseau and Dumont in France, and Oppenheimer in the United States found that between three and four in every hundred children are born blind. The United States census report gives double this number but as has already been noted, where the investigations are not made by expert observers the conclusions are of little value.

Congenital anomalies are found represented by almost all kinds of defects and abnormalities. The eye-ball may be seemingly absent, (anophthalmos) or unduly enlarged, (megalophthalmos). Cataract, the most common defect found, is frequently associated with other imperfections, so that unfortunately in many cases its removal does not succeed in giving sight. Discoloration of the lens. Twitching or oscillation of the eye-balls, usually associated with some other defect together with imperfect vision, (nystagmus). This may be either lateral or rotary and is usually increased by looking to one side or the other. Degenerative changes in the cornea. Paralysis or imperfect development of the muscles. Night blindness, color blindness, astigmatism and myopia are among the common defects which have been observed. The absence of a strip of the pigmented portion of the iris frequently extending from the pupillary margin to the edge of the optic nerve and termed a coloboma, is by no means uncommon, while the remaining cases are made up of excessive pigmentation of the retina (retinitis pigmentosa) and deformities and defects including any of the ocular structures, or absence of pigment giving the pink appearance of the eye of the white rabbit (albinism).

It is exceedingly rare to find a perfectly smooth membrane in the
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orbit giving no evidence whatever of even an undeveloped eye, usually a small rudimentary nodule, often no larger than a pea, is found in what is considered to be congenital absence of the eye-balls.

Perhaps retinitis pigmentosa shows more directly the effect of hereditary influences than any other defect of the eyes. This is a condition which, by reason of the gradual deposit of pigment throughout the periphery of the retina the field of vision is narrowed until the sight becomes shut in as though one were looking through a tube.

Coloboma, or absence of a portion of the iris, has been for many years studied by eugenists. Von Hippel considers it an hereditary defect in the developmental impulse. In a study of this condition made by Streatfield, a normal female transmitted the defect to about half of her children but only in the male line was the defect shown. The eugenic conclusions concerning certain congenital eye defects based upon modern studies of the Mendelian law are exceedingly interesting and valuable.

Concerning coloboma of the iris Davenport says (Heredity in Relation to Eugenics) "No female with the coloboma defect should have children since all sons will be defective in the structure of the pupil. For males with such a defect the danger in marriage is also great, for either all or half of the sons of such a father, although married to a woman from a normal strain, will be defective, but the daughters will not be defective in this respect unless the wife belongs to a strain with this defect. Two normal persons may marry with impunity, except that if the woman belongs to the abnormal strain, it may be that half of her sons will be affected.

In hereditary atrophy of the optic nerve the sight begins to fail at about the twentieth year and the course in each case is about the same in each family, so that the family history having been carefully studied the prognosis can be made with reasonable certainty. Here again, according to Davenport, "The normal sons may marry outside of the family with impunity, but a normal daughter may transmit the defect to her sons." A defective male will probably have defective children.

It is now the very generally accepted view that acquired defects are not transmitted to the offspring, although instances are not wanting of a parent who in early life had lost an eye as the result of an inflammation and whose children were born with a defect in the eye of the same side. These would seem to be coincidences and dependent upon some other unknown cause.

Consanguinity seems to enter to a very small degree as a caustive
element in the production of blindness, unless a congenital defect of the eyes exist in one or other of the parents. As a result of Trosseau's investigations, with which most observers are now fully in accord, that without the intervention of heredity the relationship of the parents has little influence in producing defects in the eyes of the children. According to the Mendelian law, however, the recessive as well as dominant tendencies if favored by selection will rapidly lead to the elimination of the others, and, as in those of the same family like qualities are apt to be found, these give double force to the recessive characteristic and it may in that way be perpetuated. "Among the most interesting of all human pedigrees is one built up by Mr. Nettleship from the records of a night-blind family living near Montpelier in the South of France. In night-blind people the retina is insensitive to light which falls below a certain intensity—and such people are consequently blind in failing daylight or in moonlight. As the Montpelier case had excited interest for some time the records are unusually complete. They commence with a certain Jean Nougart, who was born in 1673, and suffered from night-blindness, and then end for the present with children who are but a few years of age. Particulars are known of 2,000 of the descendants of Jean Nougart, through ten generations and nearly three centuries the affection has behaved as a Mendelian dominant and there is no sign that long continued marriage with folk of normal vision has produced an amelioration of the night-blind state. Another of the common forms of Mendelian inheritance is cataract. Trosseau found 2.24 per cent of 625 cases of blindness in France due to congenital cataract."

Concerning cataract the rule is that if either parent has a congenital cataract at least half of the offspring will have it also. It is often associated with consanguineous marriages and eventually results in atrophy of the optic nerve and blindness. Cousins, especially if of retinitis stock, should not marry. Dr. Clarence Loeb, of St. Louis, some years ago had his attention called to the family history of a pupil of the Missouri School for the Blind which showed the presence of cataract in all of the members of the family for at least five generations. This led him to address letters to a large number of the leading ophthalmologists and superintendents of institutions for the blind in the United States and Europe, citing this history and requesting additional facts bearing on the results of the marriage of blind people and asking for opinions as to whether such unions were advised or discouraged. With this was a form to be filled giving the actual conditions and the family history of persons so affected. Of the 152
answers received many proved to be of great interest. The result of this inquiry, he concludes, tends to show that the majority of those who come into professional relationship with the blind are either unacquainted with or are indifferent to the dangers of hereditary blindness. Aside from the economic bearings—which are of course important but are not being considered in this connection—the marriage of persons who have lost their sight from accident or from local disease, will have no bearing on the sight of their progeny, but the statistics which Dr. Loeb has succeeded in bringing together show the danger to the eyes of the progeny of those afflicted with hereditary blindness is very great indeed, and the cumulative effort of bringing together two lines of tainted ancestry is such that in the interest of the unborn generations it should be as peremptorily prohibited by law as should be the marriage of those afflicted with a transmissible disease. The fact that a parent with hereditary blindness may have a number of normal children is no evidence against the heredity of such defects. They are most likely to reappear in the second generation or among the collateral descendants. Concerning the two defects, cataract and retinitis pigmentosa, exceedingly interesting facts were obtained. The direct heredity of cataract was present in 280 families, the father being affected 135 times and the mother 144 times, unknown 7 times; of the 965 children 554 were affected, 57 per cent., while there were 118 families afflicted with retinitis pigmentosa showing direct heredity, of these exactly one-half, 582 or 50 per cent., of the children were born with the same defect.

Prevention of hereditary blindness.—There is but one way in which the begetting of defectives may be stopped. It is the duty as it is the right of the State to protect its citizens. Every child has the right to be well-born. If the rights of person or property of a child, and more especially of an infant, be put in jeopardy the law representing the state takes upon itself to stand between that child and the danger with which he is threatened. His parents or guardians may not maltreat nor abuse him; they may not misappropriate his estate if he have one. He is not even permitted to labor while of school age lest he be deprived of the privileges of education while still a child and thereby lose a right to which the state considers him entitled. It is a capital crime to deprive him of life while he is still unborn. It should be equally a crime to deprive him of his eyes before he comes into the world. The child even though yet unbegotten is entitled to a whole and sound body in which to live, and the state should, so far as possible, so safeguard his development that he has at least an even chance to secure one.
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But shall not consideration, it is urged, be given to the unfortunate men and women whose lives are made still darker by depriving them of the joys of companionship of married life? There is but one answer, and that the further question. Shall one life weigh in the balance against an un-ending progeny of sufferers who must continue to bear the same burden without end? If a man have ten children and blind seven of them what extenuation would the fact of his desire for happiness have? Yet that is exactly the risk that a man born without eyes takes when he marries, that 70 per cent. of his children will never see a ray of light. The conclusions then, reached by Loeb after his exhaustive study of the subject, is that the knowledge of the facts of the transmissibility of hereditary blindness should be more widely spread. The marriage of those so afflicted, if permitted at all, should never be entered into without the fullest understanding on the part of those contracting such marriages, as well as those responsible for them, of the results which may be expected to follow.

In addition to these precepts the law should be invoked to prevent the hereditary blind from marrying. A clean bill of health should be required as a surety of the physical fitness of the contracting parties to assume the responsibility of parenthood. Should heredity be proven it should be an absolute disqualification. It is probably at present impracticable to secure the passage or the enforcement of such a law, but the moral force of a wider knowledge of the transmissibility of inherited blindness would not be without effect. The congenitally blind should be told that even though normal themselves, if two of their children are born blind there is great danger of subsequent ones. They should be warned against the marriage of their children into families tainted with the same defect, they should be told that sisters of men suffering with congential atrophy of the optic nerves, though they themselves be normal, may transmit to their children, who in their turn may carry it to another generation. The laws of heredity may be cruel and seemingly unjust but they are immutable, and finally there is no gift within the power of the gods that begins to measure up in value with a clean and fine inheritance of body and mind.

Ophthalmia neonatorum (birth infections of the eyes).—Perhaps no form of preventable blindness is more dreadful than that which develops in the otherwise perfectly well eyes of new-born infants during the first days of life. It runs a course of a few weeks, and if not actively, vigorously and intelligently treated results not only in the destruction of the eyes as visual organs but leaves them changed in form and repulsive to the sight. This condition is due to the introduction into the eyes of the new-born child at, or shortly after, birth
of infective matter usually from the discharges of the mother. It may occur at a later period, however, by infection carried through soiled clothes, through washing the infant in unclean water, or in various other ways. It is largely preventable by using extreme care in the first toilet of the new-born child. It is more largely preventable by introducing into the eyes of the child as a part of its toilet, an antiseptic germicidal solution of one of the silver salts which is harmless in its effect upon the eyes themselves but destructive to the infective germs, and in almost every case it is curable if the child receive prompt and intelligent attention. An infection of the eyes of this character may be produced through the agency of any one or more of a number of pus-producing germs. The most virulent and the commonest is that carried from the gonorrheal pus and known as the gonococcus. Almost all of the cases resulting in the destruction of sight are due to this infection, although other germs such as the pneumococcus, the Klebs-Löffler bacillus, the Kock-Weeks bacillus, the streptococcus and other micro-organisms will cause pus-producing infections and some of them of a serious character. In every suspected case it is desirable to use a prophylactic solution because after the infection has developed, although it is almost always controllable, it may prove to be serious and frequently scars may be left, even if the eye balls themselves are saved, leaving permanent defects of sight. It is almost invariably due to the existence of an often unsuspected or unrecognized gonorrhea in the mother, as frequently months and sometimes years after manifest evidences of this disease have disappeared, the gonococcus still remains in the deeper tissues ready to develop when the tissues are subjected to the strain of the birth of the child. For many years the proportion of children whose eyes were lost through this condition constituted nearly 10 per cent. of the entire blind population. Its infectious nature had long been known and various measures had been adopted for its control, but it was not until 1881 that Credé, a noted Belgian obstetrician and writer, after instituting a number of experiments reported the remarkable success which he had achieved by the use of a 2 per cent. solution of silver nitrate. Immediately after birth, and on the completion of the child’s toilet, one drop of a fresh preparation of this solution was allowed to fall between the opened lids of the child and upon the cornea from a round glass rod one-eighth of an inch in diameter. Great emphasis is placed upon the exact method by which this application is employed as a failure to understand it and the indiscriminate use of this strong preparation has itself caused serious injury to the cornea. In some instances where the method was imperfectly understood or inaccurately employed the strong solution was allowed to be dropped
in the eyes at intervals of several hours. It must not be so used and
should never be used as a prophylactic except in the extremely care-
ful manner and in the minute amount recorded by Credé. Indeed
the general feeling has been that the irritation produced by a 2 per
cent. solution, except in special cases, in judicious hands is stronger
than is necessary and is apt to produce what is known as silver catarrh.
This is a redness of the eye ball with a mucous discharge which to
the inexperienced might in itself look like an infection, and conse-
quently in many of the cities and states in which this preparation is
now gratuitously given to physicians and midwives it has been reduced
to the strength of 1 per cent, and in this form when used according to
direction is entirely safe. The amount of blindness produced through
the neglect of precautionary measures due to this condition as found
in various Schools for the Blind has been very large. In 1907 an
inquiry was sent to the various Schools for the Blind in the United
States as to the number of children, as far as could be determined, who
had lost their sight from this cause. Among the reports were the
following:

REPORTS FROM SCHOOLS FOR THE BLIND, 1907.

<table>
<thead>
<tr>
<th>Schools for the Blind</th>
<th>No. blind from ophth.</th>
<th>No. of new admissions</th>
<th>neo-</th>
<th>Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York State School for the Blind</td>
<td>13</td>
<td>4</td>
<td>30.7</td>
<td></td>
</tr>
<tr>
<td>Pennsylvania Institute for the Blind</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overbrook, Pa.</td>
<td>27</td>
<td>9</td>
<td>33.33</td>
<td></td>
</tr>
<tr>
<td>Institute for the Blind, Austin, Texas</td>
<td>(Not definite. About 10.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perkins Institute and Mass. School for</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>the Blind</td>
<td>43</td>
<td>13</td>
<td>30.0</td>
<td></td>
</tr>
<tr>
<td>Colorado School for the Blind, Colorado</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Springs</td>
<td>7</td>
<td>3</td>
<td>42.8</td>
<td></td>
</tr>
<tr>
<td>Western Penn. Inst. for Blind, Pitts-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>burgh, Pa.</td>
<td>28</td>
<td>8</td>
<td>28.57</td>
<td></td>
</tr>
</tbody>
</table>

(Percentage of total number in school, 31.37.)

| Missouri School for the Blind, St. Louis| 19                    | 6                     | 31.57|
| State Board of Education for the Blind. |                       |                       |      |           |
| Hartford, Conn                         | 8                     | 1                     | 12.50|

(Since creation of Board in 1893, 34.74 per cent.)

| State School for the Blind, Columbus, Ohio | 61                    | 6                     | 9.83 |
(Reduction of usual percentages and as low as at any time in last twelve years.)

Maryland School for the Blind............. 13 4 30.77
(Percentage of total number in school in 1905, 25.50.)

Ontario Inst. for Blind, Brantford, Ont. 23 5 21.74
(Percentage of total number in school, 24.7.)

The average then of the new admissions in the fall of 1907 to the ten schools in which exact records were kept and representing eight states and the province of Ontario, was 25.21 per cent, or one-quarter of the whole number needlessly blind.

That these are not unusual results is shown by the following report from the Pennsylvania School for the Blind for the past eight years:

1900 .................................. 11 out of 25 = 44.00 per cent
1901 .................................. 10 out of 26 = 35.00 per cent
1902 .................................. 9 out of 39 = 23.00 per cent
1903 .................................. 14 out of 50 = 28.00 per cent
1904 .................................. 15 out of 56 = 25.00 per cent
1905 .................................. 21 out of 42 = 50.00 per cent
1906 .................................. 12 out of 38 = 31.00 per cent
1907 .................................. 9 out of 27 = 33.33 per cent

The average percentage of these eight years is 33.36 of the whole number admitted. As this enormously high proportion of blindness due to ophthalmia neonatorum is found in states maintaining the highest standards of medical education and general sanitation, there is no doubt whatever that when exact statistics can be obtained at least as large a percentage due to this cause will be found elsewhere throughout the country.

It has long been recognized by the medical profession that efforts should be made for the control of a condition so easily reached and so amenable to intelligent care and this led to the adoption of measures on the part of the American Ophthalmological Society, largely through the efforts of Dr. Lucien Howe, of Buffalo, to compel midwives to report the existence of such infections promptly to some physician, and many states have passed such laws. It became evident in course of time, however, that it was not alone the midwives who were responsible, careless as their methods were, but that many cases of blindness occurred where practically no attention had been given to the eyes at or after the birth attendance on the part of the midwife had ceased. It seemed necessary therefore that some organized movement should be taken of a medico-social character in which information might be
more widely diffused concerning the danger which menaced the eyes of the new-born child, and that knowledge should be more widely spread of the imperative necessity of prompt measures for the treatment of such cases when the disease developed.

In 1906, therefore, the American Medical Association appointed a committee to make effective the details of a plan that might give uniform legislation and definite instruction to the medical profession and laity concerning the prevention and treatment of ophthalmia neonatorum. The President of the Association, Dr. W. J. May, appointed as this committee Dr. F. Park Lewis as Chairman, with Dr. J. Clifton Edgar as obstetrician and Dr. F. F. Wesbrook as sanitarian. For seven years this committee conducted the work actively, meanwhile having recognized other prolific preventable causes of blindness, and adding to the committee as active members the following eminent ophthalmologists: Drs. George E. de Schweinitz, Thomas B. Holloway, Casey A. Wood, John Green, Jr., Clarence Loeb, William Campbell Posey, Mark D. Stevenson.

In 1908 the summary of the work necessary was formulated by the committee.

As to the manner in which this might be done the conclusions in detail which are proposed may be broadly outlined as follows:


Cooperation: a. United and concerted action in carrying these provisions into effect.

First. It is necessary to secure the enactment of laws in each state or federal territory requiring the registry of births and placing the supervisory control and licensure of midwives in the boards of health, requiring that all midwives be examined and registered in each county and that they be required immediately to report each case of ophthalmia occurring under their ministrations, under penalty of fine for neglect if found guilty, and for a subsequent offense forfeiture of license. In all states the registration of physicians should be maintained with equal thoroughness.

Second. The distribution by health boards of circulars of advice to midwives and mothers, giving instructions as to the dangers, method of infection and prophylaxis of ophthalmia neonatorum. This has been most effectively carried out by private organizations in England and France. It has also been done to some extent in New York and other cities, but never as a general movement.

Third. The preparation and distribution by the health boards of
ampules or tubes containing the chosen prophylactic, with specific directions for its use. The consensus of opinion on the part of both obstetricians and ophthalmologists is that this should be some solution of silver. The vast majority prefer the 1 per cent. solution of silver nitrate. The special chemical used, however, is merely advisory, each health department should be free to use whatever prophylactic it deems best. It should, moreover, be provided with outfits for taking cultures from the eyes or suspected secretions on request of those making application for its use.

Fourth. To insist on the maintenance of proper records in all maternity institutions and other hospitals in which children are born. If reports were filed with the department of health as to the number of infections, the nature of the prophylactic employed and the results as to the corneal integrity not only would the statistics thus obtained be of great value, but the fact that such records were required would cause greater care on the part of the authorities in regard to cases of this character.

Fifth. Periodic report to boards of health by all physicians engaged in obstetrics of the number of cases of ophthalmia neonatorum that have occurred in their practice within a specified time, whether or not a prophylactic was used—if so, what—together with the result.

Sixth. Of great importance is it that there may be more widespread knowledge concerning ophthalmia neonatorum and its dangers. Helen Keller voices a very proper public sentiment when she says: "The problem of prevention should be dealt with frankly. Physicians should take pains to disseminate knowledge needful for a clear understanding of the causes of blindness. The time for hinting at unpleasant truths is past. Let us insist that the states put into practice every known and approved method of prevention, and that physicians and teachers open wide the doors of knowledge for the people to enter in. The facts are not agreeable reading. Often they are revolting. But it is better that our sensibilities should be shocked, than that we should be ignorant of facts on which rest sight, hearing, intelligence, morals, and the life of the children of men. Let us do our best to rend the thick curtain with which society is hiding its eyes from the unpleasant but needful truths."

Seventh. Most essential is organized and concerted effort throughout all of the states of the Union. The skeleton of such an organization has already been formed and the plan has met with the general approval of the profession in nearly two-thirds of the states. If the chairmen of the Sections on Ophthalmology, on Obstetrics and Diseases of Women, and on Hygiene and Sanitary Science were to select
a representative in each state and territory to support and strengthen
the movement already under way, a conference of these representatives
might be held at a central point and general plans laid down which
could be carried out concurrently. As the chairman of each of these
sections has already given his approval of this report, such an organ-
ized movement could be started without delay and the inspiration and
incentive of united effort would do much to carry it to an effective con-
clusion.

Such conclusions as those outlined by the committee are in fact at
the present date actively under way, in that the Sixth Ophthalmological
Congress to be held in St. Petersburgh in 1914 will in all probability
make provision for the devotion of a portion of a session to the con-
sideration of the conservation of vision and the prevention of blind-
ness.

The state of New York recognizing the importance of this subject
in 1903 by active legislation constructed a special commission to
study the condition of the blind and report upon the preventable
causes of blindness. This commission consisted of Dr. F. Park Lewis,
Mr. O. S. Burritt and Mr. Lewis Carroll. A preliminary report was
made to the legislature advising further work on these lines, and in
1906 a new committee was constructed consisting of Dr. F. Park
Lewis, Mr. E. P. Morford and Mr. W. J. McClusky, which in a more
elaborate report urged that a permanent committee be constituted to
carry on this work in behalf of the state. In the present year, 1913,
these recommendations have been carried into effect and a commit-
tee consisting of the following persons has been appointed, but has not
yet been organized. Dr. John H. Finley, New York City; Miss Lucile
A. Goldthwaite, New York City; Mr. Herbert L. Satterlee, New York
City; Miss Gertrude Bingham, New York City; and Mr. Geo. B.
Burd, Buffalo, N. Y.

In 2,370 children examined in twenty-one Schools for the Blind as
late as 1912 it was found that 684, or 29 per cent., had lost their sight
as a result of ophthalmia neonatorum, while of the new admissions 88,
or 22.7 per cent., had become blind from the same cause.

Recognizing the importance of the protection of infants from
ophthalmia neonatorum a special appropriation of $5,000 annually has
been made by the N. Y. Department of Public Health, for this pur-
pose. Under the effective administration of the Commissioner Dr.
Eugene H. Porter, a 1 per cent. solution of silver nitrate is made in
the State laboratory, which together with a small dropper and descrip-
tive matter, in several languages, is sent to physicians and others
engaged in obstetrical work. A new measure is about to be intro-
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duced by which cases of ophthalmia neonatorum must be promptly reported to the Department of Public Health, and sanitary nurses retained by the department in various centers of the state will be promptly sent when necessary to give effective and skilled nursing where sight can be saved thereby. These measures ought to practically eliminate ophthalmia neonatorum as a cause of blindness in the state of New York.

A copy of the report of the Commission for the Blind for the State of New York for 1906 happening to fall under the eyes of Miss Louisa Lee Schuyler, one of the members of the Russell Sage Foundation, she was struck and deeply moved, as she says in her report to the Foundation, by pictures of blind children under which was written that these children were unnecessarily blind. This led to an application to the Russell Sage Foundation for a grant by which an association might be formed and work carried on for the prevention of unnecessary blindness. A grant of $5,000 was made and there was organized the Committee for the Prevention of Blindness of the New York Association for the Blind. After five years of effective work the committee became a distinctive association having as its secretary Miss Carolyn C. Van Blarcom, and during this time many publications have been issued, lectures have been given and lantern slides prepared which have been loaned throughout the entire United States in the endeavor to carry instruction and to secure cooperation for the protection of the eyes which are menaced by blindness. So important has the work become that in 1913 the committee on the prevention of blindness was enlarged at the request of the Section on Ophthalmology of the American Medical Association under the chairmanship of Dr. Frank Allport, and an aggressive movement will now be carried on which is destined to include the entire medical profession of the country.

Trachoma is another menace to the integrity of sight. Its importance has for many years been fully recognized by the federal government and no immigrant enters our ports without having his lids everted and their condition examined. Its cause is not yet well known. It flourishes best where sanitary conditions are worst. It is slow and insidious in its development. A mass of sago-grain elevations gradually fill in the retrotarsal fold, limiting the lid movements and leaving the eye half closed. The infection is carried by means of the atrocious roller towel, which is still found in some primitive establishments, and by other methods of direct communication. The health departments of many cities have prohibited the use of roller towels; they should be forbidden everywhere. When once established trachoma is exceedingly difficult to control. Notwithstanding the strenuous methods
employed to keep it out it seems to have become firmly seated in cer-
tain sections of this country, while in others it is almost entirely
absent. The public eye clinics of Chicago are filled with patients show-
ing the resultant deformities. Wilder, in a series of careful studies,
located a center from which it seems to proceed in southern Illinois.
It has been found especially prevalent in the mountain ranges of Ken-
tucky and Tennessee among the poor whites who live under most
unsanitary conditions, often in little huts or hovels without windows
and where the infection is readily carried from one to another, while
in Oklahoma it has become a public menace.

An annual clinic has been held in these mountains by Dr. J. A.
Stucky, who, with several nurses on horses and mules' backs, has pen-
etrated far beyond the railroads and given these poor sufferers neces-
sary treatment. In this he has been ably aided by Miss Linda Neville,
Secretary of the Mountain Fund, who through her published writings
has drawn attention to the needs of these people, many of whom are
strong and vigorous and will prove valuable and productive citizens
when a better civilization has reached them.

In reply to an inquiry addressed to the Office of Indian Affairs,
Department of the Interior, under date of Oct. 25, 1911, a letter says:
"We have in the field four traveling experts in trachoma who devote
their entire time to the treatment of the pupils of the Indian schools
for this disease. We have compiled a number of statistics in regard
to its prevalence among Indians, and the percentage ranges from zero
to 75 in various schools in Indian communities. In many cases the
disease is typical and mild, while in others it is followed by severe
sequelæ, resulting in serious impairment of vision, entropion and
blindness in a large proportion of those suffering from this disease.'
A pamphlet has been issued by the United States government on
trachoma.

As an example of the seriousness of this condition recent examina-
tions by a government expert at the Indian stations in Oklahoma shows
as follows:

At Shawnee ...............162 were examined—160 had trachoma.
At Sax and Fox ............130 were examined— 77 had trachoma.
At Otta .................... 76 were examined— 42 had trachoma.
At Ponca ....................133 were examined— 92 had trachoma.
At Darlington .............250 were examined—210 had trachoma.

Despite the fact that the disease is assuming serious proportions,
and especially in Oklahoma where the number of Indians is large, the
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government maintains but four nurses in the work and but two physicians. It is bad enough that such a serious state of affairs should have been permitted to obtain among the poor wards of the nation. It becomes alarming when we realize its possible extension to our own people, a catastrophe which has actually occurred, for still more recent reports show that almost 50 per cent. of the white children in the public schools of certain districts have become infected. Daniel W. White, United States government eye and trachoma expert, recently examined the public schools of Pawnee, Okla., and found 48 per cent. of the pupils affected with trachoma; and he estimated that all of the public schools of that state will show, on examination, that 20 per cent. to 40 per cent. of the pupils are affected with trachoma. He seems to think it very strange that its existence should be general and yet the medical fraternity of the state has not given it more serious consideration. Dr. White has made a close study of this disease all over the United States and has personally examined 100,000 Indians in Oklahoma, and found 70,000 of them affected. This does not include the number of white people whom he has also examined in that state. The following are his exact figures:


<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of pupils examined</td>
<td>495</td>
</tr>
<tr>
<td>Number presenting trachoma</td>
<td>237</td>
</tr>
<tr>
<td>Number presenting no trachoma</td>
<td>159</td>
</tr>
<tr>
<td>Number of suspicious cases</td>
<td>58</td>
</tr>
<tr>
<td>Number of cases of conjunctivitis</td>
<td>42</td>
</tr>
<tr>
<td>Percentage of pupils with trachoma</td>
<td>59 plus</td>
</tr>
<tr>
<td>Percentage of pupils having no trachoma</td>
<td>41 minus</td>
</tr>
<tr>
<td>Percentage of suspicious cases</td>
<td>21</td>
</tr>
<tr>
<td>Number of pupils presenting impaired vision due either to refractive errors or inflammation of the lids of the eyeballs</td>
<td>39</td>
</tr>
<tr>
<td>Percentage of normal eyes of total examined</td>
<td>32</td>
</tr>
<tr>
<td>Percentage of trachoma</td>
<td>48</td>
</tr>
<tr>
<td>Percentage of suspicions cases</td>
<td>12</td>
</tr>
<tr>
<td>Percentage of conjunctivitis</td>
<td>8</td>
</tr>
</tbody>
</table>

From these statistics it would seem imperative that measures be taken immediately by the federal government to supplement the able efforts of the few men who are now employed in fighting this disease
in order that its extent may be determined and steps taken to prevent its further spread.

For centuries trachoma has been a scourge of Egypt and hence has been known as Egyptian ophthalmia. In this country 3.2 per cent. of the population are blind in one eye while 1.2 per cent. are blind in both eyes. In 1903 Sir Ernest Cassel, a well-known philanthropist, established an endowment of 100,000 pounds for the control of this plague in Egypt. Two movable ophthalmic hospitals were formed and placed under the control of Mr. A. F. MacCallan, an ophthalmic surgeon. These consisted of several large Indian tents with suitable equipment and a complete set of ophthalmic instruments, that provide accommodations for 12 patients, but the greater part of the work is for the treatment of out-patients, of whom they reach about 300 daily. The edge of the work has only been touched but the benefit already is appreciable, not only in helping the eyes of these poor sufferers but by giving them some idea of general sanitation of which, heretofore, they have had none.

Until some such movement is undertaken in the United States, in the sections in which the disease is most prevalent, the most encouraging measures to have it stamped out, will be found in the efforts of individual philanthropists through whom it is hoped an organized movement may be inaugurated. This, together with the efforts of the United States government to bring the existing conditions to the notice of the public, should ultimately succeed in freeing the country from a plague which is costly not only in its destruction of human eyes but in the large economic losses resulting from rendering ineffective a population which should be productive.

Blindness from wood alcohol.—Among the toxic amblyopias that are produced either by drinking or by inhaling its fumes that of wood alcohol is one of the most prompt in its effect. Wood alcohol is the methylated spirit resulting from the destructive distillation of wood. It is sold under various names, such as "Columbian spirits," "Eagle spirits," "Green wood spirits," etc. A number of years ago, when it was first put on the market it was so imperfectly purified and the odor was so disagreeable that there was little danger of its being used as a drink, or even as an adulterant. More recently it has been so highly refined that its disagreeable qualities have been almost wholly overcome, and to a corresponding degree it has become dangerous. It has been used largely in place of grain alcohol in making varnishes, hair-dyes, liniments, etc., and for rubbing the body after baths and massages. Its chief danger is as an adulterant of food stuffs, such as flavoring extracts, particularly Jamaica ginger and lemon extract,
in proprietary remedies and even as a beverage. The largest num-
ber of fatalities have resulted from its sale by saloonkeepers as "white
whiskey." In Whitestone, Ind., on August 16, 1912, it caused the
death of four men and the blindness of a fifth. These men purchased
and made a mixture of one gallon of wood alcohol and three gallons
of grain alcohol. All drank freely of it. The symptoms that fol-
lowed were chiefly headache, nausea, vomiting, extreme weakness,
clammy sweats, weak pulse, blindness, dilated pupils, sighing respira-
tion, convulsions and death. Blindness came on six or eight hours
before death. The survivor of this debauch was the first to fall sick
and the first to become blind. A woman in the Erie County almshouse
drank half a pint of wood alcohol which had been used for cleansing
purposes. She shortly went into a stupor which lasted 48 hours from
which she recovered, but was left permanently blind. In 1893 and
1894, Casey Wood, of Chicago, and the late Frank Buller, of Mon-
treal, collected reports of all cases of death and blindness which they
could find in this country and Canada. They found records of 275
cases of death or blindness from this cause. The number has since
been increased to nearly a thousand. The fumes of wood alcohol
in a confined space with a limited amount of air are no less deadly.
In 1911 two workmen who were engaged in varnishing the interior of
a beer vat, in which the varnish was thinned by wood alcohol, were
overcome by the vapor arising. One died, the other became perma-
nently blind.

Laws have been passed by Massachusetts, New York and other
states, making it a misdemeanor to sell or supply for sale this danger-
ous substance without having attached to it a label marked with red
letters, "Poison, not for internal use." It has also been made unlaw-
ful to use it as an adulterant for drugs or food stuffs. The most
obvious measures which suggest themselves as the first steps to be
taken for preventing further deaths from wood alcohol poisoning
are:

1. That every container of wood alcohol in any form and in any
mixture shall be properly labeled.

2. That adequate ventilation in industries where the fumes of
wood alcohol constitute a menace to workingmen shall be required.

3. That educational work among saloon-keepers, brewers, drug-
gists and other tradesmen, as well as the public at large, shall be
undertaken.

4. That the use of the innocuous and equally effective cheap, or
cheaper, industrial or "denatured" ethyl alcohol be encouraged in
lieu of the poisonous Columbian spirits or any other form of wood alcohol.

*Industrial accidents.*—The constant interrelation between various activities of life again is exemplified in blindness resulting from industrial accidents. It is a common misapprehension that every accident is an act of God and that it must necessarily be accepted without complaint or criticism. Exceedingly interesting and valuable in this connection is it to know that the prevention of accidents has so largely occupied the attention of the great casualty insurance companies that one of them has issued a book for general distribution, showing the common causes for accidents and how they can effectually be avoided. The writers on the staff of the Fidelity and Casualty Company of New York, have consulted the vast number of records of the company and have visited a large number of factories and other places. In the preface of their book they say: "The desirability of preventing accidents no one will question. Aside from the humanitarian aspect of the matter, which must appeal to every lover of his kind, the financial loss alone due to accidents is so great as to warrant the most complete precautions for their prevention. In the year 1908 the large sum of $22,392,072 was paid in premiums to insurance companies for liability insurance. The prevention of accidents absolutely is, of course, impossible, but much more can be done to prevent them than at first sight appears. It is to Germany that we must turn for exact information regarding the causes of accidents. From statistics collected there in connection with workmen's compensation insurance, it appears that the greater number of accidents (59 per cent.) are due to the negligence of employers or employees, and the smaller number (42 per cent.) to the inevitable risks of employment. It will be seen therefore that more than half of these accidents are not only not inevitable, but are absolutely preventable, and are due to the want of skill and to carelessness, want of guards, deficient factory arrangements, acting against rules and other evidences of neglect which might and should be avoided. In this connection it must be borne in mind that the precautions for preventing industrial accidents are far and away more complete in Germany than in the United States.

American statistics are very incomplete, but it would seem that about 15 per cent. of injuries are those affecting the eyes. As a fair index of the relative proportion of eye injuries to other accidents the following figures from the New York State Labor Department Reports are given:
BLINDNESS, PREVENTION OF

<table>
<thead>
<tr>
<th></th>
<th>Eye Accidents</th>
<th>Total Accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>June, 1911</td>
<td>1,012</td>
<td>13,716</td>
</tr>
<tr>
<td>Sept. 1911</td>
<td>1,123</td>
<td>15,369</td>
</tr>
<tr>
<td>Dec. 1911</td>
<td>1,075</td>
<td>16,215</td>
</tr>
<tr>
<td>Mar. 1912</td>
<td>1,120</td>
<td>14,995</td>
</tr>
<tr>
<td>June, 1912</td>
<td>1,287</td>
<td>15,371</td>
</tr>
<tr>
<td>Sept. 1912</td>
<td>1,631</td>
<td>19,567</td>
</tr>
<tr>
<td></td>
<td>7,248</td>
<td>95,233</td>
</tr>
</tbody>
</table>

As these are accidents none of which resulted in less than one day’s disability it shows that many of the minor eye injuries, some of which, through infection, might later become severe, have been omitted.

C. W. Price, assistant to the State Industrial Commission of Wisconsin, reports that the McCormick works in Chicago, after introducing the use of protecting goggles, reduced the number of eye injuries from 50 a month to about 4, and of these none were of more than trifling importance. W. H. Cameron, who has charge of the safety work of the American Steel Foundries, by the adoption of life protective measures has reduced eye injuries about 85 per cent.

The age at which these accidents occur is usually between twenty and forty years, the most productive period in a workingman’s life. To show how complete was the loss to the man and how small the compensation, it is reported by Miss Crystal Eastman, from her Pittsburgh survey, that for the loss of an eye the compensation in eleven cases was as follows: One man received $200; two, $150; one, $100; one, $75; two, $50; one, $48; and three received nothing.

The United States Steel Corporation has so seriously taken up the study for the protection of men in its employ that a very complete organization has been developed for this purpose. The chief safety inspector of the American Steel and Wire Company, writes: "In some of the companies which were brought together in 1901 to form the United States Steel Corporation, organized safety departments have existed for the last fifteen years. In all of them more and more attention has been given to safeguarding the employees, until at present each of the main constituent companies has a corps of trained specialists who devote their time to studying the causes of accidents and to devising means to prevent them." New impetus was given to this work by the interest manifested in it and the policy adopted toward it by the officials of the Steel Corporation. Every year, beginning with May, 1906, all of the men in charge of these matters for the several subsidiary companies have been called together at the general

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offices in New York for discussion of the problems connected with their work. At these meetings the officers of the corporation have given assurance of support to the subsidiary companies in every practical undertaking for the prevention of accidents. This resulted in the formation in April, 1908, of a central committee of safety.

Some idea of the breadth of the field before the new committee may be gained from the fact that it includes 143 manufacturing plants, in addition to mining and transportation properties, employing in all approximately 200,000 men. Meetings of the committee are held about once a month, when arrangements for inspection are made and reports

Pouring Molten Metal. (Illinois Steel Co.)

The goggles worn by the men while pouring molten metal are imported from Germany. There are also signs, in the English and Foreign languages at the places where molten metal is poured, warning the men that if they do not wear these goggles while pouring metal they will be sent home. Here the wearing of goggles is compulsory.

considered. Drawings, photographs, rules, specifications, etc., are submitted and such as seem desirable are sent out to all the companies. During the two years since the institution of this central committee of safety, its inspectors have reported to it in round numbers six thousand recommendations for increasing the safety of employees in the plants, mills, mines, and on the railroads and steamship lines of the organization. Of these recommendations, 93 per cent. have been adopted by the committee and carried out by the subsidiary companies.

One of the most common sources of accidents to the eyes is flying bits from emery wheels. A device has been adopted that makes it possible to cover a large portion of the wheel, leaving enough of it for use by the men, and other devices have been adopted by which the men's eyes are shielded from flying bits of the wheels. Many of the companies supply these protecting devices to those to whom they sell wheels, and allow them gratuitously the use of these protecting devices
as long as their wheels are used, so that in many cases there really is no excuse for a very large number of these accidents, many of which are exceedingly serious.

Chipping Castings and Other Metal.

When men are doing heavy chipping, such as "ragging" rolls, they are provided with wire face masks. (Illinois Steel Co.)

Grinding Metal on Emery Wheels. (Illinois Steel Co.)

Each man is provided with a pair of large plain glass spectacles which he wears when he has occasion to do any grinding. He keeps the spectacles locked up when not using them. The men are not allowed to wear the same glasses because of the danger of transferring diseases of the eye.
Instructions should be given to the workmen, and in every shop some such advice as the following should be posted where it is easily seen: "Never run a wheel above its indicated speed;" "A workman at an emery wheel should keep his eyes and body out of the plane of rotation of the wheel; chips from the wheel will be less likely to strike him if this suggestion is heeded." The grinder will find that large glasses made of plain glass, or indeed his own spectacles, should he wear them, will afford great protection from flying particles. Or he may use other protectors made with glass in front and gauze surrounding the glass.

It must be said that many of the workmen object to the use of these protective devices, not realizing dangers to which they are subjected, and it has always been a source of difficulty with employers to secure from the workmen the co-operation necessary in this mode of protection; here again we come back to the same point at which we started—the necessity of intelligent educational work. If the men can be made to understand what an injury would mean and that they are in constant danger there will be little difficulty, if proper devices are given to them, to have them used. The reason that many of the men do not use the devices is that improper ones have been given to them, for instance, isinglass spectacles, through which they cannot see clearly.

Another very common cause of injury is from what is called a mushrooming hammer, whose hammering surface is driven by the outer
edge so that the bits are easily broken off and fly into the eye. Hammers are sometimes, too, made of cheap material, badly surfaced, so that not only the outer edge but the entire surface of the hammer breaks readily, and bits are carried into the eyes, making it a danger-

Chipping Castings and Other Metals.

The men who are employed as clippers in the casting yards are urged to wear goggles and effort has been made to get goggles that would be satisfactory to the men and which would not inconvenience them. The glass goggles appear to be giving the best satisfaction.

ous instrument in the hands of a man who has to use it daily. The saving of a dollar or so in the purchase of a cheap hammer is often a very costly experiment. This subject is adequately dealt with by Dr. S. C. Ayres, who submitted such a hammer for expert examination, the result of which was exceedingly interesting, because it
demonstrated the fact that this hammer was being sold very commonly and that good hammers can be easily obtained. It was demonstrated that if the hammer was made of good material and properly annealed, such accidents would practically never occur. Of course this applies equally to other tools. The cost of a new hammer is a dollar and a quarter. The cost of the loss of an eye, as determined by the courts of Texas, is $6,500. Would it not be profitable to require that the tools of workingmen be made of such material as to reduce the possibility of such an accident to the ultimate minimum?

In this connection the accompanying illustrations with their legends will explain the efforts made by the Illinois Steel Co. to protect the eyes of their employes.
BLINDNESS, PREVENTION OF

DANGER
YOU ARE WARNED AGAINST WORKING WITHOUT EYE PROTECTORS OR WITH BATTERED TOOLS. GET PROPER TOOLS AND EYE SHIELDS FROM FOREMAN.

NEBEZPECNO
TEBE JE ZAKAZANO PRACOVAT BEZ SKEL NA OCI ALEBO SE ŠPATNÝMA NÁSTROJI. ODSAŤTÉ DOBRE NÁSTROJE A SKEL NA OCI OD FORMANA.

VESZÉLY
ÖVKEDJ ŠZEMVEDŐNELKÜL VAGY ELROMOTT SZERSZÁMMAL DOLODNI. KÉRJEN FOREMÁNJATÓL RENGETÉSZSERSZÁMOT ÉS ŠZEMVÉGD.

OBAZNO
KADA RAĐIS PAŽI DA JE TVOJE ORUĐJE SASWIM CIJELO. NOSI NADOĆELE. SVE ČESE DOBITI OD FORMANA.

NIEBEZPECZENSTWO
NIE PRACOWAJ BEZ ŠKIEL. JAKÒTEŻ ROZBITEMI NARZĘDZIAMI. DOBRE NARZĘDZIA I ŹYŁKA NA OCZY MOŻNA DOSTAĆ OD FORMAMANA.

W.A. FIELD, GENERAL SUPERINTENDENT.

Warnings Posted.

The chipping yard foreman makes sure every morning that each man is provided with a perfect pair of goggles, and he urges the men to wear them. In addition to this, signs in the English and foreign languages are posted in the yards, warning the men of the danger of chipping without the eye protectors. (Illinois Steel Co.)

Electric Arc Welding. (Illinois Steel Co.)

A different kind of a shield is provided for the arc welder. The shield, which is fitted with colored glass, is suspended in front of the workman so that he watches the work through the colored glass and is also protected from the heat. All goggles and shields are provided by the company free of charge.
In Germany, where the protective devices are practically universally employed among all classes exposed to ocular injury stone-masons are obliged to wear protective goggles when at work.

_Sympathetic ophthalmia._—As one of the consequences of neglected injury of an eye, sympathetic inflammation of the fellow eye must always be reckoned with. It may arise from the retention within the eye ball of a foreign body, or an injury involving the ciliary region which would cause a slow, progressive inflammation of the iris and ciliary bodies gradually involving the internal structures of the eye until the sight is destroyed.

The remedy is the prompt removal of the foreign body, whenever this can be done, from within the eye ball, or, when danger is threatened, the removal of the infected eye itself.

_Phlyctenular ophthalmia._—One of the causes of defective sight, though it rarely results in blindness, is phlyctenular ophthalmia. While it has not definitely proved to be tubercular it is found in those poorly nourished and having a tubercular predisposition. It consists in small elevations in the margins of the cornea which invade the superficial corneal tissues leaving more or less scarred and opaque tissue and permanently lowering the efficiency of the sight. These conditions occur in young children, usually between two and ten years of age, and are combined with the intense dread of light that is almost always associated with imperfect nutritional conditions, and because of taking into account the home conditions emphasizes the necessity of "The Value of Social Service" in all dispensary and hospital work having to do with the treatment of the eyes. This phase of preventive work is constantly being recognized. Many of the patients presented at eye clinics can receive but temporary help until their home conditions are bettered.

Diseases of the eye due to malnutrition from improper feeding are more commonly the result of ignorance than of poverty, and helpful advice as to the adoption of better methods are usually not only welcomed, but gladly followed.

It is often impossible for the physician, even if he had the time, to get behind the barrier of timidity and apprehension within which the poor patient is held; and yet such knowledge is often essential to effect relief which can be obtained only by intelligent and sympathetic intervention of the social visitor, who by supplementing and explaining the advice of the surgeon of the urgent necessity of treatment, may save eyes that through neglect would otherwise be lost.

_Glioma._—(Cancer within the eye.) A condition fortunately occurring rarely, but which always should be promptly recognized when it
BLINDNESS, PREVENTION OF

appears, is that of glioma, or cancer within the eye ball. It usually becomes manifest between the third and fourth year of life and appears very much like a cataract for which it is often mistaken. But cataract of this form rarely occurs in young children, and with the pupil enlarged it is shown to be deeper and to have a yellowish cast which has given it the old name of "amaurotic cat's eye." As soon as the diagnosis is made such an eye should be promptly removed, as otherwise the disease after filling the eyeball, breaks through the coats involving the entire head and resulting in the death of the child. If the eyeball be removed while the growth is still encapsulated, in a very large proportion of cases, the disease is removed with it.

Golfball accidents.—A rather unusual form of accident to which attention has recently been called is severe burns of the eyeballs from the fluid contained in certain makes of golf balls. The resiliency or "carry" of golf balls has been increased by winding a fluid core with ribbons of rubber or other material. Several times recently investigators have undertaken to open these balls, when the fluid contents, which is of an exceedingly acrid character, has spurted in the eye. The effect has been to produce an inflammation of an exceedingly aggravating character. In a case reported by Casey Wood, who was the first to call attention to this form of accident, in a recent number of the Ophthalmic Record, a golf ball of unknown manufacture was cut into by a young man to see how it was made, and the thickish fluid with which it was filled squirted into his face and left eye. There was immediate pain in the eye, a burning sensation about the orbit and the lids were swollen shut. Thomas E. Phillips, of Milwaukee, reports a similar case in which a boy of twelve years ran a knife into the side of a golf ball. The fluid, under pressure, was forced into the eyes causing ulceration of the cornea. Some flew by the boy and struck a little girl in the face, burning it quite badly. Examination of the fluid showed it to be a solution of zinc chloride. More recently others have had similar accidents brought to their notice. In a case by Carpenter and Baer the fluid which the ball contained was found to be a strong alkali. The eye became affected with severe iridocyclitis with hypopion, and general necrosis of the lower quadrant of the cornea. Remarkable improvement followed a few subconjunctival injections of normal salt solution. Ten weeks after the accident the eyeball was quiet with vision of 6/6. Langdon and Nance also record cases of the kind. The last observer saw his case three weeks after injury, and had to advise enucleation.

Casey Wood urges upon ophthalmologists the manifest duty of discouraging the use of the so-called water-core balls. The public is
ignorant of the dangerous character of their contents, and although
explosion under ordinary conditions of use is rare, yet it is not an
uncommon event that a person impelled by curiosity will cut into
them with such disastrous results as have just been described. Further-
more, as a matter of fact, the solid core balls are quite as effective
and enjoy an even greater measure of popularity than the dangerous
fluid-core balls.—(F. P. L.)

The United States Golf Association, at the request of W. C. Posey,
has issued a warning to the clubs in their membership to beware of
cutting into these dangerous balls.

Referring to preventable blindness in the United States, and espe-
cially in the state of Massachusetts, Henry Copley Greene (Pre-ses-
sional print, Am. Med. Association, Section of Ophthalmology, June
1913) has, largely from his own experiences, given a most interesting
account. A full synopsis of this contribution to the subject is accord-
ingly given here:

Among the one hundred thousand or so blind in the United States,
probably thirty thousand are preventably blind. Preventable blind-
ness is by no means purely a medical question. It results from the
combined failures of the medical profession, business, statecraft and
social service.

The problem of preventable blindness may be simply stated as one
in the elimination of the waste involved in fruitless law-making;
bungled administration; medical education unworthy of the name;
ill-distributed and often wasted medical service; a frequently careless
industrial system, and social service, eagerly interested in immediate
needs, but sometimes dull to the essential need of eliminating this
waste.

Among perhaps six thousand persons becoming practically blind
each year, the blindness of about eighteen hundred is due to prevent-
able causes; but these causes are themselves caused by factors which
may significantly vary, state by state, city by city and even year by
year. To study and define this civic ill, to forecast the possibilities of
cure, and to prescribe and apply the remedy we shall probably find is
the proper work, not of unaided medical committees, but of what may
be called social engineers, acting, preferably, under state direction,
and in consultation with very varied groups of experts.

While studies of the causes of blindness in foreign lands are not far
to seek, we have, for this country, mainly information gathered in
schools for the blind, and throwing no light on the problem of blind-
ness among adults. If we supplement such information by data from
state and hospital records, we find that the social body suffers from
two great classes of blindness-producing ills. The first class, which may be called the purely medical class of causes, is apparently by far the more important; but the second, or social class, may prove to be of equal moment.

Causes of blindness. Preliminary results seem to show that the responsibility for 320 cases of practical blindness in three Boston hospitals (1908-1909) is to be attributed to the causes enumerated in the accompanying tabulation. The percentages given are approximate. In varying proportions these diseases are probably the main causes of blindness throughout the country. What steps, medical and social, should be taken to limit them?

**DISTRIBUTION OF CAUSES OF BLINDNESS IN 320 CASES.**

<table>
<thead>
<tr>
<th>Cause</th>
<th>Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glaucoma</td>
<td>15</td>
</tr>
<tr>
<td>Injuries</td>
<td>14</td>
</tr>
<tr>
<td>Uveitis</td>
<td>14</td>
</tr>
<tr>
<td>Optic atrophy</td>
<td>11</td>
</tr>
<tr>
<td>Diseases of the cornea (excluding gonorrheal conjunctivitis, interstitial keratitis and trachoma)</td>
<td>7</td>
</tr>
<tr>
<td>Gonorrheal conjunctivitis</td>
<td>7</td>
</tr>
<tr>
<td>Syphilis</td>
<td>6</td>
</tr>
<tr>
<td>Trachoma</td>
<td>2</td>
</tr>
</tbody>
</table>

*Work being done for conservation of eyesight.* To meet these problems and others, partly medical and partly social, we find organizations at work for the conservation of sight in Arkansas, California, Indiana, Kentucky, Maryland, Massachusetts, New York, New Jersey, Ohio, Pennsylvania and Wisconsin. The active work done, however, has been largely confined to public education through pamphlets, lectures, etc., except in Kentucky, Massachusetts, New York and Wisconsin. Perhaps the most distinctive achievements in these states have been (1) in Kentucky, the traveling clinic by means of which Dr. Stucky and his assistants have carried into the mountains their campaign against trachoma and other eye diseases and defects; (2) in Massachusetts: (a) study of the causes of blindness; (b) the joint campaign by which the State Board of Health and the State Commission for the Blind seem to have more than cut in half the prevalence of blindness from ophthalmia neonatorum; (c) the work of the Commission for the Blind, through its field agents, in teaching patients, charitable agencies, etc., in the remote districts how to make the most of existing facilities for
treatment; (d) the opening of a special class for children with defective vision by the Boston School Board, and (e) the elimination of waste in eye clinics through the development of social service departments; (3) in New York: (a) improved training of midwives; (b) special schools for children with trachoma; (c) a recent investigation of wood-alcohol poisoning, and the introduction of legislation to prevent it, and (d) the instituting of a modified system of reporting for gonorrhea and syphilis and the appropriation of funds for a special hospital for these diseases; and finally, (4) in Wisconsin, the employment of an ophthalmologist among the Milwaukee school physicians, the compulsory use of a preventive, and the activity of the industrial accident board in promoting safety work among employers and employees.

In addition to these efforts toward the conservation of eyesight we find laws in many other states either intended or capable of being used to prevent blindness. For instance, for the campaign against ophthalmia neonatorum we have (1) a law in fifteen states requiring birth returns in a week or less, but in only seven states requiring returns in less than five days; (2) laws permitting boards of health in many states to send out literature to parents as soon as their babies' births are recorded; (3) requiring a question, on the birth return, as to the use of a preventive in at least five states; (4) authorizing free distribution of a preventive in at least six states and in the District of Columbia; (5) requiring the use of a preventive at every birth in Wisconsin, and at all births in lying-in hospitals in Massachusetts, and (6) definite requirements that cases of ophthalmia neonatorum be reported by physicians in five states: Kansas, Massachusetts, Nebraska, New York and Utah. As for the control of syphilis, we find the disease at least recognized in California, Massachusetts, New York and Porto Rico. Finally, of use in work for the safety of sight in industry we have a variety of factory laws, and especially the workmen's compensation laws, which are covering the country state by state, and which can be made to furnish the employer with a hitherto unfelt motive for safeguarding his employees' sight.

Steps which should be taken. What steps should now be taken to turn these and other laws to full account, to procure additional laws, where needed, to secure their enforcement, to coordinate the work of state bureaus and commissions, hospitals, public health organizations, etc.—in a word, to promote efficient work for the conservation of sight?

In view of the facts already cited, the following measures immediately suggest themselves:
Scope of work. A campaign of medical and lay education and research, governmental action, medical treatment and social work, carried on, wherever possible, to limit and to remedy ocular disease, especially the more prevalent and damaging diseases and defects.

Education (general medical). Medical schools urged to lay stress on the interrelation of ocular and general disease, to teach their students the importance of consultation with ophthalmologists, and also a high sense not only of human service but also of the physician's duty to uphold the health laws, both national and state.

Medical treatment. Making it the duty of state boards of health or of special private agents to study the needs of all localities, and in cooperation with medical schools and hospitals, to bring to the notice of young ophthalmologists opportunities for work in places especially requiring their services.

In remote districts where peculiar conditions require it, promoting such clinical expeditions as those of Dr. Stucky in the Kentucky mountains.

In large cities, self-supporting evening clinics, with paid ophthalmologists in attendance, organized to compete with charlatans and inefficient practitioners and to provide self-respecting patients on low wages, with facilities for expert treatment otherwise hard to secure.

In clinics and hospitals stress laid on making the specialist's work efficient, by insisting on proper treatment of diseases underlying local eye symptoms, and by keeping patients under treatment long enough to secure results.

Records. To promote intelligent study of the prevalence and results of eye diseases, a committee on records to request hospitals and ophthalmologists to include in all their eye-records the following data: age; sex; single, married, widowed or divorced; birthplace; birthplace of parents; occupation or school grade; in possibly syphilitic cases the number of children still-born, dead, or living, and in traumatic or possibly traumatic cases, the tool or machine used, and the manner of injury. To facilitate the comparison of results the following standards of vision to be officially adopted:

Blindness, the German standard, vision fingers 1 foot or less.
Practical blindness, vision less than 20/200.
Partial disablement, vision 20/70 or less.

Continuous study of causes. The prevalence of blindness studied in each state in relation to its more prevalent causes, on a basis of reports of cases of blindness to state commissions or other central agencies.

Schools and institutions. In the management of institutions, state
and local authorities to set a standard of work for the preservation of sight. In schools, the pupil’s eyes to be regularly examined, preferably by trained physicians; records kept showing the effect of the school curriculum on eyesight, and parents induced or compelled to furnish necessary eye-glasses or treatment for the eyes. Where necessary, the state “neglect law” amended to make this possible. Especially in reform schools and prisons, ophthalmologists regularly in attendance, and close cooperation secured between ophthalmologists, general physicians and the probation officers having oversight upon discharged prisoners. All male gonorrheal, and all syphilitic patients, detained until cured. Compare present Massachusetts law on syphilis.

Social service. Paid social workers made part of the regular staff of all eye clinics, so as to economize the work of the physicians in charge, as fast as the necessary funds can be secured.

Ophthalmia neonatorum. The symptoms of ophthalmia neonatorum officially defined as redness and swelling of the eyelids and unnatural discharge from the eyes, within thirty days of birth; ophthalmia neonatorum made reportable by physicians as well as nurses and parents.

Local boards of health given ample powers over reported cases, subject to the supervision and control of the State Board in requiring adequate standards of treatment.

State birth registration laws amended to secure birth notification within three days, and preferably within forty-eight hours, and warnings as to the danger of ophthalmia neonatorum sent to all mothers immediately on receipt of birth notices.

A suitable prophylactic distributed free to all physicians and to midwives where midwives are registered. The use of this prophylactic required at all births in lying-in hospitals, and at least strongly recommended to physicians.

Syphilis. Workers for conservation of vision to join with associations for sex education, etc., (a) in setting adequate standards of treatment for syphilis, congenital and acquired; (b) in raising the physical standards of marriage, and (c) in urging the federal government to increase the number and equipment of United States public health surgeons in foreign ports, in order to extend to syphilitic patients the system of exclusion at the port of embarkation now applied to emigrants with trachoma.

Defective sight. Classes especially adapted for children with defective sight organized in all large cities, not only to provide education for children not properly inmates of institutions for the blind, but also to aid in the preservation of their sight.
Best method of pushing the work. How can these and other important lines of work best be carried forward? Not merely by committees, whether exclusively medical or partly lay. Such work obviously requires the services of an executive agent. As experience suggests that such an agent will work more ingeniously when stimulated by association with persons blind, recovering from blindness and becoming blind, he should preferably be associated with a school for the blind, or directed by an association or state commission for the blind. As effectiveness requires coördination of the work of varied state and city departments, whether of health, labor, education or law, this agent can probably best work under a state commission for the blind. The practical problems of conserving sight, however, are so complex and varied that their developments should be constantly supervised by a committee of experts—ophthalmologists and other medical specialists, public health experts, experts in education, industrial safety-work, etc.

While this type of organization is perhaps the most efficient to date, each state should freely work out its own form and its own methods. In doing so, however, each state should have the opportunity of testing its organization, its plans and its achievements by matching them up with the organizations, the plans and the achievements of other states. For busy men and women such comparisons are at present difficult almost to the point of impossibility. To make such comparisons easier some form of interstate organization is clearly needed.

An interstate organization will probably be more stable, if begun as a loose federation of existing state organizations, than if imposed, however wisely, from above. As a beginning, arrangements might well be made for publishing in ophthalmologic journals, or jointly in such journals and in the Outlook for the Blind, a periodic report from each state.

This work might well be undertaken by a joint committee from the American Medical Association and from the existing state organizations for the conservation of eyesight; and this committee might also be empowered to bring about a federation of state organizations as soon as a vital demand for such a federation is manifest. Compare, also, Hygiene of the eye; Conservation of vision; Institutions and occupations for the blind; School children, Examination of.

Blindness, Psychic. Soul-blindness. Mind-blindness. Object-blindness. Visual apraxia. Pragmatagnosia. Although this is generally regarded as one of the forms of visual aphasia, yet it is properly
a disease distinct in most cases from that cerebral affection. In this condition a patient is unable to recognize by sight objects that were at one time entirely familiar to him. Those visual memories which one recalls in the recognition of particular objects are no longer accessible. That this curious symptom may result the brain disease must necessarily be situated either in the cortex or in those tracts that associate certain portions to the cortex. Assuming such alterations the rest of the brain and cord may be entirely normal and yet the individual will be psychically blind.

As Mills states (The Eye and Nervous System, p. 127), the pathological cause of mind-blindness is, in the first place, a lesion or lesions of the visual portion of the concrete memory field. Usually the disease is on both sides of the brain, but transient forms of the affection, and perhaps, in exceptional instances, the persisting disorder may be caused by a destructive lesion of the left optic memory field. In the second place, lesions of the tracts which connect the higher visual field with the lower or primary visual centres may cause this symptom. When the affection is due to a lesion of the association fibres it is, if unilateral, so situated as to destroy the tracts which connect the primary or lower visual centres on both sides with the higher visual area on one side. See Neurology of the eye.

Blindness, Psychology of. See Psychology of blindness.

Blindness, simulated, Arlt’s test for. This is a test for ocular malingerer, by means of weak (+ 0.25) lenses, with which the simulator pretends that his sight is considerably decreased or improved in the supposed weak eye. It is not as useful as the Fles (q. v.) box, or some modifications of it.

Blindness, simulated, Armaignac’s test for. This device, like so many instruments for the detection of simulated monocular blindness, is a modification of the mirror arrangement in Fles’ (q. v.) box. The malingerer, unless he closes one eye and makes a direct observation, is pretty certain to believe that he is seeing with his admittedly sound eye when he really fixes with the alleged amblyopic eye.

Blindness, simulated, Astegiano’s test for. This device, for detecting simulated monocular blindness, is a modification of the Fles (q. v.) box. It measures the visual acuity of the pretended blind eye, the malingerer imagining that he is seeing with his admittedly sound eye.

Blindness, simulated, Baroffio’s test for See Baroffio’s test.

Blindness, simulated, Barthélémy’s apparatus for the determination of. See Barthélémy’s test.

Blindness, simulated, Baudon’s test for See Baudon’s test.

Blindness, simulated, Baudry’s test for See Baudry’s test.

Blindness, simulated, Bélow’s test for See Bélow’s test.
Blindness, simulated, Bertin-Sans’s test for. See Bertin-Sans’s, ophthamoscope of.

Blindness, simulated, Billot and Baudon’s test for. See Billot and Baudon’s test.

Blindness, simulated, Binnendijk’s test for. See Binnendijk’s test.

Blindness, simulated, Bonalumi’s test for. See Bonalumi’s test.

Blindness, simulated, Bravais’s test for. See Bravais’s test.

Blindness, simulated, Chauvel’s test for. See Chauvel’s test.

Blindness, simulated, Coronat’s test for. See Coronat’s test.

Blindness, simulated, d’André’s test for. This is a test box for detecting simulation of unilateral blindness, a modification of the instrument of Fles, which is intended to induce the malingerer to see with his pretended blind eye an object which he thinks he is seeing with his sound eye. It is fully described in the Recueil de Mémoires de Médecine, 1882, p. 4.

Blindness, simulated, Delay’s test for. When light is flashed quickly and suddenly into first one eye and then into the other with a skiascopic or similar mirror the patient does not know into which eye the rays are directed. This can easily be demonstrated on any patient by means of the ordinary ophthalmoscopic mirror. An intelligent malingerer will recognize in which of his eyes the image is formed from the size of the mirror itself, the shape and the source of light and the movements of the hand manipulating it. That these defects might be remedied, Delay (Des principaux moyens de reconnaître la simulation de l’amaurose unilatérale. Thèse de Montpellier, 1887) suggests the following modification of this test for the purpose of detecting ocular malingerers: “It will be necessary for this experiment,” says Delay, “to make use of a mirror of small dimensions (two centimeters square, for example) placed in front of a source of light of sufficient intensity and size. We obtain thus a very evenly-lighted surface, the appearance of which can be in no way changed by the movements which the examiner makes to direct the reflected rays to the right or to the left. The mirror, whatever its position, will appear thus as a single luminous point. Moreover, the experimenter can place himself behind a screen, which shuts off everything except the glass of the mirror, and work far enough away, so that the movements which he impresses on it to vary the direction of the rays, may be sufficiently insignificant to be unobserved by the person who is examined.

“Some signs or test-type letters traced (reversed) on a sheet of glass, or cut out of black paper and pasted on transparent paper, are brought before the lamp, which is placed behind the patient. In
illuminating alternately and rapidly, and by making the patient name the reflected signs, the physician will thus determine the visual acuity of the eye that has been declared to be amblyopic (the distance at which the sign is recognized being represented by the distance of the mirror from the patient examined, and of the test-signs from the mirror).”

**Blindness, simulated, Driver's test for.** This is a simple and ready device for the detection of feigned blindness. Driver interposes a vertical ruler, four centimeters broad, at a definite distance between the eyes of the patient and two of Snellen's test-types in such a way that the ruler acts as a screen hiding the right test-type from the left eye, and the left test-type from the right eye. If the patient succeeds in reading the letters on the two scales, he discloses his fraud, and at the same time indicates the degree of vision of the eye which he claims is defective.

**Blindness, simulated, Dujardin's test for.** This is one of several tests for ocular malingering in which the patient is placed before distant test-types and a trial frame containing a plain glass or very weak lens in front of the alleged amblyopic eye. A very convex or concave lens of 20 dioptres is placed in front of the better eye, and the suspected individual is not allowed to close either eye but is asked to read the test-types. Of course if he succeeds he must have read with the eye that he has declared blind or defective and his answers determine the visual acuity of the supposed weak eye.

**Blindness, simulated, Fitow's test for.** In this case the Snellen or some other form of test-type is shown to the suspected individual—one letter at a time. Characters of smaller dimensions than those which correspond to the distance from the patient being chosen in each instance. The distance from the test chart is then greatly diminished but always to a less degree than the size of the types. True malingerers are almost certain to betray themselves, especially if they have pretended a unilateral amblyopia.

**Blindness, simulated, Fles's test for.** The Fles box. This was one of the earliest, as it is one of the best devices for making the alleged blind eye see an image which the malingerer imagines he is seeing with his good eye. It consists of a rectangular box in which two mirrors of a definite size and orientation are placed vertically with an inclination of one hundred and twenty degrees. The small dimensions of the apparatus, causing prolonged efforts of accommodation before the images are found, and the images being formed so near to one another that they have a tendency to blend, produces a lack of precision in the answers of the patient. Consequently, with the
object of rendering the plan more practical, Fles's box has undergone modifications. Baroffio inclines the mirrors at one hundred and twenty-five degrees; Binnedijk and Armaignac make them movable on a hinge in such a way as to vary the angle which they form, and to obtain such relations of the images that, without closing one of the eyes, it is impossible to know which is the image perceived by the right eye and which is seen by the left.

**Blindness, simulated, Fontorbe's test for.** This is one of the numerous tests with lenses and letters used in something after the style of the red and green spectacles used in the Snellen test (q. v.).

**Blindness, simulated, Fridenberg's test for.** This instrument was devised by Percy Fridenberg, to reflect the image of a test card in such a way that it can be seen by only one eye at a time, and a quantitative demonstration of vision made without the subject of examination obtaining any clue as to which eye is being tested. The mirror is mounted on a horizontal arm in such a way as to permit of varying its distance from the test card, and of presenting it alternately to either eye by revolving the bearing through an arc of 180 degrees. The lateral tilt of the mirror can be changed at will, and is indicated by a pointer on a horizontal scale. When the pointer is at 90 degrees, the plane of the mirror is at right angles to the line of vision of the eye on the corresponding side, and this eye sees its own image. The test card on this side, however, is not normal to the mirror, and its reflection is seen only by the opposite eye, which the subject presumes to be unconcerned in the visual act,
as it does not appear in the mirror. By switching the mirror over to the opposite side of the arm, a similar double test can be applied, so that in all eight variations are rapidly obtained. The mirror can be adjusted laterally to correspond exactly with the interpupillary distance and correcting glasses inserted in the trial frame, if necessary. The test is simple, rapid and exact, gives no clue to the simulant, and can be demonstrated without theoretical explanations to the members of a commission or jury.

Blindness, simulated, Frölich's test for. This device is a modification of Monoyer's test with double prisms (q. v.). The inventor added to the double prism a red glass which can be adjusted sometimes before the two prisms placed base to base and sometimes before the space which separates them; sometimes before one or the other prisms. In either case three images are formed in the Frölich test. The upper and the lower, or the single middle image, can thus be colored red at the will of the examiner. The apparatus is more complicated than that of Monoyer. The fact that the second red glass, which is placed before the eye that is said to be defective, must render difficult the incessant surveillance that is indispensable to exercise in order to prevent a malingerer from closing the eye and discovering the number and color of the images which it is to his interest to declare that he sees or does not see. For this reason this test is less valuable than many others.

Blindness, simulated, Galezowski's test for. For the purpose of detecting the ocular malingerer this observer utilized the property of double refraction by means of a prism made of Iceland spar. In this way both binocular and monocular diplopia is produced. There is alternately double monocular and binocular vision, by placing successively in front of the eye a double refractive lens of Arago, and the ordinary prism which cannot be distinguished from this lens by external appearance. The use of a double refractive lens presents the advantage of assuring the person examined that he certainly sees double, but it presents several inconveniences, among others a perceptible difference in the images.

Blindness, simulated, Graefe's test for. This is one of the numerous prism tests for feigned blindness. A 12° prism is placed in front of the sound eye with its base up. The patient is then made to look at letters cut from a printed scale and pasted on a piece of white paper. This produces double vision, with the words or letters placed one above the other. Most malingerers will read the upper line as well as the lower and thus determine, in spite of themselves, the visual acuity of the affected eye.
Blindness, simulated, Harlan's test for. This test is practically the same as Dujardin's test (q. v.).

Blindness, simulated, Helmbold's test for. This means of detecting the ocular malingerer is a variation of Barthélémy's test (q. v.) except that two charts are employed, one with ordinary test types and the other with the letters printed reversed. The latter are intended to be read by reflection from a mirror.

Blindness, simulated, Herter's test for. This is one of several well known tests with the plain mirror; another, quite like it, being that of Delay (q. v.).

Blindness, simulated, Hogg's test for. This important and valuable test for the detection of ocular malingering is by some authorities ascribed to Z. Laurence. It is well described by Baudry (System of Diseases of the Eye, IV, 882) as follows: "Whether the ordinary cased stereoscope, the American, the horizontal, or the open stereoscope, or any improvised apparatus is used, the principle of the instrument is always the same. There are two prisms, placed bases out and apex to apex; and it is chiefly the prismatic action of the stereoscope which is turned to profit for the production of the different images by their superposition, their fusion, their displacement, or their intercrossing. In a general way the use of the stereoscope, already difficult when the two eyes are not of the same refraction, demands as an essential condition of success the integrity of binocular vision. Another inconvenience that is inherent in the different methods is the difficulty in preventing the malingerer from momentarily closing one of the eyes (which makes the test ineffective), and from his being able to realize the situation of the objects, owing to the prismatic coloration or to the differences in the clearness of the images. A person who has normal vision in the two eyes, and who looks through the prisms of a stereoscope, fuses and involuntarily superimposes the two lateral images in a single combined image. It is in this way, for instance, that the first figure will assume the appearance of the second in the stereoscope when suitably placed on the same card. Again, a sentry box on one side and a soldier on the other

![Stereoscope Test for Pretended Blindness.](image-url)
can be arranged so that a person looking at them through a stereoscope will fuse them binocularly and will see the soldier in his sentry box.'"

There are some persons who do not immediately succeed in fusing the images, and, in consequence, they appreciate the situation. Others who are anisometropic, or are amblyopic in one eye, are said to always see double images. To guard against these inconveniences experiments have been devised in which the displacement or intercrossing of the images produced by the prisms is utilized. A very simple arrangement consists in placing two wafers, one red (1) on the right and the other black (2) on the left (see the figure), one centimetre from the vertical line which divides the test-card into two equal parts and which corresponds to the partition of the instrument. The malingerer, being previously unconscious of the intercrossing, will think that he sees on the right side what ought to be seen on the left, and will betray himself at the outset (Vieusse).

A better method is the following. On a stereoscopic chart, on each side of the median line, four wafers are pasted. (See the figure.) The two upper ones, red on the right (1), black on the left (2), are situated at one centimetre's distance apart. The two lower ones, yellow on the left (3), blue on the right (4), are five centimetres distant. There will be, as a result of this disposition, a crossing of the upper and approximation of the lower wafers. (See the fourth figure.) The malingerer, if he does not close one of his eyes during the experiment, will be at a loss to designate the wafers which are on his right and those which are on his left. Nothing is easier than to arrange a chart to vary the number and the position of the wafers, and to replace them by pictures or signs for the illiterate, by figures, or by words that are susceptible of transposition.

**Blindness, simulated, Jackson's test for.** For the purpose of detecting feigned blindness, Jackson advises that two cylinders with their axes at right angles be placed before the good eye while the suspected eye is covered with a correcting lens. The patient is then asked to read and while doing so one of the cylinders is rapidly rotated so that
the healthy eye is prevented from seeing. If the suspected person continues to read, he must do so with the alleged amblyopic or entirely blind eye.

**Blindness, simulated, Javal-Cuignet's test for.** This is one of the oldest, simplest and best of methods for detecting ocular malingerers. Baudry (Norris and Oliver's *System*, IV, 867) says of it that after the physician has tried this method on himself, he is to hold fixedly, some thirty-five centimetres from the eyes to be examined, a sheet of paper on which are traced dots, figures, and printed letters. A pencil or a finger is to be interposed at an equal distance from the nose and the paper in the median line, in such a way as to render some of the letters, figures, or dots invisible in each of the visual fields. If the patient reads these letters or the whole line accurately, the deception is detected. By taking into consideration the size of the letters which have been recognized, an approximate measure of the visual acuity can also be obtained.

Apparently very simple and not requiring any costly apparatus, the Javal-Cuignet method presents some difficulties in its application. It requires absolute immobility of the head and a printed page; the physician also must be able to fix in his own mind the details of the test and to familiarize himself with it in order to interpret with rapidity and certainty the answers of the patient. So as to lead the patient more surely into error, it is advantageous to make him perform lateral movements of the eyes by moving the finger, a pencil, or even a sheet of paper. The paper should, by preference, be transparent, for by standing behind, with the eyes above its upper margin, it can be very easily noticed which is the point or letter that should disappear in accordance with any lateral movements that may be induced.

**Blindness, simulated, Kugel's test for.** This is a device whereby the use of cylindrical glasses is intended to unmask the pretense of unilateral blindness. Kugel (Ueber Diagnose der Simulation von Amaurose und Amblyopie. *Wiener med. Wochenschr.*, 1889, 6, 7, 8 and 9) directs the patients to look at a candle burning in a box closed on every side except on a level with the anterior wall, at the middle of which there is an opening of three millimetres in diameter which is fitted with a glass. A patient having normal sight sees this point of light in the form of a luminous cross if cylindrical lenses with the axes perpendicular to each other are placed before the two eyes; while under the same conditions, a person affected with unilateral amaurosis will see but one luminous line, which is vertical or horizontal in accordance with the direction of the axis of the cylinder.
Blindness, simulated, Laurence's test for. See Hogg's test.

Blindness, simulated, Lippincott's test for. This is a device for exposing the ocular malingerer by means of cylindrical glasses. (See New Tests for Binocular Vision, *Trans. Am. Ophthal. Soc.*, 1890, pp. 560-565). When binocular vision exists a two-dioptr e cylinder with its axis at 90° is placed before the healthy eye and the patient is asked to look at a near object—a card or a book. If he describes precisely that the card or book has one side longer than the other it is proof that he is seeing with both eyes.

Blindness, simulated, Mareschal's test for. This is an apparatus for the detection of ocular malingering arranged somewhat after the box of Fles and Monoyer. It is generally known as the pseudoscope (q. v.). Unlike the Monoyer and Fles box, it has but one mirror and is inferior to the devices of these discoverers.

Blindness, simulated, Marini's test for. By means of a modification of the pseudoscopic box of Fles (q. v.), Marini adapted eye-pieces containing prisms to the apparatus of the former, thus converting it into a stereoscope and really applying the test of von Graefe.

Blindness, simulated, Martin's test for. This consists of an apparatus intended to modify somewhat the Javal method (q. v.) for the determination of binocular vision. In front of a box 35 × 20 cm. are two openings fitted with eye-pieces. About 15 cm. in front of the latter, and in the median line, a rod one centimetre in diameter, which can be raised or lowered according to necessity, is placed. Facing the window, the examiner holds the apparatus between his hands, the posterior wall of the box being placed against his chest. He is then to make the patient look through the anterior opening, the rod having been previously raised. If the patient reads all the letters, the fraud is discovered and the visual acuity is measured. Should the malingerer declare, on the contrary, that he can only read certain letters, it is merely necessary to make sure that they are in reality hidden by the rod from the eye that is claimed to be blind.

Blindness, simulated, Melsken's test for. This apparatus is built on the principle of the Fles box (q. v.), but modified by Prato in that, instead of mirrors, tubes attached to the eye-piece run across the box and end in objectives upon which are printed pictures of different objects. By means of a simple mechanism the examiner may obtain at will either direct or crossed vision and, thus confused, the malingerer is pretty certain, sooner or later, to describe the object corresponding to the tube opposite his pretended blind eye.

Blindness, simulated, Michel's test for. This test is one of the numerous modifications of Arlt's test (q. v.). A trial frame containing
a twenty dioptrre lens set before the good eye and a very weak or
plane lens before the alleged amblyopic eye. If the malingerer reads
most of the distance test-letters we know that he must be doing it with
his alleged blind eye.

**Blindness, simulated, Monoyer's test for.** This pseudoscopic appara-
tus, one of the modifications of the Fles box (q. v.), has two mirrors
so placed as to make the malingerer believe he is reading or seeing
with his acknowledged good eye when he is actually visualizing with
his alleged poor eye. Screens separate the two mirrors and make
it difficult for the patient to discover which eye he is using.

**Blindness, simulated, Ohlemann's test for.** This observer devised a
test for pretended blindness of one eye. Following the suggestion
of Alfred Graefe, he placed before one eye a prism of ten degrees,
base down, and requested the suspected person to fix a light 4 or 5
metres distant. If he sees two lights he is a malingerer and this
test is further confirmed if he continues to see two lights when a
similar prism is placed in the same way before the other eye.

**Blindness, simulated, Prato's test for.** This is one of the numerous
modifications of the Fles box (q. v.) or pseudoscope. The mirror has
been omitted, but two cylindrical tubes cross from the eye pieces
and end in transparent objectives upon which are drawn two dif-
f erent objects. The malingerer is pretty sure to be caught in describ-
ing the object which he thinks corresponds to his seeing eye, but that
is actually perceived by the pretended amblyopic eye.

**Blindness, simulated, Pupil test in.** As Baudry and Marlow state
(*System of Diseases of the Eye*, IV, 863) the reaction of the iris to
light-stimulus is extremely definite, and constitutes a valuable sign
which allows the physician to ascertain objectively whether or not
the retina is sensitive to light. Before investigating the pupillary
motility, however, it is well to make sure of the absence of synchiae,
miosis, or inflammation, as well as of psychical or sensory stimulation.

"The patient must be placed in an apartment which receives light
through a window in such a way that the eyes are equally illuminated.
Strong and feeble illumination should be successively employed. If
the right eye is blind and the healthy left one is covered,—but in
such a way that it can be observed,—there will be complete immobility,
not only of the iris of the right eye, when it is first covered by the
hand and then exposed to diffused sunlight while looking at a dis-
tant object, but also of the iris of the left eye; the sphincter of which
would be sympathetically contracted if the retina of the right eye
retained sensibility to light. The patient being next placed in a
dark room, the amaurotic right eye, for example, is to be covered.
The physician, while continuing to observe it, should throw a pencil of light on the healthy left eye, varying the intensity of the illumination, or make the patient fix with his eye upon an object that is placed very near and towards the nose (accommodation and convergence). In each instance the pupil of the right eye will contract if the iris is not under the influence of a mydriatic. The method recommended by Arlt for the purpose of ascertaining if the retina is sensitive to light consists in illuminating the macular region of the retina for a brief period of time, when, if light-perception be preserved, blinking and some lachrymation will be observed. An examination of the pupil becomes a delicate and a doubtful matter if the eye, amblyopic only, still possesses quantitative perception of light, for in this case any opinion may be erroneous, to the detriment of the patient. No conclusion, therefore, except that which is obtained from a number of tests, controlling one by another, should be given. The same applies when a real or an artificial mydriasis exists. An eye with a dilated pupil is far from always being an amaurotic one. It may be only amblyopic, or it may possess a normal visual acuity, although presenting, in the latter case, functional disturbances resulting from dazzling and loss of accommodation. The following plan is the best method of making a differential diagnosis. The patient is placed in a dark room. The degree of contraction of the sphincter of the healthy left iris when light is focussed upon the eye is to be observed. The eye is then to be screened; this done, the light is thrown by means of a lens on the right eye with its dilated pupil. If the retina of the latter eye is insensitive, the pupil of the left one will not vary; if the right eye is amblyopic only, the left pupil contracts slowly and feebly; if its visual acuity is normal, the contraction of the left pupil is as pronounced as if luminous rays are thrown directly upon the left eye. Mydriasis is often induced with fraudulent intent. It behooves the physician not to be misled by it. Cases are common in which the imposture is a very shallow one, soon resulting in the confusion of the too simple malingerer. In such cases the pupil is dilated ad maximum; the iris is almost imperceptible, so much of it being effaced. Sometimes there remains a slight conjunctivitis of special type that is due to the prolonged use of the mydriatic. When, however, the malingerer is well informed, he makes use of a minute dose of the drug, and ceases the instillations some time before the examination, so as to obtain only a medium dilation. In such a case doubt is permissible, it being necessary to make such arrangements that the malingerer cannot again have recourse to the mydriatic. In artificial mydriasis, stimulation of both retinae produces no con-
traction of the pupil. To recapitulate: the fact that the right pupil remains motionless when exposed to a bright light, while it contracts under the influence of convergence and accommodation, points with great probability to the existence of a unilateral amaurosis. In the case of amblyopia, examination of the iris and pupil will furnish much less conclusive information than when it is a question of the simulation of unilateral amaurosis. An amblyopic eye still possesses, in fact, quantitative perception of light. Unless there is simulation, or indeed a true or artificial mydriasis, a more or less marked sluggishness of the movements of the iris compared with those of the healthy eye should be demonstrated. It will be easily understood that there may exist only minimum differences, the interpretation of which is difficult and therefore doubtful. It is always necessary to remember, in this examination of the light-reflex, that the iris-reaction may be lacking in an eye that is sensitive to light, in the same way as in cases in which the iris reacts normally, although the retina is no longer sensitive to impressions by a luminous agent.'

Blindness, simulated, Schenkl's test for. In pretended unilateral blindness this observer first places before the patient's two eyes sixteen-degree prisms, one base up, the other base down. The patient is then asked to count the parallel lines that are generally found on Snellen's test-types for near and to touch the lower and upper lines. This he will be unable to do if he is not really affected with unilateral amaurosis.

Blindness, simulated, Segal's test for. In this method of testing the verity of alleged monocular blindness a one diopter convex cylinder is placed before each eye—the axes of one at right angles to that of the other. If reading with these is as easy as without glasses the case is probably one of ocular malingering.

Blindness, simulated, Silex's test for. This observer has modified the well-known Arlt device (q. v.) by placing a series of plain or very weak concave lenses (without regular order) before the sound eye, following it by a comparatively strong convex glass (six diopters) in front of the same eye. As is well known, the normal eye can by means of a six-diopter convex lens be rendered artificially myopic, thus making it unable to read small letters farther away than about seventeen centimetres. The patient is asked to read at a short distance and the distance of the test-types is gradually increased appreciably beyond seventeen centimetres. If the ability for reading continues to be possible from seventeen centimetres on, it can only be done with the eye that has been declared to be defective. In this experiment, as in the preceding, it is easy to convict the patient of
his trickery at once by asking him to continue reading after the sound eye has been closed.

**Blindness, simulated, Vieuxse's test for.** This is a modification of the stereoscopic test first introduced by Laurence and Hogg. See **Blindness, simulated, Hogg's test for.**

**Blindness, simulated, Vossius's test for.** This device is a modification of the Arlt method (q. v.), using a strong convex glass before one eye.

**Blindness, simulated, Wicherchiewicz's test for.** This observer recommends, before applying the Arlt test for alleged monocular blindness (with a strong lens in front of the sound eye), that skiaseopy be used and the correcting lenses be placed before the suspected eye.

**Blindness, Simulation of.** **Ocular malingering.** **Feigned blindness.**

**Pretended blindness.** **Simulation of ocular disease.** This is an important section of ophthalmology inasmuch as ophthalmologists who have to do with many cases of injury are very likely to be called upon to examine patients who pretend blindness, partial or total, in one eye or both. In addition to this pretense, persons who seek damages from an individual or a corporation may not only feign blindness more or less pronounced but they have been known to apply some irritating substance to the eye so as to exaggerate the injury. Silver nitrate, sand, sulphate of copper and other agents have been so employed.

Frank C. Todd in a lecture delivered at the University of Colorado in Denver, July 23, 1912, has very thoroughly discussed this matter. An extended synopsis is given here. In addition to the tests mentioned by Todd a number of others will be given under appropriate special headings.

Patients sometimes pretend to be blind or partially blind for the purpose of securing damages as a result of a supposed or real injury. Often it happens that the patient really has suffered some slight injury, but claims a greater defect in eyesight than really exists, with the object of securing larger damages. Others pretend blindness in order to secure pensions, insurance money, etc., while others may feign blindness in order to avoid military duties or to be admitted to some charitable institution. Children sometimes pretend defective eyesight to avoid school duties. In the latter class, and often in the case of some adults, a very effective method of discovering deception and bringing about good vision is to prepare for an operation on the supposed blind eye.

It does not often happen that a patient will claim total blindness in both eyes, as it is a very difficult task for a man to play such a rôle. It is almost impossible for a man to deceive those who see him daily,
and there will usually be found some acquaintance who is ready to testify against him.

One case that came under my observation claimed total blindness in both eyes and played the part well. However, testimony showed that during the time he was supposed to have been totally blind he had been observed by several to pass his cane through the loop produced by the complete curl of a small dog’s tail.

Most of these patients are ignorant as to the various tests, but some of them may be intelligent and more difficult to entrap. The examiner must be alert and the proper tests for the individual case will have to be selected. With a careful study and the proper applications of tests the examiner should be able in practically every instance to convince himself as to whether or not the patient sees in both eyes and in most cases will be able to determine quite accurately the acuity of vision.

The examiner has to guide him the objective and subjective tests.

The refraction of both eyes should be secured by the use of the ophthalmometer and skiascopy. The eyes should be inspected externally and with the ophthalmoscope previous to making the subjective tests. Most of the tests require the correction of any refractive error while being made, and the ophthalmoscopic examination will be of value in determining whether or not disease exists and the condition of the pupil—as to whether adhesions exist, for instance.

**Objective tests.** These depend mainly upon two points, i. e., first, the reaction of the pupil; second, the direction of the visual axis.

**Reaction of the pupil.** This consists of determining whether there exists reaction of the pupil to light and whether this reaction is consensual. As known, reaction to light may not take place even when sight exists, as when synechiae are present or in paralytic mydriasis. Contraction of the pupil to the light is a reflex motion, the optic nerve serving as the afferent nerve and the third nerve controlling the sphincter pupilæ serving as the efferent nerve. Consequently, the reaction to light is good evidence of the existence of sight, and the more prompt the reaction (depending, however, somewhat upon the patient’s age), as a rule, the better the sight. Of course, it is impossible to determine the degree of sight accurately by such a test, and it is further possible to secure a reaction to light even in a sightless eye. Practically, however, if contraction of the pupil to light takes place, we may consider it probable that sight exists, and a test of positive value is the following: If contraction of the pupil to light does not take place in the eye where applied and consensual reaction does take place (i. e., reaction of the pupil of the eye to which the light is not applied), it is evidence of the fact that the eye is blind.
In testing the reaction of the pupils to light, the patient's gaze should be directed straight ahead, the light cut off by the observer's hand (covering both eyes), which should then be suddenly removed, and the effect of the sudden stimulus of light noted. The presence or absence of consensual reaction is shown by keeping one eye shaded while the other is exposed to the light, noting the effect on the shaded eye as well as the effect on the eye exposed.

In making tests in any case of partial or total blindness in one or both eyes, bear in mind that contraction of the pupil takes place in conjunction with accommodation and convergence (all of these actions being controlled by the third nerve and the three nuclei for these actions being situated contiguous to one another and connected by association fibres). Therefore, when making the test of the reaction of the pupil to light, the patient should focus his vision at the same distance during the entire test.

The fact that the pupil of the alleged blind eye remains motionless when exposed to a bright light, whereas it contracts to convergence and accommodation, points to the existence of monocular blindness.

In testing the totally blind eye the other methods to depend upon are the customary objective tests with the ophthalmoscope to determine the presence of any intra-ocular or fundus lesion, taking the tension, determining the depth of the anterior chamber, noting the transparency of the lens, etc.

If the patient has used atropine in one eye there will be a maximum dilatation of the pupil and no reaction of the pupil in the atropinized eye. The sensitiveness of the retina to light in this eye may then be tested by observing the consensual reaction of the pupil that takes place in the other eye when the light stimulus is applied to the eye with the dilated pupil, and will serve as correctly as a guide as if the reaction took place in the eye where the light stimulus was applied.

A knowledge of the reaction of the pupil to light and convergence will enable one to work out in each individual case the proper pupil tests to be applied.

Fixation of vision. The absence of the physiological stimulus of binocular fixation of vision allows a blind or partially blind eye to assume the anatomical position of rest, which is upward and outward, and we find in the case of an eye which is partially or totally blind that it fails to maintain proper fixation. When, therefore, perfect parallelism exists under all conditions, it is good evidence of the presence of sight, and furthermore, of sight which is nearly as good as that of the other eye—good enough, at any rate, to produce single binocular vision.
In testing fixation vision, remember that there are some cases of strabismus in which the patient may consciously or unconsciously free accommodation from convergence and may suppress the image in one eye.

Harlan’s test. Place a pair of trial frames on the patient, correcting refraction of alleged blind (right) eye, and over seeing (left) eye place a strong (15 or 20 diop tres) concave or convex spherical lens. Urge the patient to read while both eyes are open. If he succeeds it is with the eye he has claimed to be defective and his answers indicate approximately the degree of his visual acuity.

Jackson’s test. Place two strong cylindrical lenses before the seeing eye, one convex to neutralize the concave. Without the patient’s knowledge suddenly turn one lens at right angles to the other, allowing the patient to continue reading.

Test with 10 degree prism. A 10 degree prism is placed before the seeing eye, base down or out. If it produces double sight when looking at the candle light the patient must be seeing with both eyes. This test only determines that fact and does not determine the acuity of vision. The patient may be aware of this test and deny that he sees double.

Test with 40 or 50 degree prism. Place a 50 degree prism, base down, over the seeing eye while the patient is looking at a light or some letters across the room. This will throw the object looked at out of the field of vision for the seeing eye, and if the patient continues to read the letters or sees the light he is seeing with the alleged blind eye.

Test with double prism. A double prism with bases together may be placed over the seeing eye in such a way as to produce monocular diplopia. If the patient sees three lights he is seeing one with the alleged blind eye. If he denies seeing two lights when the prisms are properly placed it is evidence of dishonesty.

Test with black disc with small central opening. A test which the writer has practiced with success consists in using a black disc with an opening in the center (which is placed over the seeing eye, in which there may be a prism or the double prism). The patient is instructed to look at the light or the letters across the room and asked to read them out loud. While he is reading them the head is gradually moved by the examiner so that the chin is raised in such a way that the visual axis passes through the opaque disc. If the patient continues to read he is reading with the alleged blind eye.

Javal-Cuignet method as modified by Martin. The apparatus may be made by using a shoe box about twelve inches long, in one end of
which two apertures may be made through which the eyes of the patient are to look. At the other end some printed matter is placed. Five inches from the printed matter in the median line a hole is made through which an ordinary lead pencil may be inserted. With the light to the back of the patient the examiner may face the patient so that he can observe his eyes, and the patient is instructed to read. The pencil will interfere with continuous reading of the words unless the patient has reading vision in both eyes.

Driver’s method. Driver similarly interposes a vertical ruler about 1¼ inches wide between the patient’s eyes and two of Snellen’s test types in such a way that the ruler acts as a screen before the seeing eye, hiding the right test type from the left eye and the left test type from the right eye. If the patient succeeds in reading the letters on the two cards the fraud is disclosed and the degree of vision indicated.

Test with 6 diopter convex lens. The normal eye may be rendered myopic with a 6 diopter convex lens. Test type is placed very close to the eyes and the patient allowed to read, gradually increasing the distance until the reading is beyond the focus of the seeing eye. If the patient continues to read he is reading with the alleged blind eye and the degree of vision is approximately measured thereby. This test may be reversed by placing the strong lens over the alleged blind eye and allowing the patient to read at the normal focal distance of the seeing eye; then placing the print within the focal distance with the eye covered with the 6 diopter lens and nearer than the near point of the seeing eye. In this test a trial frame should be used and plain lens placed over the seeing eye if it is normal or if required, the patient’s presbyopia being corrected so as not to bring the focus, however, at near point nearer than ten inches.

Baroffio test. This consists in the use of atropin or eserine. Baudry suggests pilocarpine may be used to better advantage, as it does not produce the symptoms that either of the other drugs produce. This should be dropped into the normal eye, and it will bring the reading focus so close that the patient will be unable to read with the normal eye unless the print is held very close. In this test as in all others we should take note of the state of refraction.

Test with mirror for slight defects of vision. If the malingerer is pretending to have only a slight defect of vision the test with the mirror in one of various ways is of value. The best method is to use a test type of symbols (instead of reverse letters, which may excite the patient’s suspicion) such as the E’s placed in various positions. Place the patient midway between a mirror and a chart of E’s
(or other symbols or letters like II and O, which appear the same both ways), at which he looks, then have him read the smallest he can. Now have him turn half way around and read them in the mirror. The distance by the mirror is three times as great, and his visual acuity is measured accordingly. Similarly two charts may be used, one with reverse letters. The patient is told to read a chart across the room, and then in a mirror beside it which reflects reverse letters that are placed over his head. Thus the letters seen in the mirror are located double the distance of the direct letters from the patient, and the acuity of vision may be determined. The malingerer is apt to read in the mirror the corresponding line to the direct letters, showing that his vision is twice as good as he pretends.

Test with 6 or 8 degree cylinder. Place upon a piece of paper a number of vertical lines. Place over the seeing eye the strong cylinder, axis 90. Holding the paper at a definite distance, not nearer than three feet, ask the patient to count the number of lines. If he succeeds it is evident that he has good vision, which may be quite accurately measured, as it is impossible to count the lines through the cylinder.

Tests of Priestley Smith and E. Jackson. Movements of the eye using a 6 degree prism, noticing the movements of the eye in the effort to secure singular binocular fixation. Supposing, for instance, we place a 6 degree prism, base out, before the alleged blind eye while he is fixing his vision upon a bright light at the other end of the room. The effort to secure binocular fixation of vision will cause the right alleged blind eye to turn inward and again to go out when the prism is removed.

Test of von Welz. This same test is suggested by von Welz, using a 20 degree prism base outwards and having the patient read at the reading distance, observing the movements of the eye during the reading.

Cuignet test. Lighted candle is brought in front of the good eye and is slowly carried toward the side of the blind eye. Patient is detected if he declares that he still sees the candle when it is just concealed from the sound eye by the dorsum of the nose.

Duane suggests a method to prevent the malingerer from outwitting the examiner by slyly closing the alleged blind eye as follows: While the patient is reading out loud quite fast and is occupied with what he is doing, suddenly place a prism of four degrees, base down, over the alleged blind eye, making sure that the eye is open at the time. If the sight in this eye is really very poor, it will make little difference to him whether the prism is placed before it or not and
he will read as before, but if he sees fairly well with this eye the inter-
position of the prism will cause confusion and he will either stumble
in his reading or be unable to continue.

Berdohl's test. While a prism of twenty degrees' strength is
being rotated before the feigned blind eye, the patient is requested
to read aloud some small printed matter. This will be an exceedingly
difficult procedure for the patient to do if good vision exists in
both eyes.

Baudry's Test. Baudry has devised an apparatus by which there
is obtained a series of double images that are so similar that the malin-
gerer cannot distinguish the false from the real one or discover whether
the double vision is of a monocural or binocular diplopia. A dark
glass or of color is placed before the flame of a candle which is
situated at a distance of three meters. "A triangular prism divided
into two parts by a line of horizontal section is united by its base to a
transparent medium with parallel surfaces and of the same thickness.
The whole glass represents one portion of a beveled mirror without
mercury, divided into three distinct parts, which lie with their unpol-
ished cut surfaces in apposition. This glass is concealed in a circular
metal box which is perforated on each surface by a central opening,
one of which has a diameter of six and the other of three millimeters.
A simple mechanism which allows sometimes one and at times the
other of the two lines of separation and at the same time a small part
of the adjoining portion of the glass to be brought before the pupil
of the sound eye, is thus obtained. As the lines of division and the
adjoining portions of the glass that are brought before the pupil are
absolutely identical in appearance, sometimes monocural and some-
times binocular diplopia, unknown to the malingerer, even if he knows
in advance the construction of the instrument, can be evoked with
the greatest ease."

This test may be used in various ways, which the examiner will
be able to work out for himself.

Snellen's test. This depends upon the fact that while similarly
colored rays may pass through a colored glass, rays of a comple-
mentary color are stopped. Supposing, for instance, we have made
a certain number of letters of a definite size, these letters being upon
glass through which the light can shine and being alternately red
and green, the background being opaque and black. Now place this
chart of letters over the window in such a way that the light will
shine through the glass. Place upon the patient a trial frame con-
taining a red glass over the seeing eye. If the patient is blind in
the other eye the green letters will appear black and he will only
read the red letters. If he reads the green letters in addition to the red ones he reads them with the alleged blind eye; thus the acuity of vision may be measured.

**Test made with red and black letters on white background.** Print upon a white paper with a red pencil words alternately red and black. Now place over the seeing eye a red glass. If the patient is blind in the other eye he will be only able to read the words printed in black. If he reads them all he is reading with the alleged blind eye and the acuity of vision may be thereby measured.

**Stereoscopic tests.** These may be made with the ordinary stereoscope, the printed matter so arranged that certain portions of it are not present before one or the other eye. If the patient reads consecutively he is reading with both eyes. This test may be greatly varied by using different symbols or figures, only a portion of which is present on each side so that it requires binocular vision to see the complete figure.

**Test with the Worth amblyoscope.** Another test which I have not seen described but which I have used with great effect in one case and one which had more effect on the jury than any other test is the use of the Worth amblyoscope. The amblyoscope should be so arranged that when the normal eyes look through it the images are crossed. The amblyoscope should be carelessly laid upon the table or in such a manner that the claimant can clearly see that the tubes do not cross. Now let us take two subjects and let us place in the tube which will be seen by the right (blind eye) a picture of a bird which is much smaller than the bird cage which will be placed on the left (seeing) eye. Now, let it be remembered that the amblyoscope is so arranged that these images are crossed so that the bird-cage will be on the right though seen by the left eye and the bird on the left though seen by the right eye. If the claimant is malingering, having previously observed that the tubes do not cross, he will claim to see only the object on the side of the admittedly seeing eye, in this instance, the bird. This conclusively proves not only that he is malingering but that his sight is good in the right eye.

**Feigned total or partial blindness in both eyes.** As previously mentioned simulation of total blindness is unusual because of the difficulties entailed in carrying out the fraud in the daily routine. It is more often met with in hysterical subjects and occasionally in those who are amblyopic in both eyes. One who is really totally blind assumes a characteristic attitude. He walks with a hesitating step and has an expressionless face and a dull stare. His eyes turn upward and perhaps slightly outward.

The objective tests have been given above. The tests for the reaction
of the pupil to light and the directions of the visual axis are important. A history of the case to determine the length of time which the patient claims to have been totally blind may be confirmed or unconfirmed by the testimony of those with whom he has lived. These patients should be taken unawares.

A test may be made pretending that the examiner is trying to find out whether or not the patient can determine direction in hopes to catch him off his guard. The examiner may go to one side of the room and ask the patient to approach him. In his way may be placed some articles of furniture, though care must be taken that the patient may not injure himself. Observation should be made as to whether or not the patient avoids the objects placed in his way.

A patient who complains of sudden total loss of vision must assume the attitude and gait of a blind man, walking stiffly and hesitatingly with hands outstretched; face impassive; expression dull; eyes turned upward; eyelids immovable even at sudden flashes of light or objects threatening and quickly brought towards his eyes. The compression bandage may be applied for a day and see if the patient can maintain the role of the blind patient as well as when both eyes are uncovered.

Schmidt-Rimpler suggests that the patient be told to look at his own hand which he holds a short distance from his eyes. A blind man will easily succeed in casting his eyes in the direction of his own hand while a pretender may affect to look in a different direction, believing that he is thereby deceiving the examiner.

Field of vision. Fantastic fields of vision may be secured. Maps should be made of the fields taken at different distances. It will be found in the case of a malingering that they do not correspond. The map shown at the greater distance will be apt to show a smaller field than that taken at a near point. Fields taken for various colors may not correspond to the normal state or to any diseased condition. Such fields will prove confusing to the patient and of value to the examiner in determining whether or not he is honest.

Priestley Smith suggests the application of the von Welz test to supposed cases of total blindness. The patient is placed in a semidarkened room, a candle light being situated in front of him in such a way that he naturally will cast his eyes toward it without being instructed to do so. A prism with its base inward is placed before one eye. If vision exists the eye will move outward and again inward when the prism is removed.

Jackson calls attention to the fact that even if one eye is nearly blind the seeing eye will move behind the prism, but in that case the blind eye will move in the same direction and to the same extent,
whereas if binocular vision exists the other eye will not move in either
direction.

In conclusion let me explain that I have not attempted to give all
of the tests which are suggested nor to describe some of the very
ingenious contrivances that have been invented for making these
tests. I have endeavored to simply bring out those which seem to
me of value and which can be applied by anyone without special and
elaborate apparatus. See, also Legal ophthalmology.

Blindness, Snow. According to de Schweinitz (Text-Book, p. 657) this,
as seen in northern latitudes, "is an affection of the conjunctiva.
There are burning pain, photophobia, blepharospasm, hyperemia
of the conjunctiva, and chemosis. In severe cases there may be ulceration
of the cornea. The pupils are small, and there is congestion of the
retina. The visual acuteness may be unaffected, or it may be dis-
tinctly lessened, especially if corneal complication or a scotoma co-
exists. The dazzling of the snow may cause restriction of the field of
vision, scotoma, and night-blindness, but when the sun shines, the
heat reflected from the surface of the snow produces an erythema of
the conjunctiva. If the sunshine is absent, a mechanical cause is
found in small flying particles of snow and ice (A. Berlin). Pro-
longed exposure to powerful electric light may produce analogous
symptoms—electric ophthalmia. Those much engaged in work with
the Röntgen rays often suffer from decided conjunctival hyperemia or
positive conjunctivitis."

In considering the question of protection from the sun's rays by
tinted lens recent South and North Pole explorers have found amber-
colored glasses the best; or masks and wooden spectacles (with slits
below an over-hanging ledge, such as the Alaskan Indians wear) will
be found efficacious as a preventive method. Since snow-blindness
sometimes constitutes an actual sunburn of the cornea this condition
requires the treatment for simple keratitis, as well as for hyperemia
of the conjunctive, also set up by the action of the solar rays.

Blindness, Soul. See Blindness, Psychic.

Blindness, Statistics of. See Blindness, Etiology of.

Blindness, Tobacco. See Toxic amblyopia.

Blindness, Unilateral reflex. This condition is to be distinguished from
unilateral reflex iridoplegia (one-sided Argyll Robertson pupil), in
which there is a response to light but not to convergence. In the
former case there is a genuine interruption of the light-conduction in
one optic nerve.

Blindness, Water. A condition brought on by the glare and other
abnormal conditions incident to travelling over water areas. They are
said to affect especially aviators, or those operating over such clear
BLINDNESS, WORD

bodies of water as Lake Michigan. At a certain height the aviator can see the bottom of the lake, and the distance to the surface of the water is deceptive. For instance, in July, 1913, aviators Day and Martin, having for these reasons obtained a false idea of their altitude, adjusted their planes for too steep a descent. Before Martin had time to right them the planes struck the waves and the pontoons were shattered. Both men were flung into the water, Day striking against the wreckage. The craft did not sink, and the men crawled to safety among the planes. (Inter-Ocean, July 8, 1913).

Blindness, Word. This is a form of verbal amnesia in which the individual loses the memory of the conventional meaning of graphic symbols. He is able to see these symbols and he knows that they are unlike other objects in their neighborhood, but he cannot translate them into words, because they are to him as if he had never before seen them. He neither knows what they mean nor can he pronounce them; they convey no more idea than if the reading matter were printed in a foreign language he had never learned. Strange to say figures can generally be distinguished and read. There are two varieties of word-blindness, respectively, cortical word-blindness and pure word-blindness. By the former term is meant that variety of aphasia the result of alterations in the brain substance limited to the cortex. Pure word-blindness is a term applied by Dejerine (Mémoires de la Société de biologie, Feb. 1892) to that variety of the disease resulting from a lesion of the tracts which enter from the primary visual centers the cortical center for word-seeing.

Cortical word-blindness is associated with agraphia and is due to a lesion in the center for visual memories for words. This in right-handed individuals lies in the left angular gyrus.

As stated, pure word-blindness is due to an interruption in the path from the visual memory-center to the speech-center. This is the reason that seeing words fails to awaken in the patient the memory of its speech sound so that he can neither recognize nor speak it. As a matter of fact we always associate the remembrance of words and letters with their spoken sounds, especially in beginning to read; hence, it is necessary for the recognition of these symbols, later in life, that each of these images—both visual and auditory—should be awakened by a stimulus applied to one or other of them.

For a more complete exposition of this subject see Neurology of the eye; also Alexia and Word-blindness.

Blindness, Zeune's law of. This observer formulated the theory that climate has much to do with blindness, that it is proportionately less prevalent in the temperate than in the frigid zone; but rapidly in-
creases in the torrid zone as the equator is approached. His statistics
give approximately the following distribution of blind to population:
Between 20 and 30 degrees of latitude 1 blind in every 100 of
population.
Between 30 and 40 degrees of latitude 1 blind in every 300 of
population.
Between 40 and 50 degrees of latitude 1 blind in every 800 of
population.
Between 50 and 60 degrees of latitude 1 blind in every 1400 of
population.
Between 60 and 70 degrees of latitude 1 blind in every 1000 of
population.
A study of the statistics of individual countries does not, as Minis
Hayes pointed out, show an entire conformity to this law. Thus, Nor-
way has 13.63 blind per 10,000, and Finland 22.45; whereas Sweden,
which lies between them, has only 8.05. Nevertheless, the general truth
remains, that blindness is more common in the frigid and torrid than
in the temperate zones.

Blind, Occupations and resources for the. See the major heading,
Institutions and occupations for the blind.

Blind, Occupations, trades and careers for the. Under the caption,
Institutions and resources for the blind, the subject will be more
fully discussed by an authority of world-wide experience in such
matters. There will be considered in particular the education and
resources of the blind in each of the United States. Here it is to be
noted that in all countries the trades and handicrafts commonly
pursued are the making of ropes, mats, brooms, baskets and bedding,
wood-chopping, metal-working, chair-caning, piano-tuning, type-writ-
ing, etc.—in fact, the list of occupations for the blind is daily increas-
ing and as in the case of recreations and amusements (q. v.) the blind
rightly aspire to play in their lives almost the same rôle assumed by
the seeing. Girls readily learn to do hand and machine-sewing, cro-
cheting and knitting.

One of our most successful and most widely-known practitioners of
medicine—a specialist in diseases of the heart and lungs—has been
totally blind since childhood; indeed all ranks and walks of life are
and have long been represented by blind individuals.

Piano-tuning is, on the whole, the best represented of all the occupa-
tions, but, just as with the sighted, the blind can only succeed as piano-
tuners when they are naturally first-class workmen. The Royal Nor-
mal College well recognizes this fact and does not recommend a tuner
who cannot pass the required examinations and obtain the official diploma.

In the United States and Canada where the general education of the blind is a charge on each State or Province, broom-making seems a remunerative handicraft. In England the workshop system for the blind is still in vogue, while in Germany a better plan is adopted. In Saxony the government officials keep a methodical supervision over their pupils after they have left the blind schools; and it is claimed that, as a result of this system, a much larger percentage of the blind become independent and self-supporting members of the community.

Probably the various branches of music afford the most highly-prized and lucrative employment not only for those who possess congenital talents, but for those who have enjoyed unusual educational advantages from early youth. As with the sighted, it is an education that not only encourages and develops native musical talent but the best qualities of mind and body. In the best equipped colleges where a musical career is provided, the first aim is manly character, healthy bodies, well-cultivated and active minds, and prompt, business-like habits, which qualify its pupils for practical life. The pupils are generally taught swimming, skating, rowing, cycling, canoeing, gymnastes (Swedish, German, and American), military drill, and in the season a great variety of outdoor sports. The course of instruction includes the following departments: general education, including the training of school teachers; the science and practice of music, including the training of music teachers, pianists, organists, choir-masters, and vocalists; technical education, including mechanical training and piano-forte-tuning. In a number of the American states the schools for the blind are no longer regarded as charitable institutions; while under the control of the State Board of Charities, they, in common with all schools for the sighted, are under the management of the Board of Education; consequently, in the United States, the blind as a class are in a better condition educationally and socially than their fellows of any other country.

Blind personages in history. See Personages, Blind, in history.

Blind, Physical education of. As E. E. Allen (Am. Phys. Education Review, June, 1906,) very properly observes, one cannot truthfully speak of the blind as members of a single class, for example, as all awkward, slothful, timid, as deep thinkers, or as naturally pious. The blind are not even all alike in their blindness. In the Overbrook Institution, made up of young people, more than half are able to see light, and half of these see well enough to avoid running into objects. This sight is not always of advantage; to those whose eyes are unequal to the demand made on them it is a hindrance, for the energy which might
effect something worth while if directed to hearing and doing runs to waste in trying to see. For purposes of getting about, however, a little eyesight is a tremendous advantage. In all active competitive games those who have some sight are invariably chosen first. Sight is of as much importance for physical as for mental growth. In weight, height and lung capacity the blind are defective. For an unattended blind man to take a long walk is not recreative, but positively exhausting. There results a disinclination for real exercise.

At Overbrook the plan of the grounds as well as of the buildings was dictated by the physical needs of the pupils. Everywhere there are straight lines and rectangles. Trees are planted in avenues dividing the different playgrounds. In front of every row there are narrow walks of brick enclosing the playgrounds on all sides, and the children know that, whereas they may run hard and fast within their plots, there is danger ahead as soon as their feet touch the hard walk. Unless the blind can run with abandon, they will not run at all. In the gymnasium the wooden floor is framed with a cement walk seven feet wide as a protection. When the foot or roller skate strikes it the feel is different and the sound is different, and is further modified by the running track directly overhead. Certain exercise is required from all. Class work teaches the lesson of coöperation. The physical training of the blind is as arduous as it is necessary. Dancing, skating, marching and running on the toes are valuable exercises to correct posture. The education of the hands is of importance.

Powell tells the same story and emphasizes the need of physical training. He finds that the conditions and environment of the blind are such as to make them prone to inactivity, and they need more systematic exercise than the seeing child. Physical education of these cases is practically in its infancy. Round shoulders, sunken chest, scoliosis, flat foot, poke neck, and hips too far forward are the physical defects. Many of the older blind boys are absolutely fearless in the gymnasium. Those who have been blind only a short time are more apt to be sedentary. Dancing tends to overcome the awkward gait and to develop ease and grace in all movements. The sense of direction is capable of marvelous development. Those pupils who can distinguish large objects and keep out of danger are valuable as leaders. The running and marching is done with the hands on the shoulders of the one in front. Music is furnished with each class by the older blind boys. Most of the students in the school are taught music and almost all are able to keep perfect rhythm in the calisthenic work as well as in marching. Cleanliness is apt to be neglected, and the hygiene of daily life and the necessity for bathing must be inculcated. The
BLIND, PRINTING OUTFIT FOR THE

desire for play is even stronger in the blind than in seeing children.
Movement seems to be the one aim and desire.

Blind, Printing outfit for the. La Nature gives the following descrip-
tion of a portable printing outfit in Braille, devised by Vaughan of
the Quinze-Vingts. The portable printing set for the blind is a box
containing types in its lower part, and above these a grille to receive
these when set. The characters used are specially cast for the purpose;
they bear at one end a letter of the Braille alphabet, and at the other
the equivalent Roman letter. These characters are also furnished with
a tongue placed lengthwise at the base of the letter, indicating its
position. This enables the types to be set vertically in grooves made
in the grille.

The method of use is as follows: The types are in the body of the
case and the Roman letters bear on an inking pad below. In the lid
is the empty grille, under which a sheet of paper may be slipped. The
blind person recognizes the type by touching the Braille characters,
and, taking them one by one, places them in the grille from left to
right. The types are thus set closely side by side. To separate the
words the groove to the right of the last word is allowed to remain
empty. When all the types are in place a slight pressure impresses
them on a sheet of paper. The same apparatus enables one who
does not know the Braille alphabet to write to a blind person, in which
case the inking pad is not used. The characters are placed in the grille,
taking care that the Roman letter is uppermost, so as to be seen by
the operator. The latter composes his words, letter by letter, and places
them in the grille, going from right to left. Pressure is then brought
to bear on a sheet of paper, placed as before, under the grille; the
Braille characters are forced into the paper, the pressure necessary
for this depending on its thickness. The paper is then turned over
and read on the other side, the Braille letters in relief running from
left to right. This invention appears quite practical and will prob-
ably be of great service to the blind. See, also, Institutions and occu-
pations for the blind.

Blind, Resources of the, in America. See Institutions and occupa-
pations for the blind.

Blind, Sixth sense of the. Javal’s views on this subject are of unusual
value because, being a well-trained ophthalmic observer, and having
become blind late in life, he had all the advantages of special prepara-
tion as well as the incentive to make a particular study of this psycho-
logical subject (see translation by C. E. Edson entitled On Becoming
Blind, p. 152). “Everyone who has carefully observed blind persons
knows that there are among them some completely blind who have,
more or less, developed what they call the sense of obstacles. One sees children run about in their play without bumping into trees; this faculty is with them even in a place where they find themselves for the first time. Walking in a passageway, they recognize without hesitation whether a door across their way is open. I am even assured that some of them have this sense sufficiently developed to allow them to count the windows of the first floor of a building which they are passing in front of. This perception of obstacles makes one think of the experiment of the celebrated Spallanzani, who saw bats continue to fly about without striking themselves, after he had taken out their eyes.

Most frequently the blind assert that the seat of the sensation which we are considering is chiefly the forehead; they never speak of experiencing it in the hands. There are some who attribute the sense of an obstacle to the pressure of the air, which is incorrect, for those whom I have asked affirm that the perception is sharper when they slowly approach the object, whose facial sensation gives them warning of its presence. This sensation is always vague, and, according to the expression of some blind people, subject to mirage; that is to say, they sometimes stop short in their walk with the fear of striking themselves, when they are not in the neighborhood of any obstacle."

Javal further says that authors are far from being agreed as to an explanation of these facts. Some tax their ingenuity to attribute them all to auditory sensations; others do not allow the auditory sense any rôle in the process; others admit that the tympanum acts as a receptor without there being any auditory perception; and finally, some blind people have said that they believed in simultaneous action of auditory and other sensations, the respective rôles of which it was impossible for them to determine.

He gives at length a number of well defined instances of what is commonly known as the sixth sense of the blind and says that the explanations of the intelligent blind observers are about as satisfactory as those of psychologists who have investigated the phenomena.

W. Hanks Levy in a work entitled Blindness and the Blind says that "whether within a house or in the open air, whether walking or standing still, I can tell, although quite blind, when I am opposite an object, and can perceive whether it be tall or short, slender or bulky. I can also detect whether it be a solitary object or a continuous fence; whether it be a close fence or composed of open rails; and often whether it be a wooden fence, a brick or stone wall, or a quickset hedge. I cannot perceive objects if much lower than my shoulder, but sometimes very low objects can be detected. This may
depend on the nature of the objects, or on some abnormal state of the atmosphere. The currents of air can have nothing to do with this power, as the state of the wind does not directly affect it; the sense of hearing has nothing to do with it, as when snow lies thickly on the ground objects are more distinct, although the football cannot be heard. I seem to perceive objects through the skin of my face, and to have the impressions immediately transmitted to the brain. The only part of my body possessing this power is my face; this I have ascertained by suitable experiments. Stopping my ears does not interfere with it, but covering my face with a thick veil destroys it altogether. None of the five senses have anything to do with the existence of this power, and the circumstances above named induce me to call this unrecognized sense by the name of facial perception. * * * When passing along a street I can distinguish shops from private houses, and even point out the doors and windows, etc., and this whether the doors be shut or open. When a window consists of one entire sheet of glass, it is more difficult to discover than one composed of a number of small panes. From this it would appear that glass is a bad conductor of sensation, or at any rate of the sensation specially connected with this sense. When objects below the face are perceived, the sensation seems to come in an oblique line from the object to the upper part of the face. While walking with a friend, I said, pointing to a fence which separated the road from a field, ‘Those rails are not quite as high as my shoulder.’ He looked at them and said they were higher. We, however, measured and found them about three inches lower than my shoulder. At the time of making this observation, I was about four feet from the rails. Certainly in this instance facial perception was more accurate than sight. When the lower part of a fence is brickwork, and the upper part rails, the fact can be detected, and the line where the two meet easily perceived. Irregularities in height and projections and indentations in walls can also be discovered.’

Javal sums up his study of the subject by remarking that ‘a short time after losing my sight, as I heard this sense of obstacles spoken of, I made some trials to see if its application could be of some use to me. These trials gave a negative result, and by a rash generalization I came to believe that this sense is the privilege of those born blind, when I received from M. Leon, in whom this sense is strongly developed, a copy of James’ book, with the following passage marked: ‘The membrana tympani is susceptible of noticing differences of pressure exerted by the external atmosphere, differences much too small to be possibly distinguished as a sound. After being seated
and having the eyes closed, let the reader ask some one to bring silently before his face an object like a large book; he will at once have a consciousness of its presence as well as of its removal. A friend of the author, trying this for the first time, distinguished without hesitation the three degrees of thickness of a board, a trellis, and a sieve held successively before his ear. Since they who see never make use of this sensation as a means of perception, we can admit that, for those whose attention is called to these phenomena for the first time, this appreciation is a quasi-sensation and owes nothing to the education of the senses. But what is perceived is very clearly and without denial the absence of limit of space, quite as when lying on the back one perceives nothing but the blue and limitless extent of sky. When some one brings an object to our ear, we at once experience a sense of imprisonment or shut-in-ness. If the object is suddenly taken away, it seems as if we were freed and in the presence of free space. And to whomsoever takes the trouble to try it, this sensation will be that of a vague appreciation of space.'

"William James adds this note: 'The proof that this sensation is tactile rather than acoustic seems to follow from the fact that a physician, a friend of the author, nearly deaf in one ear, although the two tympana are normal, feels the presence or removal of an object as well with one ear as with the other.'" See, also, Blindness.

**Blind spot, Mariotte's.** As is well known to physiologists, there is a normal scotoma in every eye, which corresponds to the optic nerve entrance. This is usually noted on the perimeter as lying three degrees below and fifteen degrees external to the fixation point. Landolt, has observed that the interval is greater in hyperopic than in myopic eyes, while Hansell says that the average distance of the centre of the blind spot from the point of fixation is the same in hypermetropia and emmetropia but is 5 mm. greater in myopia.

![Diagram to Show the Blind Spot in the Visual Field.](image)

For a demonstration of Mariotte's spot let the observer close the left eye and look intently at the cross of the accompanying figure with his right eye at a distance of one foot. He will notice that the black sphere will disappear when the rays from the circle strike the optic disk.

The blind spot is not round but elliptical. Its shape and size vary
slightly in normal individuals and greatly in various diseased conditions of the eye.

For example, in seven cases of disease of the posterior nasal sinus van der Hoeve (Archiv f. Augenheilk, vol. 67, p. 101) found an enlargement of the blind spot for white and colors. Red and green showed the largest scotomas, blue smaller ones and white still smaller. The examinations were made with a campimeter and squares of colored paper from the Heidelberg color book, of from 1 to 5 mm. sides. The blind spot was always found first and the patient instructed to announce when he saw the color, as, according to O. Bull, it is easier to observe the onset of a perception than its subsidence. The ophthalmoscopie examination revealed no changes excepting in two cases pallor of the temporal portion of the discs. After treatment, generally operation, of the nasal affection the condition improved considerably or healed completely, while two cases which were not treated showed rapid increase of the scotomas and impairment of vision. In the cases with unilateral nasal affections only the corresponding optic nerve was diseased. This and the excellent results of the nasal treatment rendered it most probable that the affection of the optic nerve was caused by the disease of the nose, viz., inflammation with suppuration or hyperplastic inflammation of the mucus membrane. In some cases it healed after sufficient drainage was established; in others the diseased mucus membrane of the sinus had to be removed.

The author thus summarizes his conclusions: 1. If in diseases of the nose there is any doubt as to affection of the posterior accessory cavities scotomata of the blind spot for white and colors must be searched for. 2. Enlargement of the blind spot for white and colors in affections of the nose indicates with great probability a disease of the posterior nasal sinus and justifies operation, if there are no other causes for the peripapillary scotoma. 3. Early treatment of affection of the posterior nasal sinus may cure the subsequent disease of the optic nerve.

Blind stye. When a hordeolum (q. v.) does not run the usual course (ending in suppuration) but is aborted and its contents are mostly absorbed; or if it assumes a chronic form and a small, hard, painless lump remains for a long time, it is called, vulgarly, a “blind” stye.

Blind, The. See Blindness. Although this subject is discussed in its various aspects in this work, yet there are certain general observations that might be made regarding the blind as a class. There are many incorrect, if not absurd, notions about them held by the laity, not to speak of numbers of the medical profession, who have not properly considered the subject. As Guillié long ago pointed out
(Essay on the Blind, 1819) a question has long been agitated, whether the loss of one sense increases the intensity of the others; whether those who are born deaf and dumb, or blind, have any real advantages over other men, as a result of the development of the remaining senses. He answers this by saying he is convinced that neither the deaf nor the blind are superior to other individuals enjoying the use of all their senses: "The address which is observed in the blind, with respect to the touch, and the aptitude of the deaf and dumb to seize all the characters of the physiognomy, result from the necessity they are in, at first, of almost continually making use of the sense of touch to supply the want of sight; and the others, of employing their sight to supply hearing and speech; the organ is in every respect similar to that of those who enjoy their sight, and though the person born blind, that was operated upon by Cheselden, after the extraction of the cataract, no longer perceived objects by the touch as he did before, it was not that by recovering his sight he lost the faculty of touching, but only that he then employed it merely as an auxiliary sense, and to correct the sight." "The opposite effect," he further remarks, "happens to persons who become blind after having seen during some part of their life: both require to form the education of the new sense they gain; the senses which replace those that are lost are more exercised; they sometimes acquire an exquisite fineness which greatly augments their susceptibility; but the eye of the deaf can never hear, and the fingers of the blind will never see. It would result from the false principle we are endeavors to destroy, that an individual who had lost two, and even three senses, would find a compensation in the superior faculties of those which remained; thus, the young girl, who was a few years since at the Institution of the Deaf and Dumb, and who was at once deaf, dumb, and blind, and thus reduced to two senses, should have found, according to this strange supposition, in touch and smell alone, the means of acquiring ideas, more or less perfect respecting light, sound, and speech. Nothing is more contrary to evidence; she had only a vegetative existence; she was deprived of the impression or vibration, which external objects make on our senses, which for that reason are called organic sensations, and cannot exist when the organ destined to perceive and transmit them does not exist; her soul, as if imprisoned, must have been condemned to absolute inaction." Of course Guillé lived before the days of Helen Keller.

According to the same observer, the lack of sight not only deprives the blind of the sensations which, that organ gives to those who have sight, but also extends its influence over all their thoughts, which it
modifies and distorts; all their ideas, therefore, are false or contrary to the notions we have, because, as Condillac has well observed, colored nature has no existence for them, it is blindness which plunges them in the ignorance in which they are of decorum, and which deprives them of the sentiment of social decencies. Modesty, which is one of the graces of youth, is to them almost an imaginary being, though they have a sort of timidity, which, it is true, belongs perhaps rather to fear than shame, but which greatly augments their embarrassment in certain circumstances.

The common-place but rather interesting question arises as to whether the organism as a whole, or that association of it which we called the mind, is more affected by blindness than deafness—or than its frequent accompaniment, dumbness? Guillé answers this by remarking that the deaf and dumb are strangers to all that passes around them because, although they see everything, yet they enjoy nothing. Like Tantalus, whom fiction represents as devoured by an inextinguishable thirst in the midst of water, they are continually subjected to cruel privations. "An insurmountable barrier separates them from the rest of mankind; they are solitary in the midst of us, unless we know that artificial language which the talent and charity of their ingenious teacher has created for them; and the habit which they have of reading the countenance is even very often a subject of anxiety to them. They do not always guess right; doubt and uncertainty increase their impatience and suspicions; a serious cast, like melancholy, then invades their countenance, and proves that with us they are in a real state of privation. Obliged to concentrate their thoughts in themselves, the activity of their imagination is thus greatly increased; and as attention and judgment necessarily follow the perception of ideas, they fatigue themselves prodigiously. Few deaf and dumb persons, therefore, are to be found in the lists of longevity, because the frictions are too likely, and to use a common, but exact expression, the sword wears the scabbard. The blind, more favoured than these children of silence, enjoy all the means of communication with other men. No obstacle hinders them from hearing or being heard, since the ear, which has been so philosophically defined the vestibule of the soul, is always open to them. The exchange is rapidly made, because they speak the vulgar language. Though condemned to live in profound darkness, their infirmity, in a manner, turns to their advantage, because being secure from the illusions of the sight, they are, not like us, assailed with fright; all the phantoms created by the exaltation of our imagination are unknown to them. They walk with equal security both by day and night; while we,
constantly exposed to form false judgments of the objects that present themselves to our eyes in the different situations in which they are placed, cannot deliver ourselves entirely from the internal fear which the darkness of the night makes almost every man feel, and on which is founded the apparition of spectres and frightful figures which so many people say they have seen.'

A more modern view of the relations of the blind to the seeing and to one another will be found in the interesting pages of Maurice de la Sizeranne's monograph, translated by Park Lewis with the title The Blind as Seen through Blind Eyes. A few extracts from this small book will throw some light upon the subject under discussion.

There is, as we know, a wide difference between hearing and listening, between seeing and observing. The deaf observe; the blind listen. The blind acquire in time a wonderful delicacy of perception and a remarkable ability to analyze sounds. They have an unusual aptitude for making subtle distinctions. The senses of touch and of smell become refined to a remarkable degree, and the impressions to which they give rise are analyzed and registered. These special senses—of hearing, touch, and smell—are more constantly and more carefully interrogated by the blind in placing themselves in relation to the external world than by those who see.

If a blind man were numbed with cold, and in an atmosphere from which every odor and sound were excluded, his condition would indeed be most helpless and pitiable; but when he finds himself in ordinary surroundings, the richness of life is manifested in its perfumes, various and significant, in its noises and in its tangible sensations. He enters with active interest into all that passes about him. Lacking sight, he still makes nice distinctions between the streets of the city and of the village, between the broad roads and open country. It is a mistake to think that for the blind all ways are alike. There are many that are well known to him, and without inquiring he not infrequently knows where he is. The dimensions of the sidewalk, the nature of the ground, the number and kind of vehicles which he encounters, all are recognized, and the streets which cross his way, the trees edging the gutters, and the different shops, become landmarks to him. Touch is not wholly in the hand, but over the entire body. Even within the shoe the foot distinguishes the kind of soil beneath it. Stop the ears of an attentive blind man, and he will still be able to tell you whether he walks on smooth or rough pavement, on wood or on stone, on a macadamized or on an asphalt road; whether he is crossing a covered drain, is on the beaten path, on ploughed land, in a meadow, or on a stubble field.
The sense of smell also brings to him impressions at once varied and characteristic. Fresh meats, pomade, damp tobacco, new leather, fish, hay, medicinal plants, the air blown over cooking truffles, paper newly printed, have odors which make known to him beyond the shadow of a doubt whether he is passing before a butcher shop or a hair dresser's, a tobacconist's or a shoemaker's, the great market or a cavalry barracks; whether the puff that comes through the air-holes is from the laboratory of a druggist or the office of a physician; whether he is opposite a newspaper stand or the flower-stall on the corner.

But in the blind, to the usually more sensitive perceptions of touch and of smell must always be added that of hearing doubly acute. The street is more or less filled with passing people, it is noisy or it is silent, it is crossed by a boulevard or an avenue, traversed by a line of street cars or omnibuses, while private carriages or public cabs roll rapidly along. These vehicles no more resemble one another to the ear than to the eye. The motion of the tramway is not that of the hackney coach, and the landau with its prancing horses gives a different impression to the ear from that of the family coach with its easy-going cobs.

Every sound has its meaning. It may be the bell of a convent or the clock of a hospital, a joiner or a stone-mason at work and all are noted, associated, and utilized.

This is in the city, the village, or town, but in the open country the blind have almost as many landmarks and guide-posts. Here is a little mound, a rut made by passing wheels, a rocky or a sandy foot path, there a space carpeted with grass or moss or pine needles. Now a resinous smell comes from the evergreens, the sweet breath of new mown hay floats over the meadows, or a sudden whiff is blown from a cluster of broom or wild honeysuckle. His ear catches the murmur of the brook through the trees and bushes. The lilacs do not say the same things as the oaks, nor is the rustle of their leaves quite the same in May as in October.

It goes without saying that a blind man loses many of the joys that sight alone can give; but those impressions that remain to him are so exact as to be almost painfully acute, intensified as they are by the fact that he has no distractions from sight. It is very easy to understand, then, that with all their resources the blind need not necessarily remain merely obstructions in the busy world, wearying and being wearied, unable to move from place to place without a thousand precautions and at the expense of great effort. Their lives may be full, rich and active, individual and personal.

The blind quickly learn to recognize the kind of people with whom
they come in contact. The laborer on his way to the woodyard smoking his strong black pipe has neither the fine shoes nor the light step of the department clerk with his fragrant cigar. The dainty lady, even though on foot, does not walk as the burdened market-woman, and the bustling huckster has a tread quite different from that of the pious priest on his way to church or to the sick-bed. An awkwardness of manner or an elegance of gait and carriage is manifested to the trained ear by a totality of sounds and suggestions more easy to understand and appreciate than to define; but it is certainly true that the blind recognize and admire ease and grace both of deportment and of gesture in those with whom they are brought in contact.

All this relates, however, only to the outside,—to the surface. The voice expresses the man himself and is the truest exponent of his inner life. So long as one remains perfectly silent and motionless before a blind man, it is impossible for him to know or to conjecture who it may be or what are his intentions. But it is impossible long to remain absolutely still; a movement, a cough, a sneeze, and another presence is betrayed to him, he may even know without further sign who is there. A word and the key of the whole situation is given to him. One may be recalled by the voice almost as readily as by the face, and the voice changes less. After a long separation one may have a doubt as to a friend's identity, but a word will dissipate it in an instant. It may be a certain pronunciation, a certain manner of articulating, of inflection, certain tones of the voice, that cannot be forgotten. And if these have penetrated the soul of the blind man at some supreme hour of his life, the memory, bitter or sweet, is engraved in his heart, for though he could not see the look with which the words were spoken, he heard and understood even the sigh; and at the other end of the world, after twenty years of absence, perhaps even of indifference, the whole vivid scene is recalled as the first tone greets his ear.

We are in the habit of controlling, more or less, our countenances, but not our voices, and this is to the advantage of the blind. We endeavor to alter our expression to suit the circumstance, but we forget to prepare the tones of our voices also, and this is by far the more difficult. It is not easy to sustain a discussion or even a simple conversation without betraying some emotion through the voice—anger, suffering, pleasure, or disdain. One false inflection declares the constraint, and a slight trembling, an accent a trifle ironic, makes us feel under what emotion the soul vibrates.

Regarding the parallel so often drawn between the blind and the deaf, or the deaf and dumb, de la Sizermanne remarks upon the apparent happiness of the blind and the sadness of the deaf and says
that our first impression of the deaf-mute is, as a rule, much more pleasing than is that of the blind. A visitor who for the first time enters a school of deaf-mutes and a school for the blind will find much less that is unusual in the former than in the latter. The deaf children are physically not unlike other children. You approach the deaf without apprehension, for there is no outward mark to indicate their infirmity. It is unusual that the defect of the blind is not at once evident. Almost always the lids are partially closed or the eyes enlarged or atrophied, and the impression produced is one of sadness or of pity. But this first impression is quickly dissipated, because the more intimately you know the blind the more quickly are you put at your ease, and you feel the barrier disappear that is separating you. If your blind acquaintance prove to be a man of intelligence you end by forgetting his blindness completely in the interest of your conversation. With the deaf-mute, on the other hand, the impressions are reversed. The longer you remain in his presence the more his deafness weighs on you. It is intolerable to converse with one who talks much; it cannot be much less painful if he does not talk at all, or is merely deaf and compels you to repeat every word before he can understand you at all. If the results are compared you will, implicitly at least, make brevet generals of gayety of the blind en masse.

The same writer points out what is so well-known to students of this subject, that one finds among the blind the same varied characteristics and qualities as among those who see, neither more nor less. "I trust," says he, "that those who, with me, grant without the slightest hesitancy that the blind are not by nature worth more than other men, will with equal readiness believe me when I affirm that they are not worth less."

**Blind, The, in fiction.** To every student of ophthalmology this subject should be of great importance, not only because it throws light on the psychology of blindness, but because it furnishes also an indication of the wide-spread interest that the best writers have shown in a singular relation of human life. Among those who have studied the subject and written upon it are Kipling, George Eliot, Charles Kingsley, Charles Dickens, Robert Louis Stevenson, Lord Lytton and last, but by no means least, William Shakespeare who made a careful study of blindness in its various and varying relations. Probably the best article upon the subject of the blind in fictional literature is by Janet C. Patterson, who in the *Outlook for the Blind* for October, 1912, has given a good account of the matter. We quote largely from this excellent article.
The aspect handled most frequently is that of a person becoming blind after having received a good education or after having acquired considerable success in a chosen calling. Eliot has shown such a character in the blind scholar, Bardo de’ Bardi, whose untiring perseverance taxed Romola’s unlimited patience. Kipling gives another such capable man in Dick, whose light failed, but not before he had put the final touch to his wonderful picture, ‘Melancholia.” Kingsley shows us a veritable Samson in Amyas Leigh, the fearless companion of Drake, who was blinded by a lightning flash after his stirring and dramatic action in the defeat of the Spanish Armada. Mrs. Browning pictures Romney Leigh, an active Socialist, who becomes blind after suffering much from the ingratitude of those for whom he had spent his life. His motives had been maligned, his ancestral home had been burned, and, as if to fill the cup of material adversity, blindness came. Charlotte Brontë gives us a glimpse of her hero, Rochester, when blind, subdued, and desperate, and compares him to a strong and fettered wild beast. Weir Mitchell’s blind character, Philetus, evidently lost his sight when about fifty years of age, and he had previously used it to good advantage.

Among authors of less note the same advantages of education or natural ability, or both, are given to the characters before the condition of blindness. Eugenia B. Frothingham has found in blindness a matrimonial problem. In her book, “The Turn of the Road,” the heroine decides to marry her blind lover. In Anna Farquhar’s book, “The Professor’s Daughter,” the heroine decides to humble pride and allow her admirer to burden himself with a blind wife. In “The Redemption of David Corson” Charles Frederick Goss pictures a roving quack doctor, like a buccaneer of the middle ages, but with some essential virtues, who is made blind in a fist fight and left as dead. After several years there is a view of this blind man in poverty, squalor, and solitude. He is a beggar with a tin cup and an affectionate dog.

In some of the books alluded to the horrors and agonies of approaching blindness are pictured most vividly. This can be well shown by the following cutting from “The Light that Failed,” by Kipling in which Dick is talking to Binkie, his pet dog.

“How could it have come without any warning? It’s as sudden as being shot. It’s the living death, Binkie. We’ve to be shut up in the dark in one year if we are careful, and we shan’t see anybody, shall never have anything we want, not though we live to be a hundred.’ Binkie wagged his tail joyously. ‘Binkie, we must think. Let’s see how it feels to be blind.’ Dick shut his eyes, and flaming
commas and Catherine wheels floated inside the lids. Yet when he
looked across the park the scope of his vision was not contracted.
He could see perfectly, until a procession of slow-wheeling fireworks
defiled across his eyeballs.

"Then came to his mind the memory of a quaint scene in the Soudan.
A soldier had been nearly hacked in two by a broad-bladed Arab
spear. For one instant the man felt no pain. Looking down he saw
that his lifeblood was going from him. The stupid bewilderment on
his face was so intensely comic that both Dick and Torpenhow, still
panting and unstrung from a fight for life, had roared with laughter,
in which the man seemed as if he would join, but as his lips parted
in a sheepish grin the agony of death came upon him, and he pitched
grunting at their feet. Dick laughed again, remembering the horror.
It seemed so exactly like his own case. 'But I have a little more time
allowed me,' he said. He paced up and down the room, quietly at
first, but afterwards with the hurried feet of fear. It was as though
a black shadow stood at his elbow and urged him to go forward; and
there were only weaving circles and floating pin dots before his eyes.

"'We must be calm, Binkie; we must be calm.' He talked aloud
for the sake of distraction. 'This isn't nice at all. What shall we
do? We must do something. Our time is short. I shouldn't have
believed that this morning; but now things are different. Binkie,
where was Moses when the light went out?

"'No more soldiers. I couldn't paint them. Sudden death comes
home too nearly, and this is battle and murder both for me.'"

The distress of the condition of blindness after a life of keen enjoy-
ment is also graphically portrayed by Kipling in the same book, as
the following excerpts show: "Dick had been sent to bed—blind
men are ever under the orders of those who can see—and since he
had returned from the park had fluently cursed Torpenhow because
he was alive, and all the world because it was alive and could see,
while he, Dick, was dead in the death of the blind.

"Nilghí entered with a gift—a piece of red modeling wax. He
fancied that Dick might find interest in using his hands. Dick poked
and patted the stuff for a few minutes, and 'Is it like anything in
the world?' he said, drearily. 'Take it away. I may get the touch
of the blind in fifty years.'"

"'I'll give you a piece of advice,' Dick answered, moving towards
the door. 'If you happen to be cut over the head in a scrimmage,
don't guard. Tell the man to go on cutting. You'll find it cheapest
in the end.'"

Kingsley also calls attention to such distress when depicting Amyas
Leigh in "Westward Ho!" This man, robust and virile, who had found heaven to be earth because here Spaniards could be killed, is at length pictured as "feeling for his companions' hands," and "shut up alone, with all the strength and valor and fame in the dark prison house of his mysterious doom." A suggestion is given by Kingsley of the call which blindness makes to the other senses, and of the annoyance which can be caused by little things.

"He walked along the gravel path up to the door as if he had seen it, and felt for the entrance. He is told that the doors are low. He puts out his hand and finds the books—'King Arthur,' 'Fox's Martyrs.' They lay side by side, just as they had lain twenty years before. The window was open, and a cool air brought in as of old the scents of the four-season roses and rosemary and autumn gilliflowers, and there was a dish of apples on the table. He knew it by the smell. The very same applies which he used to gather when a boy. He put out his hand and took them and felt them over. At last one fell through his fingers and fell to the floor. He stooped and felt for it but he could not find it. Vexatious! He turned hastily in another direction and struck his head sharply against the table. Was it the pain or the little disappointment, or was it the sense of his blindness brought home to him in that ludicrous, commonplace way, and for that reason the more humiliating? I know not, but so it was that he stamped the floor with pettishness, and then, checking himself, burst into a violent flood of tears."

There is a working out of this problem of blindness after sight in Weir Mitchell's book, "Far in the Forest." Philetus Richmond, a man of about sixty, who had lost his sight at fifty years of age, is an important character in this book. He is an expert woodsman, and "easily finds an important place among pioneers of North Pennsylvania, where physical strength and skill with the axe or rifle were valued, as they must needs be in such a life. These qualifications enabled the blind man to move at ease where mere untrained eyes had been failures."

In this book, "Far in the Forest," an interesting combination is made, in that Philetus Richmond, the blind man, is usually accompanied by Consider Kinsman, a man entirely deaf but quick to catch the meaning from the reading of face and lips. Here is a picture of them watching together the breaking up of a great jam of logs in the river.

"Philetus stood intensely realizing through his hearing alone the thing he could not see, and by his side Consider Kinsman, hearing nothing, was at intervals describing in his habitual way the chaotic
scene. 'Jerusher, but there's a log went nigh thirty feet out of the water. Busted, by George. Never seed nothin' like it.' And he pulled his friend's ear gently, as a conventional sign of desire to know what his own lost sense failed to give. Philetus understood and faced him, speaking with distinct articulation. 'It's like the damned broke loose, Con. It's like the devil's on a spree. Them trees has souls. . . . Hear 'em yell. Hear 'em howl.'"

It is a very different character which Dickens shows us in "The Cricket on the Hearth." Bertha Plumber is a good girl, and she has a most self-sacrificing father. His coat is threadbare, but he pictures it as new to the unseeing eyes. Their employer is hard and exacting, but is represented to Bertha as noble and indulgent. The house in which father and daughter live is one room, with the plastering off in places, but Bertha thinks it a beautiful dwelling. And so the child builds her world from her own supply of goodness and her father's bright interpretations.

In "The Scapegoat," by Hall Caine, a little girl, to whom the world is opening, is captivated by the reflection of her own face in the water, thus presenting an attractive and unusual feature in a story of the blind experiencing sight.

An ideal blind child is shown in the daughter of John Halifax. Muriel carries such an atmosphere of good with her that all are influenced by it, and the influence is decidedly felt among her little brothers and sisters. Muriel uses her hands skillfully and shows talent in music.

In "The Palms," the most interesting character is a graceful and capable blind girl. She does not know of her condition, and when others speak of the sparkling waters, the shining stars, and the beauty of the flowers, the blind child thinks that when well educated she too will be able to enjoy these beauties. She eventually receives her sight by a miracle performed by the pope and later becomes a martyr of the church. The condition of blindness is here treated poetically.

In all these books the blind girls are pictured as good and, for the most part, happy. The effect upon the general reader is touching. So good was Blind Agnes in the book so named that she was the one selected to prepare the napkins for the sacrament of the altar.

Among books treating of the blind from birth there is one different from all others, "Poor Miss Finch," written by Wilkie Collins. Evidently the author of this book had made a minute study of blindness. He presents some thoughts that are queer, but which command one's attention. The details of life are entered into a far greater extent than is usual in the artistic presentation of any subject. In this book
there is a unique and interesting chapter on "Learning to See." Here are some selections:

"I caught up puss, and shut my eyes and felt her soft fur, and opened my eyes again, and associated the feel of it forever afterwards with the sight of the cat.

"The moment my aunt questions me about distances she makes a toil of my pleasures. It is worse still when I am asked about the relative sizes of ships and boats. When I see nothing but a boat, I imagine it is larger than it is. When I see the boat in comparison with a ship, and then look back at the boat, I instantly go to the other extreme, and fancy it is smaller than it is. The setting this right vexes me almost as keenly as my stupidity vexed me some time since when I saw my first horse and cart from an upper window, and took it for a dog drawing a wheelbarrow. Let me add in my own defense that both horse and cart were pictured at least five times their proper size in my blind fancy—which makes my mistake, I think, not so very stupid after all."

The following cutting will be recognized as a remark of Lenotre, the famous blind merchant of France. This Wilkie Collins evidently found in his studies on the subject of blindness, and wove into the story. (See Education of the Blind, by M. Anagnos. Page 10.)

"She suddenly held out both her arms over the breakfast table. 'The stretching of these to an enormous length. I could find out better what is going on at a distance with my hands than you with your eyes and your telescopes. What doubts I might set at rest, for instance, about the planetary system, among the people who can see, if I could only stretch out far enough to touch the stars. I tell you I would much rather perfect the sense in me that I have already got than have a sense given me that I have not got.'"

The common notion is that the blind are particularly good and tractable. Dickens, in "Barnaby Rudge," and Stevenson, in "Kidnapped" and "Treasure Island," present far different pictures from this. Their knowledge of human nature led these authors to suppose that for some the loss of sight would shatter the harmony of mind and body. It is, perhaps, because the readers expect the characters to be weaker or less capable than their sighted fellows that makes Stagg of "Barnaby Rudge" and Blind Pew of "Treasure Island" seem so abhorrent and shocking. These characters would be despicable under any circumstance, but being blind they are horrible. David Balfour in "Kidnapped" remarks that his blind guide was one of the two worst men he had met in the highlands of Scotland.

In "Treasure Island" a blind man is able to command what might
be called a lawless band of pirates, and the book is more thrilling for this unique character of Blind Pew. The qualities of deceit and intrigue are what show most deplorably in the blind character which Dickens has depicted in his book, "Barnaby Rudge."

The most artistic way in which the subject of blindness has been handled in fiction is the mystic aspect, for it holds the reader in a poetic mood. The attention is drawn from the affliction and centered on the literary and spiritual values. Kipling has so treated blindness in his recent short story, "They," an excellent review of which has been written by Hamilton W. Mabie, and is as follows:

"There are many delicate and significant touches of imagination in 'They' which have their part in the unfolding of Mr. Kipling's idea and which disclose the quality of his art. The story describes the experience of a father who has lost a child, who, on a trip in an automobile in a familiar part of England, finds himself in an unfamiliar wood which, with the ancient house and garden, lies, evidently, in the country of the imagination, like the island in 'The Tempest' and the Forest of Arden. The mistress of this house is a beautiful blind woman who is childless, but has a passionate love for children, and the house is peopled with the spirits of children who have died and are drawn by the great love of the blind woman. The wood, the house, and the gardens are invisible save to the spiritually-minded and to those who have lost children. The father feels their presence in the house without seeing them, but when the kiss of his dead child falls on his hand he understands. The realism of the automobile, the coarse-minded farmer, the scene in the village where a child falls suddenly ill, bring out vividly the delicate feeling and beautiful quality of a story which recalls 'The Brushwood Boy.'"

Among books translated there are two which are particularly pleasing. One is a Danish drama by Henrick Hertz, translated by Theodore Martin. The heroine, a princess blind from birth, has been brought up in a villa among the mountains. The grounds are inclosed by a hedge, and in this little world everything is familiar. Iolanthe is kept ignorant of her condition, hence the action of the romance during which she receives her sight shows skillful management. The atmosphere of the story is serene throughout.

"'The Blind,' by Maurice Maeterlinck, the young poet-dramatist, is a play of symbolism, an eerie kind of allegory. On an island in a mystic norland wood, under the night stars, sit a company of blind folk, men and women, under the guidance of an old priest returned from the dead. They grope about in a maze and query as to location and destiny—a strange, striking effect being produced by the grue-
some setting of the scene and the implication of the words, from which the reader gathers that it is a symbolic picture of life in which mankind wanders without faith or sight in a forest of ignorance and unfaith."

Pursuing the line of reading marked out by the bibliography, it is apparent that the blind form an element in subject matter from which authors draw generously. Blindness allows of more artistic treatment than other afflictions, and is the misfortune most frequently selected for portrayal. All sorts and conditions of characters in different spheres of life are used. They are treated in a sentimental way to a great extent, and idiosyncrasies are touched upon. However, a condition of partial sight does not hold a position in dealing with the subject. There are very few heroes who begin and end their careers in blindness—seldom are they carried as prominent characters through a book of much length. Such a hero or a heroine can be found, however, and this is the highest effort of a sighted author dealing with blindness.

Out of the multitude of characters in fiction we have considered those who approach the condition of blindness with dread, those who have endured blindness after a successful career during which they had sight, those who have been born blind and who have lived in darkness to the end. We have seen that the qualities of goodness and viciousness are magnified to the reader by this application of blindness, and have noted that a pleasing and artistic way of handling this condition has been through the shadowy grasp of mysticism.

There are strong and lovable blind characters in fiction, but in justice to the living blind it can be said that in story there are no such practical lives as history itself furnishes, no one who could compare with Huber, Prescott, Fawcett, or Dr. Babeock. The blind present more surprising qualities in life than in fiction.

See, also, Psychology of vision, The; Blind, Sixth sense of the; Blindness, Preparation for the oncoming of.

Blinken. (G.) Nystagmus.
Blinkern. (G.) Nictitation.
Blinking, Reflex. The "reaction-time" is the period that elapses after light or other stimulus has occurred until a movement is made. The time of the reflex act of winking is, according to Exner, about 0.06 second.
Blinzeln. (G.) Nictitation or winking.
Blinzhaut. (G.), n. Membrana nictitans of birds.
**Blisters. Vesicants.** These topical applications are no longer used to any extent in ophthalmic operations, yet they are sometimes of considerable importance.

Vesication is the result of greater irritation than that which merely causes superficial redness of the skin. The serous exudate from the blood vessels due to blistering is not re-absorbed, but remains beneath the epidermis. Agents which produce this condition are termed epispastics, vesicants or "blisters." If the vesicle is ruptured soon after it has formed, and its epidermal layer removed, a tender surface is exposed. This unprotected area is liable to infection, hence it is better to puncture the blister with a sterile needle inserted at the most dependent part; the fluid then escapes while the loose epidermis protects the denuded area until a new layer of epidermal cells is formed.

Blisters are useful as counter-irritants and local depletants and as such have a place in ocular therapeutics.

When it is necessary to apply a blister to the ocular neighborhood this remedy is best employed in the form of cantharidal collodion, although the "paper" cerate or plaster may be used. Any of these takes about 5 hours to produce vesication. After the application has remained *in situ* sufficiently long to blister, the vesication may be much increased by following it with a poultice. The serum should be removed from the pendant bleb by prickling it, after which a soothing cerate should be applied.

Cantharidal collodion is preferable; it is more certain, more cleanly, more easily controlled and localized and probably less painful than the other form of the "fly" blister. A non-official, rubber-base plaster containing cantharides has several advantages over that made from the cerate. After preparing the skin surface the plaster is smeared with a thin film of oil and applied. When it has blistered the part as much as required it is removed.

*Anodyne vesicant* is a good substitute for cantharidal collodion and is made as follows: Camphor 20 parts, chloral hydrate 30 parts; place in a bottle, liquefy in a water bath and add cantharides 10 parts. Digest at 140° to 160° F. for one hour; strain under pressure.

*Charta epispastica* is paper spread with spermaceti, cantharides powder and other ingredients. This is cut into the shape and size needed and applied for blistering purposes.

*Papers, Chartae.* Our only official charta or powder is used for the application of mustard and when dipped into warm (not hot) water and applied to the skin, these applications act as a rubefacient. In prescriptions, "papers" are ordered by the square inch, thus:
Chartae sinapis ......................... 2 x3 inches
Dip into warm water and apply to the temple.

Chartae epispasticae vel cantharidis........ 2 x 3 inches
To be applied above the right eyebrow until it blisters.

Blitzschlag. (G.) Lightning stroke.
Blitzstoff. (G.), n. Electricity.
Blitzstoffmesser. (G.) An electrometer.

Blizzard, Sir William. A celebrated London surgeon, of some renown in ophthalmology. Born in 1743 at Barnes Elms, Surrey, he studied surgery at London under Pott and Hunter. He was soon appointed surgeon at Magdalen Hospital; later, at the London Hospital.

He wrote a number of books and articles of a general character, but only one single article that falls within our special notice. This was entitled "A New Method of Treating the Fistula Lachrymalis" (Philosop. Transact., vol. 70, 1780). His new method consisted of inserting into the lachrymal punctum the point of a fine tube, or funnel, and then of pouring via this, and on through the lachrymal passages into the nose, a quantity of quicksilver. He declared that the injection of water, as practiced by Anel, was far inferior to his own procedure, because of the fact that the quicksilver, by reason of its weight and soft, slippery character, effected a much greater degree of dilatation with a far less degree of injury. The method seems never to have been generally adopted.—(T. H. S.)

Bloch, Law of. In physiological optics, of the durations of illumination varying from 0.00173" to 0.058" the illumination needed to produce the minimum perception is in inverse proportion to the length of time in which they operate.

Bloch, Marcus Eliezer. Born at Ansbach, Germany, in 1723, he studied medicine at first with a Jewish physician in Hamburg, then at the University of Berlin, finally receiving his professional degree at Frankfort-on-the-Oder. He settled in Berlin, where he became well known both as naturalist and physician. His works on ichthyology are declared by competent authorities to be most excellent.

Bloch's only important writing, from an ophthalmologic viewpoint, is the general work entitled Medicinische Bemerkungen. Nebst einer Abhandlung von Pyrmonter Augenbrunnen (Berlin, 1774). In this book occur three passages of ophthalmologic value; those, namely, on "oblong pupils," on "leeches," and on the "Pyrmont eyesprings."

1. Oblong pupils. Under this head, Bloch reports the case of a
Berlin mechanic short of sight but sharp of sight, who had oblong pupils in the form of cones, each with both ends rounded, and each with its base directed upward. There was no pupillary light-response in these eyes, nor any pigment in the posterior layer of the iris. One son had similar pupils, with, however, in each, tiny white flecks. A daughter had an oblong pupil in one eye. Still another child had quite round pupils, but, in each, were the tiny white spots. Six other children had absolutely normal eyes. Certain other relatives (a brother, a nephew, and so on) presented various pupillary abnormalities.

Bloch gives excellent illustrations of most of these eyes.

He was not, however, the first to describe a case of coloboma of the iris, or to provide an illustration of that deformity. The history of the matter, in brief, is as follows:

a.—Galen and others among the ancients described congenital clefts of the lips, nose, and ears; not, however, of the eyes. They called the deformities colobomata, i.e., mutilations; for, of course, it was wholly unknown to the ancients that these defects were simply failures of development. They understood such things to have been occasioned always by some accident in utero.

b.—The Arabs added nothing whatever to this very important subject.

c.—The first description of coloboma of the lids was provided by Guillemeau in 1585. He says: “The coloboma of the lids is a congenital abnormality like hairlip, and can be remedied by freshening and sewing.”

d.—Congenital coloboma of the iris was first described by Bartholomus in 1673, in “Acta Med. et Philos. Hafniensia.”

e.—The first illustration of congenital coloboma of the iris was given by Albinus in “Annot. Acad. lib. vi, Tab. II, fig. 5, (Lugd. Batav., 1764).

f.—Next came Bloch, the subject of this sketch, with more exact descriptions and better illustrations.

g.—Priority in the assignment of the trouble in question to arrested development as the cause thereof, belongs to Ph. von Walther, who, also, for the first time, made use of the expression, coloboma iridis.

h.—Gescheidt proposed the name, “irido-schisma,” and Helling that of “comet pupils,” but neither of these expressions ever met with general acceptance.

i.—To the great von Ammon it remained to develop the subject still further. In 1830 (21 years before the invention of the ophthalmoscope) he discovered and described both coloboma of the choroid and
coloboma of the retina, and, in addition, pointed out the etiological relations of these malformations to coloboma of the iris.

2. Leeches. For the very first time in history, Bloch combatted the employment of the leech as a remedy in diseases of the eye. Here are his words on this subject: "Leeches have no power to bring out stagnant blood from the interior of the eyes. For the blood is led into the inner parts of the eye by an artery, which, in the interior of the brain, arises from the carotis interna; and the veins of the eye debouch into the sinus of the brain. As, now, the leeches can in no wise approach these vessels, they are wholly unable to diminish ocular inflammation, saving in so far as they diminish somewhat the quantity of the blood in general; and, in this respect, an open vein can provide us with a far quicker and more certain aid."

3. The Pyrmont springs. This passage possesses an especial antiquarian interest. "When, in 1755, it was wished to give another direction to the discharge from the old bathing-well and to close the old channel, an abundant spring was found therein, which was barrelled up. It is 60 feet from the drinking-well, the water gushes freely with a noise of air-bubbles [carbonic acid gas] and deposits, like the drinking-well, a reddish earth on the enclosure. As the drinking-well is not always open, and, further, is generally beset with the conflux of drinkers, patients afflicted with eye-diseases have turned to the new well. For weeping, inflamed and weak eyes, the spring is used in the following way: a person takes up the water in a large pitcher with a narrow neck, and brings it quickly to the eye, in order that the diseased part may be wetted with the still bubbling water."

Bloch died Aug. 6, 1799.—(T. H. S.)

Block spacing. In alphabets and print for the blind (q. v.), this is a term used to describe the plan of allotting a fixed amount of space to each character (including the following letter-space) without regard to the relative size of characters, as in the common Braille tablet work.

Blödsichtig. (G.) Weak-sighted.

Blood. An extremely popular remedy for eye-diseases in antiquity, not only among the laity but also among the learned. The blood of various animals, as well as of human beings, was employed—the cat, dog, horse, sheep, duck, goat (very popular), bat (extremely popular), and swallow (most popular of all). The blood of the duck was used especially in ocular injuries. The blood of the goat was employed for nyktalopia (what we of today call "hemeralopia"). Bat's blood was supposed to prevent the return of lashes after epilation. The blood of the swallow was used for well-nigh every ocular affection. The eye of the swallow was, in fact, supposed to be rendered stronger,
instead of weaker, by any injury thereto not extending to complete
destruction of the organ—an error which, by the way, was so strongly
intrenched in the minds of all, high and low, that it lived till the mid-
dle of the eighteenth century, A. D.—(T. H. S.)

**Blood, Diseases of the, in ophthalmology.** The blood examination in
all departments of medicine is as yet in the developmental stage and
the literature of blood findings in diseases of the eye is very scanty.
What is known, however, is of great help in the diagnosis and prog-
nosis of many eye diseases. The most recent and best paper on the sub-
ject is that of Rasquin in the *Annales d’oculistique* and it is from his
work that this section is freely quoted. Only the generally accepted
facts are given and all conflicting views are eliminated.

In all severe anemias, both primary and secondary, and in the
leukemias there are eye findings and in some of them the picture is
characteristic. These, however, are not difficult of diagnosis for they
are easily confirmed by the blood picture. Many authors attribute
to anemia variable ocular lesions, such as blepharitis and conjunc-
tivitis as well as optic nerve alterations. In the cachexias, with
intense anemia, retinal hemorrhage and serous iritis may be found,
also other disturbances leading to blindness. In the leukemias, besides
the characteristic retinal changes, the presence of retrobulbar leukemic
tumors should be emphasized. It is in the inflammatory changes of
the eye, both acute and chronic, that a careful blood study, especially
of the leukocytic changes, is of great help.

Acute microbial infections of the eye are generally accompanied by
a leukocytosis, the increase due mainly to polymuclear neutrophiles
along with a simultaneous decrease of the eosinophile cells. This
varies with the extent and intensity of the inflammatory process and
has a practical application. When such a condition of the blood is
found a few days after a perforating wound of the eye there is reason
to suspect a developing panophthalmitis. The same condition serves
for the diagnosis of an abscess of the brain in a case of choked disc.
The involution of the disease is characterized by a reversal of these
conditions.

Parasitic diseases of the eye may cause an eosinophilia. This is
found in filariasis, trypanosomiasis, sporotrichosis and in the detach-
ment of the retina due to cysticerbus.

In syphilis of the eye the blood picture is variable and usually there
is an anemia and a lymphocytosis. The picture is improved and
masked by mercury. In tabes dorsalis there is usually a marked
reduction in the hemoglobin and this with a lymphocytosis helps in
the differential diagnosis of optic atrophy due to other causes. In
tuberculosis there is no characteristic blood picture. Some anemia is usually present and frequently there is an increase of the mononuclear leukocytes, both large and small.

In an albuminuric retinitis following scarlet fever an eosinophilia is often found. This does not occur in other forms and helps in the differential diagnosis.

Likewise, in simple glaucoma, a slight eosinophilia may be found. In retinitis pigmentosa there is usually an intense anemia and a marked leukocytosis. In diabetic cataract a neutrophilic leukocytosis is usually found and this is not present in other forms. In polycythemia, Parker and Slodum report an edema of the retina with dilated tortuous vessels, especially the veins.

In sympathetic ophthalmia or impending sympathetic disease following perforating injury to an eye Ormonde and Gradle independently found a relative increase in the mononuclear cells at the cost of the polynuclear elements, particularly the polynuclear neutrophiles. The increase in the mononuclears is mainly among the lymphocytes. In some cases this ran as high as 67 per cent, with a corresponding decrease of the polynuclears. The total leukocyte count remained normal. This has been confirmed by a number of workers, especially Purtscher and Kolker who ascribe diagnostic importance to it and emphasize its help in recognizing impending sympathetic ophthalmia before any clinical signs are present.

The presence of bacteria in the blood in eye cases has been demonstrated and the finding of the agent of the disease has often helped in the diagnosis. The per cent. of cases in which the blood culture is positive has increased markedly in recent years owing to improved technic. This is also true of the parasitic eye diseases, such as malaria, cysticer cus, filariasis and trypanosomiasis.

A study of the opsonic index in diseases of the eye has not been of much help in a diagnostic way and only of moderate help in therapy. Serologic studies are of value, especially to determine the presence of agglutinins. This is not only so in diseases of bacterial origin, but at present has been determined also in parasitic disease. The Wassermann reaction is of great help and has been found in over half of the cases of known syphilitic origin. When the reaction is negative it does not exclude the presence of syphilis for over 40 per cent. give a negative reaction.—(M. M. Portis, Chicago.)

**Blood in the anterior chamber.** HypHEMA. This condition is not infrequently seen after ocular traumatisms, operative and other. It is also occasionally found in severe iridocyclitis, in intraocular neoplasms, splenic leucocytemia, in hemophilia, and in hemorrhagic
BLOOD-LETTING, GENERAL

glaucoma. As hyphema is but a symptom, its treatment is naturally bound up with the cause of the hemorrhage.

Blood-letting, General. Venesection. Although this method of treating diseases of the eye is now almost discarded, owing to a revulsion of feeling and reversal of public and professional opinion, yet to my mind, there is still a place for it, especially in cases of acute iritis, acute inflammatory glaucoma, scleritis, threatened panophthalmitis occurring in robust, full-blooded individuals that were benefited by "letting blood" in the good, old way. Webster Fox has voiced this sentiment quite recently and the ophthalmologist would do well to bear it in mind.

From four to ten ounces of blood may be drawn from the upper arm and the venesection may be repeated if necessary.

It has been said that the American is not a fit subject for phlebotomy and it is quite true that the systemic and local effects of this form of depletion may usually be reached by purgation, counterirritants and such local lymphagogues as dionin, but there still remains a class of plethoric individuals in whom acute outbursts of inflammatory eye disease urgently call for more potent remedies.

Excepting in cases of extreme anemia, hemophilia, senile cachexia, Kyrieleis recommends venesection in relapsing ocular hemorrhages, and, if not successful, as a last refuge, ligature of the common carotid. However, he believes venesection has advantages over ligature: under aseptic precautions it is a perfectly harmless procedure and it may be repeated without damage as often as required.

Blood-letting, Local. Wet cupping. Leeching. Local bleeding. For many centuries observers have agreed that the local abstraction of blood is a valuable agent for the reduction of most acute, deep seated inflammations of the eye, such as iritis, iridocyclitis, glaucoma, choroiditis, etc. The pressure exerted upon the sensitive nerve-endings by the dilated blood vessels (and increased quantity of blood in the congested tissues) is thereby removed and the severe pain which usually accompanies these abnormal conditions is often promptly relieved. Although there are several methods in use for the abstraction of blood in this neighborhood, such as scarification of the conjunctiva, opening an artery in the temple or the application of the leech, the last named is the most popular. One may use either the living animal or its substitute, the artificial leech. The latter is preferable, as it is not only more certain in its action and more agreeable to the patient, but the amount of blood abstracted can be easily regulated.

The artificial leech consists of a glass cylinder in which works a
Blood-pressure. As might be expected, and as experiment has shown, the relation between the intra-ocular pressure curve and that of the systemic blood pressure is very close. A number of observers have discussed the relation of the blood pressure to glaucoma, and D. W. Greene has established the relationship between increased blood pressure and the formation of cataract and even believes that increased arterial tension exerts some influence in the production of lenticular opacities.

Parsons (Pathology of the Eye, p. 1060) also thinks that the relationship between local and general blood pressure is extremely intimate. This, he thinks, is a "passive response, due, as in other parts of the body, of which innumerable examples might be given, to the overwhelming effect of the rise or fall of blood-pressure produced by widespread vaso-constriction or dilatation in other areas; particularly in the great vascular reservoir, the splanchnic area; vaso-constriction in the splanchnic area, for example, leads to so large a rise of blood-pressure that any attempt at vaso-constriction in the ocular area is overcome, the arterioles are burst open, and passive dilatation with consequent increased transudation of lymph and rise of intra-ocular pressure occurs. The delicacy of the response has already been shown in the representation of the cardiac and respiratory oscillations in the manometer or air-bubble. The passive effect of larger changes is clearly shown by the reproduction of the general curve of the blood-pressure. The intra-ocular curve is slightly delayed and flatter, owing to the inertia of the eye, which acts like a natural plethysmograph. The general blood-pressure may be varied by many means: (1) mechanical; (2) stimulation, etc., of nerves or parts of the central nervous system; (3) asphyxia; (4) drugs; (5) bleeding or injection of fluids; (6) death. The local blood pressure may be conceivably under the control of the nervous system as in other areas of the body—i. e., there may be vaso-constrictor and vaso-dilator nerves; it may be fur-
ther influenced by blockage, pathological or experimental, of the venous outflow.''

**Bloodroot.** *Sanguinaria canadensis.* When taken in toxic doses this plant produces palpitation of the heart, vertigo and cloudy vision. Probably *chelerythrin* is the active agent of the poisoning.

**Blood-staining.** The sclero-corneal junction may show distinct staining by blood after a conjunctival hemorrhage in that vicinity. Blood pigment may be deposited in the cornea after bleeding into the anterior chamber, although this is rare. Strange to say, the latter condition may be mistaken for a lens dislocated in the anterior chamber, and, as in the recorded cases there was increased tension, the difficulty of diagnosis was correspondingly increased. Sometimes the entire cornea is stained and it may be a month or more before the opacity disappears. In any event it generally clears from the periphery towards the center. In a case recorded by Treacher Collins the clearing occupied twenty-five days. A year subsequently a grayish patch 4 mm. in diameter persisted in the center of the cornea, and it was more than two years before the cornea was clear. That absorption should take place first at the periphery and then proceed to the center seems quite natural, as the former locality is the site of the absorbing blood vessels and most active lymph channels. The pigment is a modification of haemoglobin, the chief constituent of which is haemotoxidin or hemosiderin. Occasionally there is actual bleeding into the substance of the cornea from new vessels, in which case the haemoglobin filters through Descemet's membrane. The color of this staining varies according to the age of the pigment.

**Bloodstone.** *Hæmatite.* This substance was greatly esteemed by the Greeks, the Romans, and the Arabsians as a sovereign remedy for injuries to the eye, as well as for trachoma, hyphema, and *oculus procidens* (panophthalmitis.)—(T. H. S.)

**Blood-sucker.** The Leech. According to the popular author Pliny (*Nat. Hist.* xxxii, 24, 18), as well as a prescription of the great ophthalmologist, Meges, leeches, roasted in a new pot and then mixed with vinegar, would, if rubbed into the lids, prevent the return of eye-lashes after epilation.

Leeches were also used in ancient times, as now, for the abstraction of blood, in various diseases of the eye.—(T. H. S.)

**Blood-vessels of the eye.** Although this extremely important subject has been to some extent discussed elsewhere (see *Anatomy of the eye*) yet its histological relations may be considered under this heading. Salzmann and Brown (*Anatomy and Histology of the Human Eye-ball*, p. 180) furnish a most accurate and readable description of the
arteries of the globe which are practically all branches of the ophthalmic artery. "These course in part directly to the posterior parts of the eyeball and optic nerve, in part to the anterior segment by means of a roundabout way along the eye muscles. The veins empty their blood into the orbital veins, and by means of this partly direct into the sinus cavernosus, although anastomoses of the orbital veins with those of the face also occur. But in the eyeball itself, there can be differentiated two vessel districts, according to Leber, whose classical presentation I follow in the main—the retinal or inner, and the ciliary or outer vessel system.

The retinal system. In the adult eye this is represented by the arteria and vena centralis retinae. Its territory is, especially, the retina, a minor portion of the optic nerve and its sheaths. The arteria centralis retinae enters the optic nerve 7 to 12 mm. behind and below the bulb. It first supplies the neighboring portions of the sheaths, then its immediate neighborhood in the optic nerve, in the axis of which it courses farther on to the bulb. Its part in the supply of the optic nerve is, therefore, a minor one; only at the lamina cribrosa does it give off a larger number of fine branches. Here and in the intrachorioidal section of the optic nerve the last capillary anastomoses between the retinal and ciliary vessel systems are found, but from the inner end of the optic nerve canal on, the retinal is completely separated from the ciliary system, as a rule. This portion of the arteria centralis retinae is an end artery in the sense of Cohnheim, and, furthermore, all of the blood carried by the arteria centralis retinae is carried away by the vena centralis retinae. The arteria centralis retinae divides into an upper and lower main branch (arteriae papillaris superior et inferiores) on the inner surface of the papilla and these, again, into a nasal and temporal branch (arteriae nasales super. et inf., arteriae temporales super. et inf.) Yet even in respect to the branches of the second order there rules a significantly lessened regularity. Under further gable-like divisions the arteries broaden out into the retina mostly in a radial direction; the temporal branches alone course in wide bows above and below the fovea and, converging, send fine branches to the fovea. Finally, as a rule, a few fine branches go directly over the temporal border of the papilla to the fovea. The last extensions in the neighborhood of the ora serrata bow about in loops into the veins. These communications are, indeed, somewhat larger than the capillaries, but they only go back into the same vessel system, and cannot, therefore, functionate as collateral paths. The distribution of the veins fully corresponds for the most part to that of the arteries; the vena centralis
retinae accompanies the artery of the same name and, along with it, is united to the central connective-tissue strand by an extension of the pial sheath; it usually empties directly into the sinus cavernosus.

The ciliary system. This supplies the rest of the coats of the eyeball, the neighboring portions of the optic nerve and its sheaths, as well as the conjunctiva. The arterial radical of this system divides into the posterior and anterior ciliary arteries; the venous radical is made up of the vortex veins and the anterior ciliary veins. Arteries and veins do not correspond to each other in this system, either their course or yet in circulatory areas, so that the arteries come out more strongly in one place, the veins in another place, especially in the uveal tract. The number of the posterior ciliary arteries (art. ciliares posteriores) amounts to about twenty. They surround the optic nerve and enter the eyeball in its neighborhood and in the region of its posterior pole. At first they are distributed to the episcleral vessel net (as far as the insertions of the recti muscles), then they pass into the sclera (emissaria). Most of them pass directly out of the sclera into the chorioidea, and become known as the short posterior ciliary arteries (art. cil. post. breves). The course of these vessels shows great variation; some press into the dural sheath directly at the root and turn toward the optic nerve, others enter at a greater distance; sometimes, too, a short posterior ciliary artery branches off from a long one or, united with it, enters an emissarium. The short posterior ciliary arteries supply the back half of the uveal tract and the optic nerve; those entering in the neighborhood of the dural sheath form a circle of anastomoses about the optic nerve by means of a few branches—the circulus arteriosus nervi optici. The neighboring portions of the pial sheath, especially the very rich vessel net of the lamina cribrosa, are supplied by this. Elschnig has called attention to a special variation in the territory of the posterior ciliary arteries. A relatively large artery enters the dural sheath behind the bulb some 3 mm. from the end of the intervaginal space and, splitting the dural sheath into two leaves, courses in this to the sclera, then goes along the insertion of the dural sheath over into a circular course, and extends about halfway around the circumference of the optic nerve, dividing up into finer branches. According to Elschnig, the circulus arteriosus nervi optici is absent in such eyes; according to my observations, however, it is not always, but the branches of the abnormal artery enter the circulus or go directly into the chorioidea. At times, too, there is a larger recurrent branch for the pial sheath and the medullary section of the optic nerve. This variation occurs in about half the eyes; it
very easily escapes observation, however, because the vessel does not lie in the horizontal meridian of the papilla. As already noted, only a capillary connection exists between the retinal and ciliary systems, and this does not reach beyond the level of the choriocapillaris. This rule, however, is subject to many exceptions. Anastomoses of larger caliber, visible ophthalmoscopically, are rare and occur most frequently between the veins. A very large, band-like, flattened vein sometimes branches off from the central vein or one of its main branches, courses across through the tissue of the papilla, and disappears beneath the margin of the papilla (optico-ciliary vein, Elschnig.) Oeller depicts an analogous artery. The anatomic proof of such an anastomosis was first brought by Kuhnt; however, the vessel observed by him could not have been visible ophthalmoscopically on account of its position behind the lamina cribrosa. Elschnig then demonstrated a typical optico-ciliary vein in an eye affected with a neuritic optic-nerve atrophy. It went off from the central vein immediately in front of the lamina cribrosa and emptied into the vessel system of the chorioidea. In choked disk and other similar conditions such venous unions have been shown to exist heretofore, yet it is questionable whether these were not pathologic distensions of originally capillary unions.

Much more frequently it happens that a smaller or larger territory of the retina is not supplied by the central artery but by branches of the ciliary vessel system, or that it does not empty its blood into the central vein. Such abnormal vessels are called cilio-retinal. According to Elschnig, the cilio-retinal arteries are throughout derivatives of the circulus arteriosus nervi optici, which either go directly from this through the sclera and the border tissue in an oblique direction into the non-medullated section of the optic nerve, or take the roundabout course through the chorioidea and, therefore, appear as branches of the chorioidal arteries. In both cases they attain the intrachorioidal section of the optic nerve and bend about the border of the chorioidal foramen into the retina, where they are distributed like typical retinal vessels. This bending is visible ophthalmoscopically as a hooked curve, the characteristic index of the cilio-retinal vessel.

Cilio-retinal (or, as Elschnig calls them, retino-ciliary) veins have been anatomically demonstrated in only a single instance (Kuhnt); in this case the vein entered the sclera.

In the older ophthalmoscopic observations, especially those of Nettleship, there is much discussion about cilio-retinal veins. It has, however, been emphasized by Elschnig that cilio-retinal veins are very much more rare than cilio-retinal arteries and, independent of
Elschnig, I have come to the same conclusion. The well-known established retino-ciliary veins are often associated with other similar anomalies, e.g., with optico-ciliary vessels (Elschnig) or with abnormal vortex veins (Czermak). The cilio-retinal vessels are relatively frequent; Lang and Barrett found them in 16.7 per cent. of eyes, I, in 16.4 per cent. Elschnig estimates their frequency at only 7 per cent. but possibly has in mind only the larger vessels. Most frequent are the small macular vessels (11 per cent.); these appear at the temporal border of the papilla, and go directly to the fovea. Vessels of a caliber such that the direction of their current can be determined with certainty ophthalmoscopically, are found in some 6 per cent. and are almost exclusively arteries. They often represent those branches of the second or third order which circle about the fovea in a bow. Still larger arteries are rare; they may have the dignity of an arteria papillaris and then their place of origin is displaced just as much farther above or below as the vessel is large. Upon one occasion, I observed the complete absence of the central artery and the substitution of two cilio-retinal arteries for this vessel, as has also Bloch. The great majority of the cilio-retinal arteries occur in the temporal half of the circumference of the optic nerve and supply part of the temporal half of the retina. Nasal cilio-retinal arteries are very rare and often associated with anomalies of the papilla.

The long posterior ciliary arteries (art. cil. poster. longæ) are characterized by larger caliber and course in the horizontal meridian; there are, therefore, only two such arteries, one on the nasal, one on the temporal side. The long posterior ciliary arteries pass through their emissaria and the perichoroidal space without giving off branches, press into the ciliary muscle at its posterior border, and divide therein. These branches reach to the anterior surface of the ciliary body and there bend about along the root of the iris, but go over into the circular direction above and below, always coursing in the ciliary body. By union of these branches, as well as through anastomoses which bridge across the divisions, an arterial circle is constructed—the circulus iridis major.

The anterior ciliary arteries (art. ciliares anteriores) come from the straight eye muscles, and accompany each tendon in pairs; the m. rectus lateralis is usually accompanied by only one artery. The little trunks pass over the insertion of the tendon in the episcleral tissue with great tortuosity to within a distance of 3 or 4 mm. of the cornea; then they divide into superficial and one large perforating branch. The former supply the episcleral vessel net, the border loop net of the cornea, and the bordering zone of the scleral conjunctiva.
The perforating branches pass through the sclera steeply, often at almost a right angle (emissaria), and then at once enter the ciliary muscle. In anastomoses there, partly with the long posterior ciliary arteries or its branches, partly with the *circulus iridis major*. The system formed by the long posterior and the perforating branches of the anterior ciliary arteries supplies the anterior half of the uveal tract, the ciliary muscle first, then the *orbiculus ciliaris*, and the anterior portions of the chorioidea by means of backward-coursing branches (*art. recurrentes*), while the ciliary processes and the iris are supplied by the *circulus iridis major*.

The *vortex veins* (*vena vorticosæ*) are the most important of the veins of the ciliary system. They carry away almost all the blood from the uveal tract—the blood of the chorioidea, of the ciliary processes, and of the iris—and, moreover, for the greater part, that of the ciliary muscle. The blood takes another course only in the anterior parts of the ciliary muscle, i. e., through small veins, the *anterior ciliary veins* (*venae ciliæres anteriores*), which go from the ciliary body over into the sclera just behind the scleral roll, take up there the drainage of the Schlemm’s canal, and finally attain the episcleral tissue in the neighborhood of the border of the cornea. Here they drain the marginal loop net and the neighboring conjunctival zone, and with these and the episcleral vein form a richly divided net, which, like the vortex veins, empties into the orbital veins. The posterior portions of the episcleral tissue have their own small veins in the neighborhood of the optic nerve. The neighborhood of the optic nerve is very poor in veins as a result of this, and larger veins do not, in general, normally occur here. The posterior ciliary arteries, which course in the dural sheath, are only occasionally accompanied by large veins (Elschnig).

*Abnormal vortices* have occasionally been observed in myopic eyes at the border of the chorioidal foramen, more rarely in eyes of normal form. Whether or not they are actually more frequent or can only be more easily seen with the ophthalmoscope in such eyes (on account of the atrophy of the pigment epithelium), remains still to be decided. Most of the cases have been observed ophthalmoscopically only. Axenfeld and Yamaschita alone have made a short report of such an anatomic finding.”—(Permission of E. V. L. Brown.)

**Bloody tears.** These are slight bleedings from exuberant granulations on the conjunctival surface, generally caused by foreign bodies imbedded in the substance of the conjunctival cul-de-sac. The blood, mixing with actual tears, has given rise to this mysterious phenomenon. Sometimes the sanious discharge is quite copious and one case of death has been reported as resulting from chronic hemorrhage.
Blue, Berlin. **INDIGO.** This agent, mostly of vegetable origin (from various species of Indigofera) is a dark-blue, tasteless, odorless powder, now used as a dye or chemical test, although it was formerly given internally in hysteria, epilepsy, etc. The effects upon the eye are known to us mostly through animal experimentation. See Berlin blue.

Blue blindness. **ACYANOPSIS.** This has been also called yellow-blue blindness (Hering). A person afflicted with this form of achromatopsia sees only green and red. He usually confuses blue with green, orange with yellow, purple with red, and violet with gray or greenish yellow.

Hess (Archiv f. Augenheilk., p. 29, 1908) has proved by his observations on a case the fact that the yellow color of the human lens, without impairment of its transparency, may produce, by absorption, complete blue-blindness. A woman, aged 69, who had V. with —20.00 6/\(x\)1 and read the finest print (Nieden No. 1) fluently at from 5 to 6 cm., could not discern blue colors. In mydriasis the lens, examined by daylight, yielded a very dark brownish-yellow reflex, while with the ophthalmoscope the pupillary area appeared uniformly red, and showed no radial opacities of the lens. The fundus could be easily seen, and appeared normal, excepting a narrow cones. Intense light had no glaring effect.

In testing her color sense, Hess found that she called colors as they appeared to him through yellow glasses. A blue pigmented paper appeared to the patient almost grayish black. Tested with the spectrum, she saw only the red, yellow, and barely the green squares, while the greenish-blue, blue and violet squares, very plainly visible to a normal eye, were not perceived. Hess compares this shortening of the spectrum in its short-waved portions with his observations on chickens and pigeons, in which this is due to absorption of the short-waved light by the yellow and red oil globules of the cones. The terminal light has a similar composition in both cases; its lack of short-waved rays in both is produced by absorption through a yellowish red and yellow filter, which in daybirds consists in portions of the retina, in the patient in the lens.

Hess says it is generally true that the coloration of the lens increases with advancing age, but not equally, as lenses of relatively youthful eyes are not rarely more yellow than those of older persons. Hering proved that the lens of the newborn is yellow. See **Color sense** and **Color blindness.**

Blue disease. Cyanosis of the new-born, generally due to congenital constriction of the pulmonary artery with deficiency in the septum
of the ventricles, the aorta communicating with the right ventricular cavity. The fundi and other ocular parts generally exhibit changes that are readily seen. See *Cyanosis of the eye,* and *Blue sclerotic.*

**Blue-glass cure.** During the decade between 1870 and 1880 the so-called blue-glass cure was well-known as a supposed remedy for a number of diseases (including ocular affections) principally nervous and rheumatic. The cure consisted in allowing the sunlight to fall through panes of blue glass upon the spinal column of the patient or, in cases where the disease was local, upon the portion of the body affected. Sometimes water, kept for some time in blue bottles, was drunk to assist the cure.

General August J. Pleasonton, of Philadelphia, the most ardent advocate of this cure, was convinced of its efficacy after performing a series of experiments on plants and animals, mainly grape vines and pigs. The remarkable results he obtained caused him to try the effect of blue light upon human beings with no less noteworthy consequences. Pleasonton reported several cases of rheumatism and serious nervous troubles which were cured in a space of time varying from a few days to two or three weeks; also two cases of baldness, one of tumor in a child one month old, and one of deafness in a mule! He recommended the use of blue light as a remedy for diseases of the brain, all of which is described in his work, entitled *The Influence of Blue Rays and Sunlight,* Philadelphia, 1877. Edwin D. Babbit (*The Principles of Light and Color*) also reports a cure in a week of sciatica of eleven years’ duration; hemorrhage of the lungs (*The Chicago Tribune,* Jan. 12, 1877) and spinal meningitis. Pleasonton gives the following explanation of the blue-glass cure: The sun’s rays, arrested in their rapid progress by the blue-glass cause friction, which evolves negative electricity; the electrical condition of the glass is positive and, when the opposite electricities meet, their conjunction develops magnetism. The heat produced in these processes expands the pores of the glass and passes through. The blue rays now possess the curative attributes of electricity, magnetism, heat and light.

This, however, was not the theory held by all who believed in the blue-glass cure. Babbit opposes Pleasonton’s theory, and says: “We would have the electricity, light, heat, etc., if there were no blue glass, and * * * the meaning of the terms positive and negative electricity, as commonly used, being unknown, their use tends principally to blind one by means of terms which smack of science and mean nothing. The more the glass is heated the more the heat rays will fail to pass through, as heat is repellent.” Whereas Pleasonton advises the use of blue and clear glass mixed, thinking the effect of the former
used alone too powerful in its effect, Babbit points out that blue light is much cooler than a mixture of blue and white light.

Blue-glass test. This experiment in optics depends upon the well-known fact that the eye is not achromatic (q. v.). As Burch (Optics, p. 47) says: "Of the cone of rays refracted by the cornea and the lens towards the retina, the outside rays are red, the blue being refracted at a greater angle. Beyond the apex of the cone the order is reversed, the blue coming on the outside. If, focusing the eyes on a distant window bar, we bring slowly into line with it a paper-knife held in the hand, the edge of the nearer body appears bordered with red. But if we focus the paper-knife, the more distant window bar appears bordered with blue. The phenomenon is greatly intensified by using blue or purple glass, by which all the green and yellow rays are stopped and only red and blue-violet are transmitted. The object best suited for the purpose is the filament of a glow-lamp—failing this, a hole or slit in a card with a bright light behind it. If the object is nearer than the eye can focus, it will appear bordered with red; if beyond the limit of accommodation it will be surrounded with a blue halo. When the power of accommodation is lost the distance focused with a given pair of glasses can be determined within a centimetre or so by the absence of colour round the image."

Blue-green vision. This is an extremely rare condition, generally the result of a toxic state. Lewin and Guillery (I, p. 58) relate the case of a man, forty-nine years old, employed in an india-rubber works who became sick from the vapour of bisulphide of carbon. At first he was affected only slightly with nausea and vomiting; later, with the well-known signs and symptoms of carbon bisulphide poisoning—(alterations in the urine, functional nerve and muscle disturbances, blurring of vision, pain, etc.). His sight became worse than before, and after an attack of vomiting, he could not distinguish small objects, and everything appeared to him to be colored blue-green. He had no night-blindness. He could recognize only the largest Snellen types, at the shortest distance. Glasses gave no improvement. A short time later, for one day, he saw all objects rose-colored instead of green. The other senses were not affected. There was improvement in from three to four months, even to good vision, with glasses. Pupils normal. Hypermetropia I. D. Eye ground normal.—(C. P. S.) See Toxic amblyopia; also Color sense and Color blindness.

Blue ointment. Unguentum hydrargyri dilutum. Unguentum hydrargyri cinereum, P. G. Mercurial salve is often used alone or in conjunction with other agents as an application to the external
eye. Its action is chiefly that of counter-irritant and derivative, and as such is occasionally used in scleritis, phlyctenules, etc. It is one of the ingredients of the popular Arlt's forehead ointment.

Blue pyoktanin. See Pyoktanin.

Blue sclerotics. The condition was first mentioned by von Ammon in 1841. Others have made a number of observations, among them Sydney Stephenson, who in 1910 described the condition affecting 21 out of 32 members belonging to four generations of one family. This record was followed by that of Bishop Harmon, showing that a total of 31 out of 35 members of another family possessed the same congenital peculiarity. In J. D. Rolleston's (Brit. Jour. Children's Diseases, May, 1911), case of a male infant, age five months, the mother had developed a hard chancre of the lip for which only local treatment was received. The child had a blue coloration of the sclerotics, the mother likewise presenting an almost identical condition. The history of the family showed that her sister and also her grandmother had this affection.

H. Burrows confirms the observations of Rolleston, and gives the pedigree of four generations in which the association of blue sclerotics and brittle bones was noted. There was no instance of transmission of blue sclerotics except from a parent who actually showed this condition, and those who had white sclerotics had children with white sclerotics. Not a single case of fracture (fragilitas ossium) occurred among the latter. Of 29 individuals, 13 had blue sclerotics, and no less than 9 suffered from brittle bones, some of them suffering multiple fractures from slight violence.

A report on five generations of blue sclerotics and associated osteoporosis by F. A. Conlon (Boston Med. and Surg. Jour., July 3, 1913) furnishes the following family history:

Mr. B., aged 48, head of the present generation, has marked blue sclerotics and slight hypermetropia. He has broken a wrist and three ribs, but this occurred from considerable violence. His one sister had blue sclerotics and broke her hip from a trifling cause. Both this sister's children also have blue sclerotics, but no history of fractures. This patient's mother had the same blue sclerotics as did a sister whose only two children showed the same anomaly. Another sister had normal sclerotics, as did all of her five children. This man is married and his wife has normal colored sclera. They have five children and all five show this same peculiar porcelain blue appearing sclerotics. Of these children three show signs of bone fragility. Ethel, aged 12, fractured her left arm five years ago from a slight fall. In August, 1911, she broke and dislocated her left
hip from a fall of ten or twelve inches. In May, 1912, a dog jump-
ing on her knocked her down, breaking her right leg. Her right
eye is amblyopic, while she has 2 D. hypermetropia in her left eye.
She has a well-marked embryotoxon on the upper and lower margin
of each cornea. Sclere are a deep blue.

Beatrice, aged 25, has pale blue sclerotics. Embryotoxon on upper
and lower margin of each cornea. Brown colored irides. Mrs. B.,
aged 22, deep blue sclerotics. Slight degree of hypermetropia. Blue
colored irides. Has had one fracture. Her child, which was the
only member of the fifth generation, was born a month ago, but died
one week later. The child had deep blue sclera and died from con-
genital heart disease. Eva, aged 18, pale blue sclerotics. Embry-
otoxon on upper and lower margin of each cornea. One fracture of
wrist four years ago. Moderate degree of hypermetropia astigma-
tism in each eye. Brown colored irides. Rose, aged 14, pale blue
sclerotics. Embryotoxon on upper and lower corneal margin. No

This family is of rather small physique. This was also character-
istic of the family reported by Bishop Harmon. In no member did
Conlon find the Fuchs colobomata or oval disk which were found in
the Stephenson-Harmon family.

**Blue-sensitive end-organ.** According to the Young-Helmholtz theory
of normal color-perception there are in the eye three kinds of nerve
fibres, all of identical structure and conducting powers, but sup-
plied with different end-organs. One of these, the blue-sensitive
end-organ is so called because it is supplied with a photo-chemical
substance mostly affected by the blue rays of the spectrum.

**Blue-stone.** Copper sulphate (q. v.).

**Blue, Toluidine.** See Toluidine blue. A dark-green powder soluble
in alcohol; less soluble in water. An aniline dye-stuff occasionally
used, like methylene blue (q. v.), in ocular therapeutics, generally
in 1:1000 solutions which are of a deep blue color.

**Blue-vision.** Cyanopsia. This anomaly has been observed in connec-
tion with optic nerve and retinal atrophy; as an epileptic aura; after
cataract operation; in influenza; after an apoplectic seizure; in con-
nection with macropsia and metamorphopsia, as well as numerous
other nervous symptoms; in arterio-sclerosis of the retinal vessels;
and following an excess in alcoholics. Blue-vision cases have been
reported by de Kleijn (and one patient complained of seeing red
balls of fire) in tumor of the hypophysis.—(C. P. S.)

**Blue vitriol.** See Copper sulphate.

**Blunt hook.** This small instrument, generally known as Tyrrell’s
hook, is commonly used for withdrawing the iris from the anterior chamber. It is passed over the margin of that organ and grasps the pupillary edge. It is often employed in iridectomies and iridotomies.

Blunzen. (G.) A German (Württemberg) sausage, made by filling the stomach of hogs with meat. They are then cured by a method favoring putrefaction. This is a most common source of sausage-poisoning. See Allantiasis also Toxic amblyopia.

Blur-circles. In optics, circles of diffusion projected by a lens-system imperfectly focussed upon the plane of the screen located just beyond the image-plane.

Blut Abfluss vom Auge. (G.) A sanguineous discharge from the eye.


Blutbehälter der Augenhöhle. (G.) The ophthalmic sinus.

Blutcysten der Orbita. (G.) Hämatoma of the orbit.

Blutdruckmesser. (G.) Hämodynamometer.

Blutegel. (G.) Leech.


Blutentziehung an der Schläfe. (G.) Leeching the temple.


Blutfarbstoff. Coloring matter of the blood.

Blutgefäß. (G.) A blood-vessel.

Blutgefäßgeschwulst. (G.) Angioma.


Blutkörperchen. (G.) Blood corpuscles.

Blutkraut. (G.) Bloodroot or Sanguinaria canadense, when taken in toxic doses, produces palpitation of the heart, vertigo and cloudy vision. Probably chelerythrin is the active agent of the poisoning.

Blutschwamm. (G.) Fungus hämatodes.

Blutstaar. (G.) Cataracta cruenta. Grumous cataract. An obsolete name for an opacity due to hemorrhage into the cornea, anterior chamber or vitreous. See Cataract, Grumous.

Blutung. (G.) Hemorrhage.

Blutungen in die vordere Kammer. (G.) Bleeding into the anterior chamber.


Blutversorgen des Bulbus. (G.) Blood supply of the eyeball.

Blutwurst, Vergiftung mit. (G.) Poisoning from blood-pudding or sausage.

Body, Ciliary. See Ciliary body.
Body, Lenticular. A name given by Schultze to the outer portion of the retinal inner-rod segment.

Body, Vitreous. A synonym of the vitreous humor or substance; or (simply) the vitreous. See Vitreous humor.

Boerhaave, Hermann. In his earlier writings he gave his name as Boerhaaven. He was born, as the son of a minister, Dec. 31, 1668, at Voorhout, near Leyden, Holland. After an excellent general education, he studied at first theology—as did so many of the time, who afterwards became physicians. His father dying soon, he suffered much from poverty. Finally, by the kindness of friends, he was enabled to study medicine. He received his medical degree July 15, 1693.

We cannot here discuss the far-reaching influence which this man of almost unparalleled ability exercised upon his contemporaries, and, in succession, all the medical profession for many generations. We may, however, remind ourselves of the fact that he became undoubtedly the most celebrated lecturer in Europe. Students came to him in throngs from the remotest portions of the civilized world, and even noblemen and princes mingled with the students in his audiences.
BOERHAAVEN, HERMANN

His two chief works are: "Institutiones Medica" (1708) and "Aphorismi de Cognoscendis et Curandis Morbis" (1709).

Ophthalmologically he is important, because (1) he seems to have been the first since Saracenic days to deliver a course of lectures on the Diseases of the Eye; (2) because in those lectures (in the course, at least, delivered in 1708) he rigorously emphasized the then new theory that a cataract is not (contrary to the views of the Ancients and the Arabs) a deposit of corrupt and inspissated humor in a (wholly imaginary) space between the pupil and the lens, but the lens itself in a hardened, condensed and clouded condition. The new and true doctrine had had its origin in France. It had then been brought to Germany and to Holland by Heister. But for the great Boerhaave remained the pleasant task of teaching to his hundreds of students this revolutionary doctrine, and so of causing its dissemination and acceptance in every nook and corner of the civilized world.—(T. H. S.)

Boerhaaven, Hermann. See Boerhaave.

Boettcher's test-types. This author invented a series of (what he terms) geometrical test-types. In addition to German (Gothic) reading tests, these contain sets of square figures with a notification of the distance at which the figures of each size may be recognized and counted by a normal eye. The objection to these tests is that it is not stated what is assumed to be the normal standard of vision.

Boeuf, Oeil du. (F.) Ox eye. The cow's eye.

Bogrow's fibres. These cerebral strands run from the tractus opticus to the thalamus opticus.

Böhlm, Ludwig. A distinguished German ophthalmologist. Born at Hanau, Germany, Jan. 21, 1811, he lost his father at an early age, but received an excellent education, nevertheless, in Coblenz and Berlin. At the latter institution he became an assistant first in the medical, later in the surgical, clinic. In 1837 he was an assistant to Romberg in the Cholera Hospital. He was then for a long time a pupil of Dieffenbach, the inventor of the strabismus operation. In 1841 he received his medical degree, and, four years later, became professor extraordinary. In 1847 he was made ordinarius.

He had an extensive practice, mostly surgical, and he devoted especial attention to operations on the eye. In winter he taught ophthalmology at the University; in summer, however, he gave a course in operative surgery on the cadaver—a fact which indirectly was the occasion of his death. On July 19, 1869, while performing an operation on a cadaver, he wounded his left hand. Two days later, he suffered a slight chill. On the morning of July 27 he passed away.

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His writings, both general and special, are quite important. Among the general are: *Die Glandularum Intestinalium Structura Penitioire* (Berlin, 1835) and *Die Kranke Darmschleimhaut in der Asiatischen Cholera Mikroskopisch Untersucht* (Berlin, 1838). His later writings all pertain to the subject of ophthalmology. The most important of this group are: *Strabismus and Tenotomy* (Berlin, 1845); *Nystagmus and its Cure* (Berlin, 1857); *On the Employment of the Blue-Double-Lights on Painful Eyes* (1858); *The Therapy of the Eye by Means of Colored Light* (Berlin, 1862).

In the first of the works above mentioned, *Strabismus and Tenotomy*, Böhm performed the excellent service of pointing out that the so-called *hebetudo visus*, or 'weakness of vision,' by which had been universally understood a condition of lowered vitality in the optic nerve, really consisted of an instability in the power of accommodation. This trouble he relieved, in those who squinted, by a correction of the strabismus; in others, by convex glasses tinted blue. In connection with the latter form of treatment, he has the following
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interesting passage—a passage which discovered to ophthalmologists a new world: "The favorite explanation of 'hebetudo' as being a fatigue of the optic nerve is without analogy in the other nerves of sensation. But fatigue of the motor nerves is well known and definitely settled. Therefore a person is really obliged to explain the trouble in question as an affection of the motor nerves of the eye. The experiment with convex lenses has surpassed expectations. A multitude of persons, who, exhausted by local and general treatments of various sorts endured the whole year round, by foot-journeys and bathing trips, by abstinences and tortures, could not be freed from the supposedly weak visual powers, saw themselves by means of the little jewel of a pair of slightly convex glasses, suddenly rescued from all their troubles and sorrows, and once again enjoying a thousandfold the constant, indefatigable continuance of a sense, whose prospective extinction had hung before their eyes without cessation as a horrible ghost and had driven away completely the joyfulness of their minds." We can easily pardon the lumbering character of this sentence, because of the message which the words conveyed to a world that had suffered and waited for hundreds, even thousands, of years.

Böhlm also rendered excellent service in connection with the subject of nystagmus. In his little book of only 170 pages, entitled "Nystagmus and its Cure," he, first in history, so far as I have been able to ascertain, brings out the following facts—not all of which, however, relate wholly to nystagmus: (1) There is, for every patient afflicted with nystagmus, a "point of rest," and, as the eyes look farther and farther away from this point (beyond it or to either side) the nystagmus increases proportionately. (2) The tremulous movements are increased by diminished illumination and by psychical excitement. (3) During sleep, nystagmus disappears. (4) Objects looked at by a nystagmatic patient, do not appear to him to be in motion. (5) In a mirror, the patient cannot himself behold the movements of his eyes. (Nor, for that matter, can anyone, however sound his eyes may be, observe in a mirror the motions of these organs. See Blindness during ocular movements.) 6. At puberty the reddish pupil of an albino turns darker.—(T. H. S.)

Bohne. (G.) A bean.

Boil, Aleppo. See Aleppo button.

Boil, Delhi. A synonym for Aleppo button (q. v.) or boil.

Boiling water. Although this is a destructive agent and scalds of the eye are among the most serious of ocular injuries, yet properly applied it is a decided and useful antiseptic—apart from the steam
(also a useful ocular remedy) which arises from it. The spores of bacillus anthracis are killed by boiling water in two minutes while most bacilli and cocci are rendered harmless in a much shorter time—1 to 5 seconds. Both Randall and Lippincott find that boiling hot water dropped slowly from a fine pipett on an ulcerating surface removes only dead tissue, meantime stimulating the living margins without injury to them.

Bois. (F.) (1) Wood; (2) horns (of a deer).

Boisson. (F.) Drink; beverage; drinking; drunkenness.

Boitier. (F.) Box with compartments for dressings, etc.

Bolbomelanoma. An old and obsolete term for melanotic carcinoma of the eyeball.

Bolbomelanosis. (L.) Old and obsolete term for melanotic cancer of the eyeball.

Boll's retinal purple. The presence of a pigment in the retina—the visual purple—was suggested by this observer who intended thereby to explain the retinal changes that occur during the visual act. See Physiological optics.

Bolometer. In physics, an instrument for the electrical measurement of small amounts of radiant heat in different parts of the spectrum (q. v.) by measuring the changes in the resistance of a blackened strip of platinum exposed to the radiations.

Bolus alba. White clay. See Argilla.

Bombé iris. When the whole circle of the pupil becomes adherent to the lens a ring synechia is produced and the anterior chamber is shut off from the posterior chamber, thus constituting a seclusio pupillae. When this happens it often leads, later, to a bulging forward of the iris in consequence of the aqueous humor accumulating behind it. This may, in turn, result in an adherence of the ballooning iris to the posterior wall of the cornea and a secondary glaucoma. Finally, exudates may organize in the pupillary area (occlusio pupillae) and a total posterior synechia forms.

Bombirende Iris. (G.) Iris bombé.

Bombyx lanestris. One of the numerous caterpillars whose hairs produce ophthalmia nodosa (q. v.).

Bombyx pini. A caterpillar whose hairs cause ophthalmia nodosa (q. v.).

Bombyx rubi. One of the commoner caterpillars whose hairs produce ophthalmia nodosa (q. v.).

Bonalumi's test for simulated blindness. This is a device almost similar to Chauvel's test (q. v.).
Bone in the choroid. Ossification of the choroid. True bone has been found in eyes that have been blind and shrunken for some time, especially after a destructive iridochoroiditis. This ossification (generally limited to the choriocapillaris) is seen in inflammatory tissue, in the fibrous tissue, or rather in the fibrous tissue that replaces the atrophied choroid. The osseous mass can generally be made out by simple palpation. The amount of bony tissue varies from a few spicules to a complete shell. Although mentioned by Schon in 1838, it was first intelligently described by Knapp and Schiess-Gemuseus about 1872. It generally begins at the margin at the lens, where the deposit is thickest, and forms bars and masses showing the typical arrangement of the ordinary long bones—well-developed Haversian canals and the lamellae with the bone corpuscles properly arranged in a circle around the blood-vessels. Sometimes, even a true medulla is formed composed of adipose tissue. Parsons (Pathology of the Eye, II, 484-485) says that in "most cases bone is formed in the posterior part of the choroid around the entrance of the optic nerve, but it may begin at some distance from the optic disc. Possibly the entrance of the short ciliary arteries into the globe here may have some connection with the increased exudation. Independent foci may be seen at other parts of the choroid or in the colloid bodies on its surface. In ossification of colloid bodies their substance is replaced by fibrous tissue, in which the formation of bone then takes place. This is comparable to the process of ossification in the lens. The formation of bone is not confined to the choroid; it often appears in the detached retina and in cyclitic membranes, it may surround the lens, and actually penetrate its capsule, or it may form a mass that occupies the whole of the vitreous chamber. Bone in the choroid is never developed through cartilage, but is always of the periosteal type. The first step in the conversion of fibrous tissue into bone is seen in the more homogeneous, or finely granular, denser appearance that it assumes; it stains with eosin more brightly than the unchanged fibrous tissue. In this, the so-called osteoid stage, very few cells are seen in its substance, but already the cells at the border of the mass begin to assume an angular shape. When the deposit of lime salts takes place this osteoid tissue now appears roughly granular, and is deeply stained with haematoxylin; and as it merges into the more fully developed bone it again becomes clear and takes on the eosin stain, the spaces enclosed by the trabeculae being lined by a layer of cells, the osteoblasts. The end of a growing trabecula of bone is often seen to merge into a richly nucleated fibrous bundle. Where the fibrous tissue has attained some thickness towards the inner
surface of the choroid, ossification appears to begin in its outer layers first, so that they exhibit the lameliated structure and Haversian systems or fully developed bone, when its inner layers show only small trabeculae that still have a fibrous appearance and possess only a few lacunæ and canaliculi with their corpuscles.'

As a rule, shrunken eyes containing bony masses should be enucleated, as they are often a source of sympathetic irritation.

**Bonnaya integrifolia.** (L.) A species growing in the East Indies, where all parts of the plant is used in the treatment of diseases of the eyes.

**Bonnet, Amédée.** A celebrated Lyonnese surgeon, re-discoverer of the ocular so-called Tenon's capsule, which therefore often bears his name. Born at Amberieu, France in 1802, he received his medical training and the doctorate degree at Paris. Before his graduation he won a gold medal for his work as interne. In 1832, the very year of his graduation, he competed for the position of surgeon-major at the Hôtel Dieu, Lyons, and won the place with ease. This appointment, together with that of surgeon-in-chief, he held for eleven years.

He died Dec. 1, 1858, after an illness of only a few days. The citizens of Lyons (with a spirit unknown in America) erected to his memory a beautiful statue, which is still pointed to by them with pride. A medical prize which bears his name is also offered yearly at Lyons.

Bonnet's more important general writings are: *Traité des Maladies des Articulations* (2 vols., Lyons, 1845); *Traité de Thérapeutique des Maladies Articulaires* (Paris, 1855; 2d Ed., 1860); *Des Services rendus par la Médecine aux Sciences Naturelles* (Lyons, 1848); and *Du Soulevement et de la Cauterisation Profonde du Cul-de-Sac Rétro-Utérin dans la Rétroversion de la Matrice* (Gaz. Méd. de Lyon, 1858).

His most important ophthalmologic writing is entitled *Traité des Sections Tendineuses et Musculaires dans la Strabisme, la Myopie, la Disposition à la Fatigue des Yeux, etc.* Avec 16 Planches, par A. Bonnet, Chir. en Chef de l'Hôtel Dieu de Lyon (Lyons, 1841). This excellent work, by reason of its very exact description of the structures involved, did much to advance the operation for strabismus. "In order to rise to a truly scientific conception of the strabismus operation," he says, in this work, "one has to determine under what conditions the muscles to be tenotomized at their insertion in the sclera, keep or lose their influence upon the movements of the eye. Otherwise one cannot know what one has to do, in case the squint continues subsequent to the tenotomy, and how a conversion into
the exactly opposite form of squint is to be prevented.’ ’ Bonnet showed in this as well as in other writings, that the recurrence of a squint subsequent to operation is owing to a union of the muscle to the capsule and of this to the ball of the eye. He also pointed out the necessity, in such cases, of a freer division of the fibres of the ocular capsule, especially in the case of grown persons. He showed, further, that both the oblique muscles tended to turn the eyeball outward, and that, in outward squint, it was usually needful to tenotomize the inferior oblique in addition to the rectus externus.

The Relations of Bonnet’s Capsule. The Dark Spots Indicate the Points at Which the Eye Muscles Pierce the Capsule.

His description of the ocular capsule was better than any that had preceded. This capsule, to use his very expression, is formed of a fibrous membrane, in which the eye is held like an acorn in its cup. The capsule is, therefore, concave forwards, is united behind to the optic nerve where the structure enters the eyeball, and, coming forwards, encloses the posterior two-thirds of the ball. It does not, however, cling to the eye closely. It terminates in front by a number of fibrous expansions, of which the most distinct pass to the cartilages of the lids, so that these constitute the actual termination of the capsule. ‘‘All the muscles of the eye perforate the capsule in order to reach the sclera; they therefore consist of two portions—One outside, one inside, the capsule. Both parts are enclosed in sheaths which proceed from the capsule; the sheath for the intra-capsular portion of each tendon passes to the sclera, to which it is united. The capsule, therefore, ends anteriorly in two leaves; the one goes to the eyeball and follows the subconjunctival fascia and the sheaths of the intracapsular parts of the recti muscles; the other betakes itself to the lid-cartilages. The forward-opening angle, which the two leaves form, is the place where the scleral conjunctiva is reflected upon the lids. The sheaths of the outer and the inner recti muscles send out also strong processes to the margins of the orbit.’’

Bonnet was not the first to describe the ocular capsule. Ténon performed that excellent service in 1802 (39 years earlier than Bonnet). Malgaigne, Baudens, Boyer and Guérin also added more or less to
our knowledge of this important structure in the interval between Tenon and Bonnet. Bonnet, however, pictured this beautiful structure in such a lively and unforgettable fashion that the capsule of the eye is as generally known today by the names of its better, as by that of its first, describer.

This great surgeon and anatomist also re-invented (as some believe, invented for the very first time) the operation of enucleation of the eye. He also rendered excellent service in connection with the revival of the extraction method in the operation for cataract, and invented a number of highly useful ophthalmologic instruments.—(T. H. S.)

Bonnet d'hippocrate. (F.) Head bandage.

Bonnet's capsule. The posterior portion of the sheath of the eyeball up to the passage of the tendons of its muscles; practically the capsule of Tenon (q. v.).

Bonnet's operation. Ferrall-Bonnet operation. This procedure is the well-known enucleation of the eye. First, the conjunctiva is divided at the corneal limbus and separated from the ball (undermined with blunt scissors) for some distance back. Next, the tendons of the straight muscles are cut, and then pressure backward of the speculum against the cul-de-sacs should dislocate the ball forward. The optic nerve is then divided, shreds of remaining tissue cut away from the globe, and the enucleation is complete. See Enucleation of the eye.

Bony formation in the choroid. See Bone in the choroid.

Bonzel's operation. For iridodialysis (q. v.). The iris is detached with a small hook through an opening in the cornea.

Books in schools. See Hygiene of the eye.

Boope. (F.) Buphthalmos. Having an eye like an ox.

Boops. (L.) Ox-eyed.

Borace. (It.) Borax.

Boracic acid. Boric acid. See Acid, Boracic.

Borax. See Sodium borate.

Borax-carmin. Grenacher's solution. A useful stain for ophthalmic preparations. The aqueous solution is made as follows: Carmin, 0.5; Borax, 2.0; Distilled water, 100.0. The above ingredients are mixed and boiled, and 5 cubic centimetres of a 5/10 per cent. strength solution of acetic acid are added, drop by drop, while the mixture is being constantly stirred until it turns to a deep-red color. Filter the solution after twenty-four hours.

Staining. 1. Wash in water. 2. Stain in carmin for from five to twenty minutes. 3. Differentiate in hydrochloric acid-alcohol (concentrated hydrochloric acid, 1.0; alcohol, 70 per cent. strength,
BORAX, GLYCERITE OF

100.0. 4. Wash thoroughly in water. 5. Alcohol, carbol-xylol. Balsam.

The alcoholic solution is used if the sections are not to be brought in contact with water. It is prepared as follows: Carmin, 2 to 3; Borax, 4; Distilled water, 93. After forty-eight hours the above solution is mixed with 100 cubic centimetres of 70 per cent. strength alcohol. Allow the mixture to stand for thirty-six hours' time and then filter it. Nuclei stain red with this solution.

Staining. 1. Transfer the section directly from 70 per cent. strength alcohol into the alcohol-carmin and stain for from five to twenty minutes. 2. Differentiate in hydrochloric acid, 1.0; alcohol, 70 per cent. strength, 100.0. 3. Wash in 70 per cent. strength alcohol for several hours. 4. Dehydrate in 95 per cent. strength alcohol. 5. Carbol-xylol. Balsam.—(J. M. B.)

Borax, Glycerite of. GLYCERIN OF BORAX. This preparation contains one part of borax with six of glycerin. Diluted with a varying quantity of water this mixture, that always has a little free boric acid, is used by some ophthalmologists as a collyrium.

Bordet-Gengou phenomenon. When red blood corpuscles of one species (of the sheep, for instance) are injected repeatedly into an animal of another species (such as the rabbit) the serum of the rabbit is found to contain substances which dissolve or hemolyse sheep's corpuscles. Hemolytic serum heated to 60° C. becomes inactive, but can be reactivated by the addition of a small amount of normal serum. The amboceptors or immune bodies of the hemolytic serum combine with the complement of the normal serum and the red cells, and hemolysis results. Such a combination is known as a hemolytic system. Bordet observed that if he added normal serum to sensitized red cells, and then after waiting until hemolysis took place added this normal serum to the red cells of a second species which had been sensitized by the addition of a corresponding hemolytic serum, hemolysis of the red cells did not take place. The complement of the normal serum had been taken up or "fixed" by the first system, and hence there was no free complement available to complete the second hemolytic system.

The Bordet-Gengou phenomenon is a further development of these observations and is utilized in determining whether a given serum contains certain antibodies or amboceptors. The serum to be tested is heated to destroy its complement. A small amount of normal serum is then added together with a suspension of the organism whose antibodies it is desired to find. The mixture is incubated for a short time and then is added to red cells sensitized with heated
hemolytic serum. If the test serum contains the specific amboceptors or antibodies no hemolysis results, for the complement of the normal serum is promptly "fixed" or bound to the bacteria, and hence is not available for the hemolytic system. If, however, there are no immune bodies in the test serum, by which complement may be bound to the bacteria, the complement remains free and on the addition of the hemolytic system, completes the hemolytic reaction. The attempt has been made to use this reaction in the identification of various bacteria particularly the meningococcus and gonococcus.

Wassermann has proposed the application of the test in the diagnosis of syphilis. An alcoholic or salt solution extract of syphilitic liver is substituted for the bacterial suspension, and the test carried out as above, using the patient's serum heated to destroy its complement, and adding a small amount of normal serum to supply the complement necessary for the test. On adding the hemolytic system, no hemolysis results if the patient's serum contains syphilitic antibodies or amboceptors, for they furnish the bond by which all the available complement in the added normal serum is united to the antigens of the syphilitic organ extract and none is left for the hemolytic system. If on the other hand no antibodies are present in the patient's serum, the complement of the normal serum remains free to unite with the hemolytic system, and hemolysis follows. Wassermann's results have been confirmed by several observers. Positive results have been obtained in about 90 per cent. of cases with active syphilitic processes, 50-60 per cent. of latent cases, and in 75 per cent. of para-syphilitic affections such as tabes and paralytic dementia.—(E. E. I.)

Borel, Pierre. Born in 1620 at Chartres, France, he received his medical education at Montpellier, and returned to Chartres to practice. In 1653 he removed to Paris, became Councillor to the King and Fellow of the Academy. His most important composition is "Bibliotheca Chemica" (Paris, 1654).

Borel was one of the first (but not the very first) to teach the true location of cataract. His words (uttered in 1653) are: "Note that the cataract is not a pellicle, that is, shoved to one side, but the darkening of the crystalline itself, which, by means of the needle, is thrust away from its place, after the tearing apart of its suspensory fibres." The very first to teach this doctrine was probably Quarré. The first to confirm the teaching anatomically was Rolfinck.—(T. H. S.)

Borelli's operation. This procedure is one formerly undertaken (1857) for the relief or reduction of staphyloma. He made use of two pins inserted at right angles with one another, as shown in
accompany figure. Beneath them he passed a strong piece of silk so as to forcibly compress them together, thus strangulating the mass, as shown in the figures. A compress bandage placed over English taffeta was applied. He reports that cure took place very quickly and that it lasted for many years.

Borgne. (F.) One-eyed person. Blind in one eye.

Boric acid. See Acid boracic.

Borcin. This is a mixture of equal parts of borax and boric acid (q. v.) and may be used where either or both of these agents are indicated. In ordering it for collyria it is well to remember that borax is soluble in 20 parts and boracic acid in 25 parts of cold water. See Boro-borax.

Borine. A compound of 1 atom of boron and 3 atoms or 3 molecules of a univalent radicle. Also, a proprietary antiseptic said to contain boric acid mixed with aromatics.

Borobenphene. A trade name for an antiseptic solution said to contain benzoic acid, boric acid, glycerine and phenol. It is non-poisonous and aromatic.

Borobismuth ointment. A mixture containing boric acid and bismuth very useful in phlyctenular conjunctivitis and keratitis.

Boro-borax. A mixture of borax and boracic acid recommended by Joenicke as an application in simple ulcer of the cornea. It is made by dissolving equal parts of borax and boric acid in hot water and allowing them to crystallize. A ten per cent. solution forms a most useful antiseptic, irrigating fluid. It closely resembles boricin, (q. v.) and antipyonin (q. v.), the latter recommended by Rolland.
sodium salts are also used as a fine dusting powder directly to corneal ulcer.

**Boroformalin.** Boroformol. A proprietary antiseptic remedy said to consist of borosalicylic glycerol, benzoresorcinol, menthol, thymol, eucalyptol, and formalin.

**Boroformol.** Another name for boroformalin (q. v.).

**Boroglyceride.** A synonym of boroglycerin (q. v.).

**Boroglycerin.** GLYCERITE OR GLYCERIDE OF BORIC ACID. BOROGLYCERIDE. GLYCERYL BORATE. C₃H₅BO₃. This is a mixture of glycerine and boric acid by heat. It is a hygroscopic, white, glassy, transparent, brittle mass, soluble in cold water but decomposed by hot water.

This antiseptic is sometimes used in ocular therapy for purulent conjunctivitis in 20 to 50 per cent. solutions. C. C. Stephenson employs it as a menstruum for tannic acid in the treatment of *trachoma* (q. v.).

Webster Fox (Text-book, page 551) advises its use for *blepharitis* in the following mixture:

R

Sol. boroglycerid. 25 per cent. 0.610 (m.x.),
Ung. aquæ rose. 3.88 (ʒj).

In *herpes of the cornea* the following salve is recommended as an application to the vesicles:

R

Ungt. zinci oxidi 22.50 (ʒvj),
Boroglyceridi 7.50 (ʒi),
Phenol. 1.75 (gr. xxvi.).

H. G. Goldberg uses this agent in 50 per cent. solution in any stage of *trachoma* and prefers it to the ordinary remedies.

**Borol.** This is a trade (Parke, Davis & Co.) name given to the following antiseptic mixture:

R

Sodii boratis gr. xii,
Sodii biearb. gr. v,
Sodii benzoat. fl. ʒiss,
Eucalyptol. m ¼,
Thymol. gr. 5-16,
Menthol. gr. 1-8,
Ol. pini pumilio. q. s.

This mixture, when diluted with 10 to 20 times its volume of water, acts well as a mild irrigating fluid and cooling collyrium in most forms of *conjunctivitis*. The only objection to it is its "blunderbus"
character; probably it would act just as well if the "oil of pine, q. s.," were omitted. It is recommended as a useful lotion for hypere-
mia of the conjunctiva, in a five per cent. watery dilution.

Borolyptol. A proprietary remedy intended for both internal and external use. It is an antiseptic said to contain formaldehyde, acetoboroglycerid, combined with the antiseptic constituents of Pinus pu-
milio, eucalyptus, myrrh, storax, and benzoin. It is occasionally used as a spray and in other diluted forms for external diseases of the eye.

Bösartige phlyctänuläre Bindehautentzündung. (G.) Malignant phlyctenular conjunctivitis.

Borsäure. (G.) Boric, or boric acid.


Borsch's bifocal lenses. See Bifocal lenses.

Bothrion. Deep ulcer of the cornea.

Botryococcus. See Botryomycosis of the eyelids.

Botryomycosis of the eye-lids. This is a very rare lesion. The Botry-
ococcus (Discómyces equi of Rivolta, or Micrococcus botryogenus of Rabe, or Asccococcus Johnei of F. Cohn) causes an infection granu-
loma of the tarsus and of the conjunctiva of the lid. The disease resembles actinomycosis of the lids, and it appears as a chronic swell-
ing with the formation of grayish-yellow nodules about 2 to 4 mm. in breadth under the skin of the lids. These nodules become soft in the center and disclose a soft murky mass which contains the micro-organ-
isms. The organisms form a glomeration like a mulberry with 15 to 20 granular globules.

The cause probably is contagion from horses, in whose lungs it forms fibromatous nodules. The diagnosis is made by the microscope. The prognosis is favorable. The treatment consists in giving laxatives, with cauterization of the points of infection.

Botulique. (F.) Botulism; sausage-poisoning.

Botulism. A morbid condition produced by eating unwholesome sausages. It is characterized by constipation, nausea, vomiting, dizziness, imperfect vision, muscular prostration, and enfeeblement of the circulation, and is frequently fatal. See Toxic amblyopia; also, Allantiasis.

Botulismotoxin. Botulin. Botulinic acid. A toxic albumose of poisonous meat or sausage thought to be produced by the Bacillus botulinus of van Ermengem.

Botulismus. Botulism; poisoning from spoiled sausage or meat.

Bouc. (F.) Goat (male).

Bouche. (F.) Mouth; orifice.

Bouchon. (F.) Plug; cork (of a bottle).
Boue purulente.  (F.) Very thick pus.

Bougard's paste. A mixture containing bichloride of mercury, arsenic, chlorid of zinc, cinnabar, starch, and wheat flour. It has been used as a caustic or escharotic application to carcinoma of the eyelids.

Bougie-mètre.  (F.) The candle measure; an instrument for determining the intensity of a luminous body or of a light.

Bougies. These medicated pencils are mostly used in ophthalmic surgery for the treatment of nasal duct obstruction or other diseases of the lachrymal canals. Stilenitz (Klin. Monatsbl. f. Augenheilk., May, 1900) and Antonelli (Traitement des affectious des voies lacrymales per les sondes de gelatine au protargol. Annales d'Oculist, October, 1901, p. 277), after slitting the canaliculus and dilating the duct, introduced by Holtz's method, medicated bougies composed of cocoa butter, or gelatine in combination with protargol, or other antiseptic.

Bouisson, Etienne Fréderick. Born June 14, 1813, at Maugio (Hérault) he studied medicine at Montpellier, receiving his medical degree in 1835. In 1837 he accepted the chair of physiology at Strasbourg, but, removing in 1840 to Montpellier, he became, seriatim, professor of various general branches of medicine at that institution. From 1867-79 he was Dean of the Faculty.

Bouisson was a very voluminous writer, his collected works extending indeed to 14 imposing volumes. His ophthalmologic compositions are as follows:

1. Anatomy of a Two-headed Cat. (Soc. Chir. d’émul. de Montpellier, 1883.)
2. Review of the Most Important Facts which have been Observed in the Surgical Clinic at Montpellier. (Jour. de la Soc. de Méd. Prat. 1846.)
3. Origin of Synchisis Scintillans. (Gaz. de Méd. de Paris, 1847.)
4. Remarks upon the Insufficiency of the Ocular Fluids. (Ann. d’Ocul., 1847.)
5. Acute Ocular Inflammation with Formation of False Membranes on the Surface of the Conjunctiva. (Ann. d’Ocul., 1847, xvii, pp. 100-104.)
6. Concerning the Tears. (Jour. de la Méd. Prat., 1847.)
7. Facial Plastics. (Union Méd., 1850.)
9. History of a Blind Insane Person, who, after a Cataract-Operation, Recovered both his Sight and His Reason. (Montpellier Méd., 1860.)
10. On Ocular Inflammations Acquired while Smoking Grapevines with Brimstone. (Gaz. Méd. de Paris, 1863.)

11. Diabetes with Double-Sided Cataract. (Montpellier Méd., 1863.)

In his earliest days, Bouisson performed a good many cataract extractions. Later, however, he became a bitter opponent of extraction, and then operated for all hard cataracts by couching and for all soft ones by discussion.

A plain, warm-hearted man, he was loved by all who knew him. He died in 1884, aged 72, leaving a large fortune for the endowment or foundation of various charitable and scientific institutions.—(T. H. S.)

Boule. (F.) Ball.

Boule hysterique. (F.) Globus hystericus.

Bouquet. (F.) Anatomically, the cluster of tendons and ligaments attached to a process of bone.

Bourbillon. (F.) The core of a carbunel or of a boil.

Bourdonnet. (F.) A small pledget of lint.

Bourdon's experiment. Ocular judgment of distance forms an instructive chapter in Physiological optics. There are many experiments that have been carried out to illustrate the subject. Among these is Bourdon's, thus described by Burch (Practical Exercises in Physiological Optics, p. 67): "In this experiment three plumb-lines are suspended in a row at right angles to the line of sight. They are about 4 cms. apart, and the middle one works on a slide so that it can be placed nearer the eye than the others, or farther off, the amount of the displacement being read off on a millimetre scale. The plummetts hang in a basin of water or glycerine to prevent vibration, and screens hide the tops and bottoms of the threads so that there is nothing but the focusing power of the eye, if the observations are made with one only, or the stereoscopic sense, if both eyes are used, to enable the observer to judge their distance. On the other hand, as the lines are perfectly still, any amount of time may be taken for careful observation. The position of the head should, however, be fixed. An operator having set the middle plummet, the observer states whether it is nearer or farther away than the outer ones, and roughly by how much. A large number of experiments should be made, and the average correctness of the results recorded. Accuracy will be found to depend largely on focusing power and the acuity of vision or defining power, combined."

Bourgeois charnus. (F.) Fleshy vegetations.

Bourquenod, Jean Pierre. Son of Pierre Bourquenod. He was pro-
fessor of anatomy for a number of years at the College of Surgery in Montpellier. He seems to have practiced ophthalmology to a considerable extent, for, in the "Journal de Médecine de Montpellier," 1810, t. xxiii, p. 71-75, he has an article entitled "Rapport fait à la Société de Médecine Pratique de Montpellier sur une Tablette pour Faciliter l’Opération de la Cataracte."

The date of his death, as well as that of his birth, is unknown.—(T. H. S.)

Bourquenod, Pierre. The father of Jean-Pierre B., and an eighteenth century professor of anatomy and surgery at Montpellier, who devoted some attention to ophthalmology. His birth-date and his death-date are alike unknown. It is certain, however, that he was made a Master of Surgery in 1729, as well as one of the four "professeurs démonstrateurs" of the College of Surgery in 1742. Surgeon-in-Chief of the Hôpital Saint-Eloi, he was highly distinguished as an operator, especially on the eye.

He reported (Journal de Montpellier, April, 1775) a case of apparent anophthalmia in the new-born. At the dissection, he had found "a kind of fleshy membrane which completely obstructed the palpebral fissure. This membrane having been incised, there ran from under it at least a teaspoonful of serous fluid. Then appeared the eye itself, apparently normal, though somewhat retracted.—T. H. S.

Bourealet. (F.) A pad.

Bourse muqueuse, séreuse on synoviale. (F.) A bursa.

Boursoufflement. (F.) Tumefaction; swelling; emphysema.

Bourtonné. (F.) Said of an instrument that is blunt-pointed, or that ends in a knob.


Bouteille. (F.) Bottle.

Bouton d'Alep. (F.) The Aleppo button (q. v.) or boil.

Bouton d'Alep des paupières. (F.) Aleppo button (q. v.) of the eyelids.

Boutonnière. (F.) A button-hole incision.

Bouton noir. (F.) Atropa belladonna.

Bowditchia major. (L.) A Brazilian tree furnishing an alkaloid having convulsive, narcotic, and mydriatic properties.

Bowman's corneal trephine. This is a hand drill, thus described by the inventor: "In 1869 I had some small cutting trepines made by Messrs. Weiss, adapted, among other uses to excise a defined circular portion of the apex of a conical cornea. The instruments vary in diameter, so as to remove portions of different sizes, as required. They are also provided with a movable 'stop,' to regulate the depth of penetration. They are rotated by the finger and thumb."
Bowman, Sir William Paget. One of the greatest ophthalmologists of all time. He was born at Nantwich, England, July 20, 1816, as the son of John Eddowes Bowman, a well known banker and celebrated botanist. His medical studies were begun in the General Hospital at Birmingham. In 1833 he went to London, entering King’s College Hospital. In this institution, two years later, he became Demonstrator of Anatomy. As demonstrator he was especially noted for the attention which he paid to microscopic anatomy. At the age of 22 he visited the hospitals of Holland, Germany, Austria and France. On his return he was appointed to the chair of Physiology and of General and Morbid Anatomy. In 1843 he was made assistant surgeon at the Royal Ophthalmic Hospital, and, seven years later, full surgeon at the same institution. The latter position he held for 25 years. Then, in accordance with the requirements of the English law, he was forced to resign, having reached the age-limit—60 years. An earnest effort was made by his friends to have an exception to the law arranged for in this particular case, but Bowman himself discouraged the plan and it was soon abandoned.
For his many inventions, as well as for his literary contributions, Dr. Bowman will be remembered as long as ophthalmology shall endure. We have not here the time to consider in full these many remarkable matters, but can only select for the very briefest mention a few of the more important. The fact that the most of Bowman’s performances are, of sheer necessity, discussed in great detail throughout the various volumes of this book, renders such a course especially desirable.

1. Bowman discovered and first described the “anterior elastic lamina” of the cornea, as well as the corneal interspaces. These parts are known today as “Bowman’s membrane” and “Bowman’s tubes.”

2. He discovered and first described “the muscularity of the ciliary body,” in other words, “the ciliary muscle.” This discovery was made almost concurrently by Brücke.

3. Bowman either devised, or caused to be devised, a cheap but useful form of microscope for the use of medical students—a fact of great importance at that time.

4. He devised the plan of dilating the lachrymal punctum, and slitting the canalicular—a sort of tree-trunk of an invention, which has put forth many branches. This procedure was really devised for the relief of epiphora due to displacement or disclosure of the puncta, but its application was soon extended greatly both by himself and by others.

5. He invented the useful lachrymal probes, which still bear his name and are still in universal use.

6. He invented, for the division of canalicular strictures, his “canula lancet,” which is truly “a miniature urethrotome caché.”

7. He invented a number of ingenious procedures for conical cornea.

8. He was the first to indicate the true nature of zonular, or lamellar, cataract.

9. Bowman invented the ingenious suction-syringe for soft cataract, which still goes under his name, and is still in use. When this syringe was contrived, moreover, the suction method was much more frequently performed than now.

10. He devised numerous instruments and procedures for use in

*These appear, for the most part, in the various volumes of the “Royal London Ophthalmic Hospital Reports.” There was also a book of his entitled “The Physiological Anatomy and Physiology of Man” and another, his only ophthalmologic volume, called “Lectures on the Parts Concerned in the Operations on the Eye” (London, 1849).
BOWMAN, SIR WILLIAM PAGET

connection with cataract extraction. Among the former was the Bowman lens scoop, which is still in use. He was also the first to extract a cataract under chloroform anesthesia.

11. He invented the combined cutting-needle and hook for use in the formation of an artificial pupil by iridodesis. He also invented blunt iris hooks, which, though, speaking generally, they are much like those devised by Tyrrell, were yet "constructed of a flexible metal so that the hook could be bent to any desired angle—a matter of much convenience when operating from the nasal side of the cornea."

12. Bowman invented the useful ptosis operation which is known today by his name. It consists, as everybody knows, in looping up some of the fibres of the orbicularis muscle in such a way as to give to them a vertical direction and then of attaching the upper portion of the loop to the eyebrow by means of a cicatricial band. The full technique is given in other portions of this work.

In 1851 Donders and Graefe, visiting London, became acquainted with Bowman. Between these three there arose at once an intimacy that was never broken up until, in 1870, the youngest of the gigantic trio, the lamented Albrecht von Graefe, was removed from the circle by death. These three men were a constant source of stimulus and encouragement, each to the other two, and of aid and assistance to one another in every proper manner.

Like all great men, Bowman "toiled terribly," and with very little thought of reward. In his later days, however, honors came very thick and fast upon William—then "Sir" William—Bowman. Among them all, the distinction which he seemed to prize the most was the presidency of the Ophthalmic Section of the International Medical Congress, held at London in 1881. In 1880 he had helped to found the Ophthalmological Society of Great Britain, and now, for three consecutive years, he was made president of this organization.

He was a small, thin man, never weighing more than 125 pounds. He always dressed in black; wore even a black tie and black ribbands to his watch and eyeglasses.

His declining years he spent in retirement, chiefly in the beautiful gardens of his country residence, nestled amongst the Surrey hills. Here he is said by one who knew him well to have been wont to go within one of his gardens, or hothouses, and, closing his eyes, in order to snuff the intoxicating perfume more delightedly, to exclaim in a kind of rapture, only these three words: "Roses! Roses! Roses!"

Another story concerning him also requires to be told. When a very small boy he received a serious injury to one of his hands. A Mr. Hodgson, surgeon to the General Hospital of Birmingham, having
been called, young Bowman was so delighted by the graces of his manner and the skill and success of his treatment that he then and there conceived the idea of becoming a surgeon himself—an intention which he never relinquished. One can hardly help reflecting, in this connection, on the difference it would have made to the world of opthalmology, both of then and of now, had the skill of the attending surgeon been just a little less than what it was.

It should also be once more recorded that Bowman, high as he stood in opthalmology, at no time really conceived a desire to become an opthalmologist. All his tastes, all his inclinations, lay in the line of general surgery. Yet so remarkably distinguished were his performances in our especial field that first one general physician or surgeon, then another, insisted that Bowman should take first this ease and then that one, till, at last, his general practice was utterly wrecked and ruined, and Bowman—the Bowman of Bowman’s membrane—was an opthalmologist in spite of himself.

He died of pneumonia, March 29, 1892, aged 76, at his country home near Dorking, there among the Surrey hills, amid the beautiful roses which he had loved so well and which he had always cultivated with his own remarkably delicate hands and watched with his own discerning and affectionate eyes.

It is pleasant when one can add to the sketch of an opthalmologist like Bowman that he was a truly good man, as well as a gifted scientist. Many are the tributes, in fact, which have been paid to his gentleness, his courtesy, his loyalty to friends, his forbearance towards enemies, and all his numerous other delightful traits of character. Thus writes, for one example, Dr. W. Franklin Coleman, of Chicago: "A most courteous and gentlemanly gentleman of the good old school of gentlemen. He was a good, a very good, man. His students all loved him, and perhaps for that reason hung the more upon his words." A character like this explains, as could nothing else conceivable, the enormous influence which Bowman exercised in his day, and, to a high degree, still exercises, in the world of opthalmology. For neither inventive genius, nor didactic ability, nor skill as an operator, nor the gift for organization, nor all these things combined, can, without Bowman’s qualities of heart and soul, confer on any man the power to arouse his fellows and to stimulate them to ever higher and more determined efforts to better the condition of their fellow men.

—(T. H. S.)

Bowman’s lachrymal probes. Although there has been since the days of the inventor many modifications of these useful dilators of the naso-lachrymal passages, yet they still exist as the standards by which
to measure others. Numbered originally from one to eight and arranged in pairs (see the cut) these figures have been extended to fourteen or even larger sizes. For the effective introduction of the larger probes into and through the duct, in the presence of disease or stricture, slitting of the canaliculus is, with rare exceptions, a preliminary necessity. In a subject with a large punctum, an easily distensible canaliculus, or a lid large enough to allow of considerable retraction, it may be avoided. Such cases, however, are rare.

Bowman’s Noso-Lachrymal Probes.

The experience of Ziegler, who forcibly dilates both canaliculus and duct, generally under local anesthesia, for the cure of nasal duct obstruction, is worthy of consideration. He uses a large-sized, pointed probe and generally finds one, or, at most two, divulsions or probings sufficient.

The patient is directed to raise the eyes, and the lower lid is then stretched towards the temple, which removes, as elsewhere stated, all folds in the mucous lining of the canal. The probe is now passed horizontally into the sac. Upon touching the inner wall with the point of the probe, its handle is elevated to a point opposite the supraorbital notch, an angle of about ninety degrees, at which position the lower end of the instrument will in the majority of instances, be directed to the furrow between the cheek and the nose. The lid is then released and allowed to return to its natural position. The probe should nearly as possible be curved in correspondence with the direction of the canal. Prominent eye brows must be stretched upward, out of the way of the probe. With its finger-plate directed forward, the lower end of the probe is gently forced into the opening of the duct. Should the lid be dragged by the movements of the probe, it is evident that its end has been caught in a fold of mucous membrane, and is not properly engaged in the duct. The handle is purposely held loosely, so that the direction of the point may be instantly changed to free it from entanglements, or to alter its direction. When the point is once properly engaged in the duct, the probe remains in position without support. The upper terminus of the duct, if
should be borne in mind, is its narrowest portion, and indicates the usual location of the stricture. The probe is advanced by gently graduated pressure until its finger-plate is on a level with the lower margin of the brow, its lower end touching the sensitive floor of the nostril, where its further progress is checked. The stricture may, of course, be found in any part of the duct, and when the operator encounters an obstruction, caution and gentleness must be exercised to avoid the creation of a false passage through the mucous lining (an accident likely to happen to a careless or inexperienced surgeon). The probe, in this event, is slightly withdrawn, its proper direction again determined and the advance continued. There is less danger of making a false passage when a large or moderate sized probe is used. Bowman’s number 4, 5 or 6, for instance, is less likely to become entangled in folds of the mucous membrane than a number 2.

After insertion, the probe is allowed to remain in position fifteen minutes. It is then slowly and cautiously withdrawn. The operation should be repeated every day, or every second day, gradually increasing the size of the probe, until the duct remains well opened. The intervals of insertion may then be lengthened by a week or two, but should not be wholly discontinued until the duct is permanently established.—(H. F. H.)

Bowman’s membrane. Bowman’s layer. Lamina elastica anterior. This important layer of the cornea lies below the epithelium and upon the substantia propria. It is not seen as a distinct layer until the fifth or sixth month of foetal life. According to the measurements of H. Müller, as given by Parsons, it is about 5 to 7 microns thick soon after birth; 6 to 8 microns in the middle, and 10 to 12 microns at the periphery, at 20 to 30 years of age; and 10 microns in the middle, and 15 to 20 microns at the periphery, in old people. E. v. Hippel’s measurements in the new-born were 2 to 2.4 microns after formol hardening, 3.6 microns after Müller’s fluid. De Vries obtained the following results: New-born, 1.5 to 2 microns; 10 years to adult age, 5 to 5.5 microns; 59 to 77 years, 6.25 to 8.75 microns. The increase in thickness with age bears no relationship to the increase in thickness of the whole cornea. About the only structural details seen on cross-section of Bowman’s layer are the pores for the minute branches of the corneal nerves—made out by contour-contrasts and not by special staining. They generally run parallel to one another, though they are not always perpendicular to the corneal surface. See Histology of the eye.

Bowman’s muscle. It was not known until 1846 that there are muscular fibers in the ciliary body; but at this time Bowman discovered,
BOWMAN'S OPERATION FOR PTOSIS

with the microscope, muscular fibers which were parallel with the meridians of the eye, hence properly called them "meridional." These he considered as having their origin in the anterior part of the ciliary body and their insertion in the anterior part of the choroid. He named this newly discovered muscle the "tensor of the choroid," and in it he thought he had found the secret of the power of accommodation. His explanation was that this muscle, by making tense the choroid, so compressed and changed the shape of the vitreous as to force the lens forward, thereby increasing the distance between the macula and the lens sufficiently, he thought, to account for the phenomena of accommodation. Before that time no theory of accommodation had included the idea that there existed, in the ciliary body, a muscle. So thoroughly satisfied was Bowman that he did not pursue his investigations further, else he would have discovered, also, the circular fibers which were found later by H. Müller. Long before the discovery of either Bowman's muscle or Müller's muscle, as is well known to modern physiologists, Young had demonstrated an increase in the curvative of the crystalline lens in the act of accommodation. Müller thought that, by contraction of the circular muscle discovered by himself, direct pressure, by the ciliary processes, on the periphery of the lens, caused the increase in convexity; but Helmholtz had taught that the increase in curvature was due to inherent elasticity of the lens, which was allowed to manifest itself because of relaxation of the zonula, effected by the contraction of Bowman's muscle.—(G. C. S.)

Bowman's operation for ptosis. This operator (Royal London Oph. Hosp. Reports, Vol. 1, p. 34), after strongly everting the upper lid, made an incision through the conjunctiva along the length of the superior border of the tarsus.

The conjunctiva is then dissected back with scissors and forceps so as to expose the tendon of the levator and the superior tarsal border. The tendon is then seized with toothed forceps, and two or three sutures are passed through it at points about 2 cm. back of its insertion. It is then cut off in front of the line of the sutures, and this piece, together with the superior border of the tarsus to which it is attached, is excised with the scissors. The needles on the sutures are then passed through the fresh border of the tarsus and the tendon attached to its new position.—(W. H. W.)

Bowman's stop-needle. That undue traction on the ciliary body might be avoided in operating on the lens-system or any part of it, Bowman devised an operation which was formerly much practised. He
used two spear-pointed stop-needles with sharp cutting edges. The eye being fixed with forceps, one of the needles is thrust through the tissues of the limbus at one end of the transverse diameter, the breadth of the spear-head point being parallel to the plane of the iris. Then, putting down the fixation forceps and steadying the eye with the needle already introduced, a second needle is introduced in the same manner through the limbus directly opposite the point of the incision of the first needle. Both points are then carried on until they reach the middle of the pupillary area. Both needles are then plunged through one opening in the capsule, being careful that no tissue intervenes between the blades of the needles. The needles are then turned so that their cutting edges lie in the transverse diameter and the handles of the needles are approximated. By this movement the membrane will be divided by the two needles. If this is insufficient, the needles are carried back to the first position, and second slits made at right angles to the first. The needles are then rotated so that their blades are in the same plane as when first introduced and withdrawn. If skilfully done, there need be no loss of aqueous.—(M. S.)

**Bowman's Stop-Needle.**

Bowman's styles for lachrymal strictures. According to Soelberg Wells this ophthalmic surgeon was the first to employ appliances for dilating and keeping patent the lachrymal canals. Of course they were introduced after slitting up the canaliculi. See **Lachrymal apparatus, Operations on the.**

**Bowman's symbols of intra-ocular tension.** It is not generally known that we are indebted to Bowman (*British Med. Journ.*, Oct. 11, 1862) for the characters commonly used to designate and record degrees of intraocular tension. Although a rough and inexact method, and much influenced by the idiosyncrasy of the observer, it has long served a useful purpose and may be said to be superior to even the best tonometer (q. v.) in the hands of an ignorant or careless observer. They are employed as follows:

- **Tn:** Tension normal.
- **T+1?** Doubtful increase of tension.
- **T+1:** Slight but positive increase of tension.
- **T+2:** Considerable tension; the finger can slightly impress the coats.
Bowman's syringe. Bowman's syringe-pump. Bowman's aspirator. This instrument, once widely employed, is used to make suction upon and so to extract broken-up masses of lens matter from the anterior chamber. Aspiration should be confined to soft, liquid and traumatic cataracts. In old patients, with a hard nucleus, it is unsuitable and

in young subjects with partially clear lens matter, as in the perinuclear type, it should not be attempted until a discission has softened the entire lens mass.

The pupil should be dilated ad maximum. The corneal incision should be made with a keratome 4 mm. from the limbus; in the left eye in the superior nasal quadrant; in the right eye at the superior temporal quadrant. Then a large opening is made by the point of the instrument in the anterior capsule. Introduce the canula, with its point towards the cornea, into the anterior chamber through the cut capsule against the substance of the lens. Then, suction is made either by the syringe-pump or by the mouth.

Care should be taken to retain the end of the canula within the capsular wound and not push it behind the iris or into the vitreous.

The dangers following the operation are similar to those attendant upon discission (q. v.) and call for the same precautions and treatment. — (P. A. C.)

Bowman's tubes. Bowman's corneal tubes. Artificial passages made by forcing air or fluids between the corneal lamellae. If mercury is
employed in this way and considerable force is used tubular passages at right angles to one another may be seen. The tubules stop at the sclera where the tissue becomes dense and resistent.

Boyauf. (F.) Cat-gut.

Boyer, Alexis. A French physician of wide reputation, for some time surgeon-in-chief to the army of Napoleon. Born March 1, 1757, at Uzerches (Corrèze) in old Limousin of indigent parents, he was taught, in his childhood, nothing but reading and writing. He then became a copyist to a notary. At the age of 17 he went to Paris, where he became assistant to a barber, at the same time, nevertheless, attending lectures in anatomy. In 1781 he received from the Ecole Pratique des Collège de Chirurgie a gold medal. He was extremely active in a surgical capacity throughout the Revolution, and, in 1804, received the appointment above referred to from Napoleon. Three years later he was made a baron of the Empire.

He wrote a number of remarkable books, almost all of which pertain to general surgery; but his masterpiece, "Traité des Maladies Chirurgicales et des Opérations qui leur Conviennt" (11 vols., Paris, 1814-26) is of interest to ophthalmologists because its volume 5 is devoted exclusively to ophthalmology. This volume seems to be, as to matter, an adequate summing up of the ophthalmology of the day, but, as to style, plain and bald even to dryness and obscurity.

—(T. H. S.)

Boyer, Lucien A. H. Born of French parents at Turin, Italy, in 1804, he studied at Paris, where he received his medical degree in 1836. He married a sister of Amussat. He wrote in 1842 in an unsuccessful competition for the Monthyon prize, a work entitled "Recherches sur l'Opération du Strabisme." He also wrote "Discussion Clinique sur quelques Observations d'Hernie Etranglée" (1849) and a thesis entitled, "Des Diathèses au Point de Vue Chirurgical" (1847). From 1852-70 he was physician to the Senate.

In the aforementioned unsuccessful thesis Boyer pointed out the great importance of the strabismus operation, calling it more than the mere idle luxury which it had been supposed to be. He also described an excellent squint-hook of his own invention. This instrument was a double affair, which grasped the tendon in two places, leaving in the interval a space for the application of the scissors.

The date of Boyer's death I have not been able to ascertain.—

—(T. H. S.)
**BRACHIUM CEREBRI**

**Brachium cerebri.** Brachium of optic lobes. The bands of nerve radiations connecting the nates and testis with the optic thalamus.

**Brachyblepharon.** (F.) A short or contracted lid.

**Brachymetrophia.** (L.) An obsolete name for myopia.

**Brachy-telescope.** A form of reflecting telescope in which the small convex mirror is placed out of the axis of the large, somewhat inclined, reflector.

**Bradycorie.** (F.) This is a term proposed by Donath for that condition of the pupillary convergence reflex in the Argyll Robertson phenomenon when a pupil immovable to light contracts more slowly than normal under the influence of the convergence.

**Bradyfibrine.** (F.) Fibrin that coagulates slowly.

**Brailly's theory of optic neuritis.** This observer held, with Gowers and Mackenzie, that intracranial pressure has nothing to do with the papillitis of brain tumor, but that it is really a descending neuritis transmitted from the cranial cavity. See Brain tumor.

**Braille alphabet.** See Alphabets for the blind.

**Braille, Close.** In alphabets and literature for the blind (q. v.), this term refers to that form of Braille in which the space allotted to the first-base characters (including the following letter space) is less than that allotted to the second-base (including its letter space). Most of the close Braille now being printed is Braille with New York intervals, but some have been printed with shorter intervals.

**Braille, Louis.** (1809-1852) A blind teacher of music who modified the Barbier dotted system of print for the blind. In 1819 he went to the school for the blind in Paris. He became proficient on the organ, and held a post in one of the Paris churches. While a professor at the Institution Nationale des Jeunes Aveugles, he perfected his system of point writing. The Braille notation is extensively employed and is generally considered to be the best adapted to all purposes (and to have the letters of all languages) of the numerous systems now in use. See Alphabets for the blind.

**Brain abscess.** This is one of the causes of optic neuritis, with its various consequences. So far as prophylaxis is concerned great importance attaches to proper asepsis in the treatment of all scalp wounds, infections and head injuries, adequate drainage of otitic and mastoid suppuration, careful attention to purulent nasal discharge, inquiry into possible infection of the accessory nasal sinuses, and the assurance of the best hygiene and sanitation for children convalescing from the acute infectious diseases, particularly scarlet fever, measles and pertussis. Palliative treatment, as it applies to brain tumor and meningitis, is hardly worthy of a trial, except for a special
effort directed at the control of vomiting by the use of ice pellets taken by mouth or mustard poultices applied to the epigastrium, thus reducing the liability of the abscess to rupture. Starr has summed up the question of operative interference as follows: "When a cerebral abscess seems probable from the history of the case and from the symptoms which have developed, and the general progress of the case demonstrates the existence of an increasing and serious focal disease of the brain, it is advisable to operate, even though the symptoms may not be absolutely typical and may present many variations from their usual form. As to the surgical prognosis, Macewen says: 'In uncomplicated abscess of the brain operated upon at a fairly early stage recovery ought to be the rule.'"

Whether the focal symptoms, referable to the visual tract or elsewhere in the brain, will be favorably influenced by operation, and to what extent, can only be determined by the factors governing each case.—(D. H.)

Brain, Diseases of the, Eye signs and symptoms of. These will be discussed under the appropriate headings. See, for example, Brain tumor; Brain abscess; Cerebral apoplexy; Cerebral embolism; Encephalitis; Infantile cerebral paralysis, etc. See, also, Neurology of the eye.

Brain, hemorrhage, Eye symptoms of. See Cerebral apoplexy, Treatment of; Neurology of the eye.

Brain puncture. The value of this procedure for the relief of the intracranial pressure of brain tumor, meningitic deposits, cysts, etc., is often very great. Our knowledge of the technic and clinical value of brain puncture dates from the publication of the thorough experimental and clinical study of Neisser and Pollock, yet Middeldorpf, in 1856, had suggested the procedure on the basis of experimental evidence. Maas not long afterwards insisted on its use as a preliminary step in the operative treatment of brain abscess.

In this country Souchon, in 1889, developed a technic from animal experimentation. Schmidt, four years later, pointed out the surgical possibilities of the procedure, particularly in connection with the treatment of abscesses of otogenic origin. Payr a little later extended the technic to include the harpooning of brain specimens for histological examination, a procedure which has found little favor elsewhere, and justly so, on account of the very considerable dangers and relatively small benefits connected with it. The Kocher clinic, in 1899, already had a well-developed technic, which was published by Albert Kocher, and does not differ particularly from that at pres-
BRAIN PUNCTURE

ent in use. One year before Neisser and Pollock published their work, Nicholas Senn published a case of internal hydrocephalus, which he had treated by connecting the subcutaneous tissue of the scalp with the ventricle by means of a thin rubber drain, using at the same time elastic compression of the skull. This method of ventricle drainage was first used by G. A. Sutherland and Watson Cheyne (who used folded lengths of catgut instead of rubber), and later, though published earlier, by Henle, who used a gold tube. Since the appearance of the paper of Neisser and Pollock, the method has been tried extensively and has come to occupy a permanent if rather limited field of surgical usefulness. B. Pfeifer has reported the experience of Wernicke's clinic at Halle, and F. Krause has reported his experience with a still larger material.

Indices for cerebral puncture. For diagnostic purposes brain puncture is at present done chiefly after the dura has been exposed by cranial resection, so that possible hemorrhage may be controlled and purulent fluid be walled off from the meningeal spaces. It is generally employed to locate subdural and epidural hematomata; to locate collections of pus; to locate cysts of various origins; to locate and determine the character of brain tumors—a dangerous and not very reliable procedure, but still used by F. Krause.

For purposes of treatment it is used for temporary and permanent drainage of the ventricles in internal hydrocephalus, acute and chronic, whatever the origin; evacuation of pus and blood; evacuation of fluid from meningeal space and lateral ventricles to diminish pressure before decompression or exploratory operations.

Dangers of brain puncture. The chief danger is from hemorrhage, which is naturally very much less when the puncture is done in connection with a resection of the cranium, so that large veins can be avoided and any bleeding promptly seen and checked.

In the use of the puncture through a small trephine opening by the method of Neisser and Pollock, the chief danger is from injury to the pial veins by the point of the exploratory needle. Though normally small, in diseased conditions they are often greatly dilated and the walls are at all times very fragile and delicate. The dural veins are injured less easily, but may give rise to very severe hemorrhage at times. The branches of the middle meningeal artery may be injured during the trephining, but are more easily seen and the hemorrhage controlled by ligation.

Vascular tumors on the surface and in the tissue of the brain are still more dangerous to puncture; e. g., angiomata, angiosarcomata.
etc., may exist, which may easily give rise to fatal and unrecognized hemorrhage.

Septic infection is rarely likely to be carried in from without, but may easily infect meninges from a punctured abscess if the Neisser and Pollock puncture is done without walling off of the meningeal space. Tumor infection may easily be carried into the healthy parts of the brain by the exploring needle when the tumor lies superficially and the needle, as often happens, is inserted through and beyond it.

Focal symptoms from destruction of nerve centers are avoided by not putting in needle too deeply (four inches is the limit in any direction, and five to six centimeters is usually far enough). Pons, medulla and basal ganglia lie so deeply that there is rarely danger of striking them. Puncture in the motor area may have disagreeable after-effects, as in a case of F. Krause's, which was followed by temporary arm paralysis and severe general prostration and shock.

Sudden collapse from diminution of intravenous pressure may occur with the larger collections of blood and pus, but is especially apt to occur in the evacuation of an internal hydrocephalus. If this happens the head is lowered and the veins filled with salt solution and adrenalin. The best means of preventing this complication is to slowly evacuate the fluid.

Acute and fatal edema of the brain associated with great increase of intracranial pressure occasionally follows puncture of the ventricles. I have seen alarming symptoms develop in two cases operated on by me when exploration was being carried out. Repeated emptying of the lateral ventricles and stimulation restored the patient.

Technique and location of brain punctures. There are a few obvious rules to be observed which make the location of the puncture a relatively simple performance. Avoid blood vessels. Punctures are not made near the mid-line nor near any of the venous sinuses, for fear of wounding the larger blood vessels as well as the sinuses themselves (i.e., transverse sinus, longitudinal sinus, sigmoid sinus, occipital sinus, etc.). Also avoid the neighborhood of the larger blood vessels, particularly the middle meningeal artery. In general, avoid puncturing through a small opening because of the difficulty of seeing what one is puncturing and of recognizing hemorrhage promptly, when it occurs. Do not puncture through a sulcus, but through the convexity of a convolution, because in the sulci run the vessels. Explore for pus through the lowest possible openings, thus securing the best possible drainage, if pus be reached. Tap hematomata from the point of visible injury (unless there are other focal symptoms and the visible injury is slight).
Cranial Puncture Points. (Neisser and Pollock). Heavy Black Lines are the Craniometer Lines. Solid Black Points indicate Puncture Areas of the Different Lobes. Shaded Points for Puncturing Abscesses.

F₁, F₂, F₃—Puncture point for frontal lobe.
T₁, T₂, T₃—Puncture point for temporal lobe.
Occ.—Puncture point for occipital lobe.
P—Puncture point for parietal lobe.
K K K—Puncture point for cerebellum lobe.
P M—Mastoid process.
O—Ext. occip. protuberance.
N—Nasion (gabella).
S V—Line of direction of precentral sulcus (anterior diagonal meridian).
S. H—Posterior diagonal meridian.
N O—Base line.
N L—Naso-lambdoid line.
O, D—Juncture of upper and middle third of the central gyrus.
N D—Juncture of lower and middle third of central gyrus.
Technic of simple puncture. The locality of the puncture is shaved, washed with soap and gauze, alcohol and bichloride, 1:1,000. Local anesthesia is usually sufficient, but an anesthetist should be at hand and all preparations, as a rule, should be made for a flap operation, if it becomes necessary. Freezing with ethyl chloride, or infiltration with Schleich's solution (No. 1), or novocain (½ per cent. with 12 m. of adrenalin, 1 per cent. to the 100 cc.) may be employed. A small, semicircular scalp flap may be made or the drill may be pushed directly through the scalp and set at once to work on the bone. If Hudson's trephine is to be used, it is best to make a small flap. The drilling through the bone should then be done in the direction in which the needle to be inserted, rather than at right angles to the bone. A metal shoe may be attached about the shaft of the drill (1 to 1½ cm.), so that it will not suddenly penetrate the bone and lacerate the brain beneath. The position of the shoe may be gradually changed as the drill goes farther in. When the bone has been penetrated the needle should be inserted, after the drill is removed, and the scalp should be held fast, free of the bone, at each side of the opening by an assistant.

It may happen, especially in trephining through thick, fleshy parts, especially in fat parts, as in the occipital or temporal regions, that it becomes impossible to locate the small trephine opening with the needle point, thus necessitating trephining anew. The needle should be about six inches long, graded in centimeters, no thicker than 1.8 mm., and provided with a mandrin. The needle should be attachable to an aspirating syringe of about 5 cc. (1-10 cc.) capacity, and provided with a glass cylinder, so that fluid can be seen, if aspirated. The tip of the needle is then inserted through the dura and gently advanced in the desired direction up to a depth of five or six centimeters, depending on location.

If no fluid appears the aspirating syringe may be attached and gentle suction exerted as the syringe is withdrawn.

If fluid is not found, the needle is cleaned out with the mandrin and then inserted in a new direction. It should never be moved into a different area of the brain without first withdrawing it entirely and also examining its patency.

When the examination has been completed the wound is washed off with bichloride, 1:1,000, and alcohol, and then sealed with colloidion and cotton. A stitch or two may be necessary, depending on the size of the opening in the scalp.—(A. E. H.)

Brain, Superposition of images in the. This theory is intended to explain, through the arrangement of the crossed and uncrossed fibres
of the optic nerve, stereoscopic vision, but it is questionable whether
the phenomenon can altogether be explained on purely anatomical
grounds.

Brain, The, of various animals. In antiquity the brains of various
animals were extremely popular as a remedy for diseases of the eye,
and this not only among the masses, but also among the more highly
educated physicians and ophthalmologists. The brain of a young
dog was especially esteemed as a local application in glaucoma. It
was well rubbed into the eye with a sound. The brain of an eagle
was used in a similar manner to confer clarity of vision and tolerance
to light.—(T. H. S.)

Brain tumor, Eye symptoms of. This subject will be further discussed
under Choked disk, a symptom found in four-fifths of all forms of
cerebral neoplasms. Probably the most complete report of this ocular
sign of intracranial growth is given by Paton (Trans. Oph. Soc. U. K.,
Vol. 28, 1908).

In addition to optic neuritis, brain tumors may cause other eye
signs such as hemianopsia, optic aphasia, photopsia, oculomuscular
pareses, hemi-achromatopsia and Wernicke’s sign, all of which will
be described under their proper headings.

The diagnosis (and especially the localization) of cerebral neo-
plasms, so far as the eye symptoms are concerned, cannot, however,
be properly made, apart from other and more general signs. More-
over, other brain lesions may set up symptoms that closely resemble
those due to tumor. As stated by Spiller (The Eye and Nervous Sys-
tem, p. 432), brain abscess is one of these. "In most cases some puru-

tent foci may be detected as the cause of the cerebral abscess, and
most frequently it is disease of the middle ear. In other cases pus
in the ethmoid or sphenoidal sinuses may be the starting point for
cerebral abscess, or there may have been some injury to the bones of
the skull. The symptoms of abscess are likely to develop more rapidly
than do those of tumor and may be associated with fever, or sub-
normal temperature, chills, slowing of the pulse; or the symptoms of
meningitis may be added,—viz., transitory ocular palsies, rigidity of
the neck, Kernig’s sign, etc. Purulent meningitis often accompanies
cerebral abscess.

When the meningitis is in plaques a differential diagnosis from
brain tumor may be impossible. This form of meningitis, described
especially by the French writers, is more common in the motor area,
and I have described one of the two cases reported in this country.
In my patient the symptoms were precisely those of tumor of the
parietal lobe.

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## ANALYSIS OF 252 CASES OF CEREBRAL TUMOUR (PATON)

<table>
<thead>
<tr>
<th>Site</th>
<th>Number</th>
<th>Confirmed by operation or p.m.</th>
<th>No neureitis</th>
<th>Percentage of cases showing no neureitis</th>
<th>Percentage amongst cases</th>
<th>Post-neureitis atrophy</th>
<th>Marked neureitis</th>
<th>Average swelling</th>
<th>Highest swelling found in two or more cases observed</th>
<th>Neureitis greatest in one eye</th>
<th>Neureitis greatest in homo-lateral eye</th>
<th>Neureitis greatest in contralateral eye</th>
<th>Neureitis developing first in contralateral eye</th>
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<tr>
<td>Frontal</td>
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<td>4</td>
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<td>6</td>
<td>1</td>
<td>21</td>
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<td>13.636</td>
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<td>12</td>
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<td>0</td>
<td>0</td>
<td>14</td>
<td>4.72 D</td>
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<td>11</td>
<td>37.931</td>
<td>37.037</td>
<td>1</td>
<td>5</td>
<td>12</td>
<td>4.227 D</td>
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<td>Diagnosed as tumour but site undetermined</td>
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<td>10</td>
<td>2</td>
<td>31</td>
<td>4</td>
<td>D</td>
<td>8 D</td>
<td>11</td>
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<tr>
<td><strong>Totals</strong></td>
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<td>152</td>
<td>40</td>
<td>..</td>
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</table>
BRAIN TUMOR, EYE SYMPTOMS OF

Hydrocephalus is often associated with tumor and I have seen it so mask the symptoms of a tumor on the pons that the latter could not be diagnosed. Again, I have seen internal hydrocephalus without tumor cause the symptoms of a cerebellar neoplasm.

Hemorrhage into the brain can be easily distinguished. The rapidity of onset and the course of the symptoms are unlike what is seen with brain tumor, but sometimes hemorrhage into a tumor occurs, and the diagnosis then is made chiefly by the sudden increase of symptoms.

The differential diagnosis between general paralysis of the insane (chronic meningo-encephalitis) and cerebral tumor usually is easy, but I have known the former to be regarded as tumor, and the danger of mistake is greater when the encephalitis is of rather rapid onset. Usually, however, a correct diagnosis can be made.

Aneurysms may give the symptoms of brain tumor. In some cases the stethoscope applied to the head may be of assistance, but I have known a supposed tumor at the chiasm causing bitemporal hemianopsia to be in reality an aneurysm in this region, and to present no signs characteristic of aneurysm.1

Treatment. Apart from such operative procedures as a decompression, spinal puncture, removal of the tumor, etc., very little that is effective can be done to relieve or cure the pareses, optic diseases and loss of vision entailed by the presence of a brain tumor. Medical treatment is occasionally of some use especially if the tumor is syphilitic. Specific treatment becomes imperative and urgent. In brain tumor the inunction plan may be used and with good success, but if rapid mercurialization is desired to suppress fulminating signs and symptoms, the deep intramuscular injections are to be preferred. The symptoms of vesperal headache, somnolence and fleeting paralyses should yield in from two to four weeks after beginning the inunctions.

If after four to six weeks of vigorous treatment no improvement takes place, the idea of a syphilitic lesion should be abandoned.

Potassium iodide should always be adjunctive to this treatment, with the caution to give same in ascending doses until two hundred to three hundred grains, if necessary, are taken daily. There is a widespread preference among neurologists for the saturated solution in increasing drop doses, but when badly borne, iodonucleoid or iodalbin may be substituted. Massive doses of iodide, except in rare instances, need not cause gastric distress if sufficiently diluted. I frequently give the full daily dose of three to four hundred grains in a quart of milk (if so great a dilution is necessary), and let the patient drink of it at intervals, so long as he gets the quantity prescribed for the
twenty-four hours. Ordinarily, it may be taken either before or after meals. [If there be no optic atrophy salvarsan may also be employed in conjunction with the Wassermann reaction as a control.]

Particular care of the mouth and teeth will prevent salivation: 1: Pulv. potassii chloratis, 3ii; Ol. cinnamon, gtt. x, rubbed up well, with directions to use same as a tooth powder after meals, will assist in keeping the teeth and gums in good condition.

The routine use of mercury and iodides in non-syphilitic tumors is to be deprecated because it is useless, although some instances of "apparent" improvement have followed its administration.

1. Headache. The coal tars, such as phenacetine, acetanilid, and antipyrine, in liberal doses, ten to twenty grains at a time, will relieve; pyramidon in five grain doses does good, but for intractable severe cephalalgia I have found nothing to equal codeine by mouth in one grain doses, often repeated, and later morphine, also in large doses, since small ones never suffice. If the growth is inoperable, then one's conscience need not trouble about developing in the patient a habit for morphine or opium. Ice-bags or hot fomentations to the head may afford some relief. 2. Vomiting, when not controlled by ice pellets taken internally, counter-irritation to the epigastrium, or sodium bromide in large doses, is only relieved by morphine. 3. Sleeplessness. Long-continued warm baths may be tried, and the hypnotics, veronal, isopral, trional, sulphonal, paraldehyde, chloralamid, and finally opiates should be given. 4. Convulsions (epileptiform) may yield to massive doses of bromides, but not for long. 5. Apoplectic attacks and paralyses must be treated symptomatically as they occur. 6. Optic neuritis: Strychnin nitrate, gr. 1-30 to gr. 1-15, hypodermically, has given temporary improvement and similar betterment in vision has followed the use of potassium iodide.—(D. H.)

**Brain tumor, Operations for.** The various forms of encephalitic neoplasm, as well as of the other intracrani al exudates or collection (meningitic, abscesses, hemorrhages) that generally set up the same or similar eye symptoms are discussed under **Choked disk**, to which the reader is referred. He is reminded that even when optic neuritis, muscle pareses, hallucinations of sight, hemiopia, etc., are present these signs do not necessarily mean more than that some abnormal irritant within the cranium is producing increased intracranial pressure. They do not, considered by themselves, throw much light on the character, situation or size of the encephalic growth or lesion. While this is true there are some **probabilities** to be considered which may with the aid of the neurophthalmologist enable one to make a definite diagnosis. One of these aids is Marcus Gunn's law, viz: that
unilateral, or preponderantly unilateral optic neuritis is in favor of the tumor being on the same side as that on which the neuritis is more intense.

Having satisfied himself with the help of both ophthalmologist and neurologist as nearly as possible of the character and situation of the cerebral neoplasm the surgeon will seriously consider its removal.

The general technic of exploration and decompression (see Choked disk) for cerebral tumor has been elsewhere described. It remains now to speak of subtemporal decompression (H. Cushing. Subtemporal and Suboccipital Decompression. Surg., Gyn. and Obst., I, 1905, No. 4, p. 297) for unlocalizable or inoperable tumors above the tentorium; (b) suboccipital decompression, usually bilateral, less often unilateral, for exploration and decompression in the case of disease located below the tentorium; and (c) special procedures practiced in the removal of certain tumors.

The tumors are cysts, tubercles, vascular tumors, cortical and subcortical tumors, capsulated and non-capsulated tumors and hypophysis tumors.

It also remains to give briefly the technic of hemostasis, obliteration of the resulting cavity after tumor excision, exploratory incision of the cortex, the two-stage operation, and the prevention of shock and collapse.

Subtemporal decompression is done that the temporal muscle may reinforce the skin and galea in restraining post-operative prolapsus cerebri after decompressive procedures, thereby avoiding a fungus, with consequent dangers of septic infection of the brain and meninges. In my clinic a semicircular incision is made parallel to and one centimeter below the origin of the temporal muscle. Anteriorly, it reaches not quite to the hair border and, posteriorly, it runs somewhat lower, behind the pinna of the ear. Skin and superficial fascia are stripped downward toward the base of the flap, leaving the temporal muscle and fascia exposed. These are now separated bluntly in the direction of their fibers down to the periosteum. The two edges of the muscle are also separated to a maximum extent by blunt retractors. The periosteum is then incised and pushed back with an elevator on both sides as far as possible. Then the cranial cavity is opened in the usual way, except that the bone is bitten away with the Macewen forceps over the entire area of the decompression. A dural flap is made with the base upwards, opposite the base of the skin flap. The decompression is thereby completed and it remains to close the wound. Catgut sutures unite the edges of the temporal muscle and fascia. The skin is sutured with silkworm gut.
usual dressing is then applied and the after-treatment is the same as for the decompression measures previously mentioned.

I have had very good results with the Cushing technic in so far as the prevention of prolapse is concerned. Occasionally it has not been possible to approximate the muscle edges closely, owing to the bulging of the brain. In this case I close the opening in the muscle as well as possible below and trust to dural flap and skin sutures to control prolapse at the upper end of the opening.

The chief fault I have to find with Cushing's method is that the area is not always a silent one. Paresis of the face and arm center at the lower end of the Rolandic area is not rare, and I have seen one case in which the leg center was involved in the resulting prolapse.

The Subtemporal, Submuscular Decompression Operation of Cushing, showing Method of Separating the Temporal Muscle and of Biting the Bone away with Forceps. The dura has been opened.
BRAIN TUMOR, OPERATIONS FOR

Cushing himself now uses a straight vertical incision in place of the flap, but I still prefer the older method.

Suboccipital decompression is a very useful procedure for tumors below the tentorium and much preferable in these cases to decompression over the hemispheres, as recommended for this class of tumors, as well as for the supratentorial tumors, by Horsley.

The important feature of Cushing's operation is that the cerebellum is exposed on both sides at once, so that the entire posterior surface lies free to the view; the whole organ can be dislocated in any direction, and especially laterally, so that its other surfaces can be explored, as well as the adjacent basal ganglia, nerves, bone, dura and tentorium. The tentorium may also be incised through this opening and the overlying occipital lobes exposed.

Cerebellar tumors and cysts and acoustic and cerebello-pontine-angle tumors are well seen and attacked by this method.

The operation has the additional advantage that the bone need not be preserved, the thick nuchal fascia and muscles serving as a thoroughly adequate protection to the cerebellum against post-operative prolapse and trauma. It is easy to preserve the periosteum here and, eventually, there may develop some new bone, though not often.

Technic. The tourniquet cannot be applied to this locality, so that other measures for hemostasis must be relied upon, chief among which are rapid operating, pressure on the flaps by an assistant and prompt catching and twisting, or ligating, of bleeding points.

Incision for suboccipital decompression. I use the incision of Cushing in preference to that of Krause. A horizontal cut is made through skin and galea at the level of the external occipital protuberance, and this incision is continued two and one-half to three inches on each side of the middle line. Then, beginning at the external occipital protuberance, a cut is made in the middle line through skin, nuchal muscles and fascia down to the level of the second or third spinous process.

Hemorrhage at this stage is free and is best controlled by rapidly pushing the flaps up from the bone, turning them back, and having an assistant exert pressure on them. The assistant may also catch the chief bleeders with Kocher's forceps while he is exerting pressure on the flaps.

A trephine opening in the occipital plate is then made and the De Vilbiss forceps used to enlarge it, and ultimately the rongeur forceps also, since there is no particular object in preserving the bone in this well-protected locality.
Particular care must be taken to avoid wounding the venous sinuses or, where it becomes necessary to cut through them, to ligate them in advance.

Subtemporal Decompression in Brain Tumor.

The occipital sinus is usually impossible to preserve, but the transverse sinuses must be spared, at least on one side. The sinuses are best protected by separating the dura from the bone with a Braatz or similar probe, well in advance of the rongeur forceps.
BRAIN TUMOR, OPERATIONS FOR

When the bone has been removed the whole posterior surface of the cerebellum lies exposed to view and may be easily dislocated in any direction to assist exploratory and operative procedures.

Closure is as previously described for any decompressive operation.

Acousticus tumors are best attacked by this method, the dislocation of the cerebellum to one side allowing of a very free exposure of the cerebello-pontine angle and permitting of total extirpation of tumors, parts of which might easily have been left behind in the old unilateral procedure, to say nothing of the much diminished danger of trauma to the cerebellum and danger of shock, collapse and respiratory failure from pressure on the medulla. It is also much less frequently necessary to sacrifice part of the cerebellum in order to enlarge the field, as was the case in the older operations.

Special procedures in the removal of cerebral tumors. Certain varieties of tumors require special methods of attack.

Cysts, unless they lie in the cortex, are usually located by exploratory puncture or exploratory incision of the cortex. After they have been located by the needle mere aspiration is, however, usually not sufficient for a cure. If left to themselves, they are very apt to refill and cause a recurrence of symptoms. Therefore, every cyst should be well opened up and packed or drained, so that it will have an opportunity to become obliterated.

If there be present a well-marked cyst wall, it should, as a rule, be excised, if possible, and such excision is imperative in the case of parasitic cysts.

The entire wall of the cyst should be carefully explored before the packing is inserted, so that any tumor nodes will not be overlooked. Certain tumors, e. g., glioma and sarcoma, are very apt to undergo cystic degeneration, which may reach such a high grade that the tumor itself is entirely overlooked, so greatly does the cyst development dominate the picture.

In the case of parasitic cysts, the subdural space should be well walled off with iodoform gauze, as in the case of abscess drainage, and the wound and cyst cavity should then be irrigated with some antiseptic solution, e. g., bichloride 1:2000, before the wound is closed. Macewen uses one per cent. carbolic acid, also powdered iodoform.

Tuberculoma should be treated, as a rule, as a tumor. When possible, the whole mass should be dissected out into normal tissue and the wound washed out with an antiseptic, e. g., carbolic acid, ½ per cent., before closing it.

If this is not practicable, owing to size or location of the tumor, or the condition of the patient, the mass may be scraped out with a
sharp spoon, irrigated with carbolic lotion, packed with iodoform gauze and allowed to close by granulation. It is, of course, just as necessary to pack off the subdural space in such a case as for abscess or parasitic cysts.

Subcortical Tumor. The dilated veins and discolored, uneven cortex enable us to locate such subcortical tumors at operation. Any one of these three characteristics is enough to act as guide for an exploratory incision.

Syphiloma is attacked like tuberculosis and excised. Drainage afterward is less important than with tuberculoma, but specific treatment must be continued during convalescence, and until all symptoms (even the Wasserman reaction) have disappeared. I have always
used Hg and KI for specific treatment, but recent reports in the literature make it appear that the Ehrlich-Hata "606" is likely to supplant older methods.

Temporary decompression alone of syphilitic tumors is of great value sometimes in saving the eyesight when the action of specific treatment is slower than usual.

Vascular tumors, when excised, require very careful hemostasis. When lying cortically, all the large veins and arteries running to the tumor must be doubly ligated and the vessels cut between the ligatures. When possible, the excision should be done through the surrounding healthy tissue, proceeding very carefully and bluntly, in order to seize all vessels before dividing them.

Vessels which do not enter the tumor should be saved wherever possible, to avoid subsequent encephalomalacia in the neighborhood of the operation site. Ligatures should be of fine catgut and gently tied, since the vessels are delicate and easily torn. Tamponade and finger pressure must be largely relied upon to stop hemorrhage that forceps and ligatures will not control.

Capsulated tumors, if benign, should be shelled out of the capsule, using the finger-tip as far as possible to peel them out. Small remnants may be removed with the curette.

Malignant tumors, when capsulated, should be removed with the capsule. The knife and Kocher director are more useful than the finger. More attention must be paid to avoiding hemorrhage and saving all possible vessels than in the case of the intra-capsular removal.

Subcortical tumors. When a tumor with definite localizing symptoms is not found on opening the dura, it becomes necessary to make an exploratory incision into the cortex. Some local enlargement of cortical veins, local flattening of gyri, obliteration of sulci, diminished or absent pulsation, some slight local abnormality of color and resistance on palpation may point to the spot to incise, or all these indications may be absent.

When working over the sensori-motor area, electrical stimulation may be used as an additional guide to localization.

It is, however, in these cases often necessary to incise more or less blindly and in doing so the following rules are helpful:
1. Always make the incision on the convexity of the convolutions, near their center, and not in the sulci or near them, for in the latter location lie the blood vessels. 2. Make the incision parallel in direction with the long diameter of the gyrus. There will then, as a rule, be fewer nerve fibers cut than otherwise, and any blood vessels severed
will usually be small, and such an incision may be enlarged with less damage to the cortex than a transverse one. 3. Spread the edges of the incision gently with thin, smooth, metal retractors and extend it gradually inward. The finger-tip, protected, of course, by a rubber glove, may also be inserted in the opening, the better to feel tumor resistance. 4. Make the incision as small as possible to avoid cutting nerve fibers unnecessarily, and cause as little trauma as possible to its edges with finger and retractors. If no pathological changes are found, do not consume time in useless manipulation and search. Make another incision at the next most likely spot, or close the wound and transform the operation into a decompressive one. The pressure symptoms will then be relieved and at a later period localizing symptoms may develop which will admit of a subsequent successful attack.
BRAIN TUMOR, OPERATIONS FOR

Unless the localizing symptoms before operation were very definite, there is little use of prolonging an exploratory operation after the first cortical incision or two have been made. The results of further incision are then not likely to compensate for the injury done the cortical cells and fibers.

In operative and exploratory procedures on the cerebellum, cerebello-pontine angle, floor of the posterior fossa and vicinity, there is especially great danger of shock, collapse and respiratory failure from pressure on the medullary and, to a less extent, on the pontine centers.

Cushing's bilateral decompression of the cerebellum, in that it allows free dislocation of the cerebellum and permits the operator to see just what he is doing, is a great help in avoidance of such undue local pressure, and in many cases where this method of attack is used the operation may be completed at one sitting.

It is, however, at present, more usual to do a two-step operation, where the removal of the tumor is contemplated.

At the first sitting the bone window is cut out and the dura exposed. The skin and muscle are then sewed back in place and the patient put to bed to recuperate.

A week to ten days later, if the patient's condition permit, the skin stitches are removed, the flap turned back and the dura opened, preferably as a flap, after careful isolation of the occipital and transverse sinuses and usually double ligation of the former. The second step may be done under local anesthesia, when desired, or even without any anesthetic at all. (Cushing and Thomas. Removal of a Subcortical Cystic Tumor at a Second Stage Operation without Anesthesia. Jour. A. M. A., March 14, 1908, Vol. L, p. 847.)

Then the exploration and tumor excision are completed, hemorrhage stopped and the dura flap sewed in place with catgut, unless subsequent decompression be desired owing to inability to remove the entire tumor. In this event the dura is left unsutured, the skin and muscle flap stitched back in place and tincture of benzoin and silver foil, or collodion, applied to the suture line of the skin, after which the usual dressings are applied.

As an example of the results obtainable by modern cranial surgery, the history of a patient (of O. W. McMichael and Alfred Murray) operated on by me January 27 and February 3, 1910, using the suboccipital procedure of Cushing in two stages is worth abstracting. The diagnosis before operation was left cerebello-pontine angle tumor. At the operation a cyst containing serous fluid was found at the assigned location, but imbedded in the cerebellar substance. It was drained and its wall curetted. There was immediate cessa-
tion of pressure symptoms dating from the performance of the first stage of the operation.

Headache and vomiting disappeared and patient stated that he thought his vision was better, though ophthalmoscopic examination showed only a trifling change.

Serous Cyst of the Cerebellum, near the Cerebello-Pontine Angle. (Halstead.)

The improvement in vision after the completion of the second step was very marked, as shown by the charts and ophthalmoscopic examination.

When we consider in this case the man's fate without operation, his life slowly blotted out, tortured with pains (only partially controlled by the continuous use of morphine) the onset of blindness, deafness, imbecility, we must recognize the great boon that brain surgery has been to him. In contrast with this picture the patient's eyesight
is preserved, though not quite in toto, owing to partial atrophy consequent to his choked discs; and we believe that an earlier operation would have shown still greater improvement. He is free from pain, eats well, vomits no more and has not the morphine habit. He is still deaf in the left ear, but hears all ordinary conversation with the right. His intelligence is undiminished and he is able to attend to most of his routine duties and continue his business. (A. E. H.)

Braise. (F.) Live coal.

Branca. A layman of high distinction in the annals of science, because to him is due the revival of plastic surgery, including the plastic operations on the eyelids. He flourished at Catania, of Sicily, in the 15th century.

Plastic surgery began in India, our earliest records of the subject occurring in the Susruta Sanhita (collection, or works, of Sanhita). In the writings of the ancient Greeks we find no references at all to this subject. It is likely, however, that this portion of the healing art was practised in ancient Alexandria, because Celsus* described the following plastic operation, as if it were generally known—though, indeed, it bears the name of "Celsian" at the present day: "The following is the method of cure: First to reduce the mutilated part to a square; from its inner angles to make two transverse incisions so as completely to divide the part which lies within these lines from that beyond them; and afterwards, to approximate the part we have thus opened. If they do not completely meet, then, beyond the lines already made, we must make two lunar incisions turned towards the wound, so as to separate the integument only: for in this way its approximation will be facilitated: not that we are to use violence, but to gently draw it so that it may easily yield, and not retract considerably when let go."

Celsus also describes the following plastic operations, devised for the eye exclusively: "Sometimes, in consequence of cutting away too much of the integument in this method of treatment, and occasionally from some other cause, the eye remains uncovered. The Greeks call such patients 'lagophthalmous,' or hare-eyed. In this case, when the deficiency of the palpebra is considerable, no treatment can restore it; but when trivial, it may be remedied. A lunated incision should be made in the skin a little below the eyebrow, so that its cornua may have a direction downwards. The wound should go to the depth of the cartilage, which should not itself be injured: for,

* So far as we can tell from the MSS. preserved to our day, he was the first to describe this operation.
if that be incised, the eyelid falls down, and cannot afterwards be raised. The skin, therefore, should be merely divided, so far as to allow it to descend a little upon the lower part of the eye, as the consequence of the gap in the wound above, into which lint is to be introduced to prevent the reunion of the divided tegument, and to promote granulation in the center; for after the part has in this way become filled up, the eye is covered as it ought to be.

"As the upper eyelid is liable to a disorder in which it does not descend far enough, and therefore fails to cover the eye, so there is an affection of the lower, in which it is not sufficiently elevated, but hangs down, and cannot be joined with the upper. This also is sometimes caused by the same bungling in the operation, and is sometimes the effect of old age. The Greeks call it 'ektropion.' When it originates from bad treatment, it requires the same remedial process as has been above expounded, only that the cornua are to be turned towards the cheeks, and not towards the eye. When the result of old age, it should be entirely cauterized externally with a small iron, and afterwards anointed with honey; after the fourth day it should be fomented with the vapor of hot water, and anointed with such medicaments as have a cicatrising quality."

Running our finger down the page of history, we find the following further entries concerning this subject:

Antyllus recommends for cicatrical ectropion the taking out of a lambda-shaped strip of skin from the inner side of the lid, cutting away the scar, and stuffing the area where the loss of skin occurs, with charpie.

Demosthenes advises for cicatrical lagophthalmos excision of the scar and then the forcing apart of the sides of the wound with lint, the object, of course, being to replace the former, and presumably too extensive a cicatrix, with a larger and more accommodating one.

Paulus of Ægina recommends for cicatrical ectropion a simple incision through the scar and then the crowding asunder of the lips of this incision with lint.

The Arabs, ingenious as they were in many ways, seem not to have made any progress in the plastic surgery of the eye—or, for that matter, in plastic surgery of any sort.

And so we come again to Branca—the subject of this sketch. Branca raised the subject of plastic surgery from a very low to a very high plane of development. Did he do this independently, or had he help (directly or indirectly) from India—where, from all accounts, the subject in question was, till Branca's time, much further advanced than in the countries of the West? We do not at all know. We do, however,
know that Branca performed repeatedly and with very great success
the rhino-plastic operation as this had been developed in India—i. e.,
the method of transplantation from the forehead to the cheek.

Branca's son, Antonio, carried both the science and the art of plastic
surgery to a still higher degree of perfection, his most important con-
tribution to the subject being the method of rhinoplasty by trans-
plantation from the upper arm.

The cheek or forehead method is known today as the Indian method,
the upper-arm method, however, as the Italian.

Branca, his son Antonio, and other members of the Branca family
practised plastic surgery for many years as a very secret art, and
became renowned for their skill throughout the civilized world. Their
achievements lay for the most part in the surgery of the nose, lips,
ears, and eyes.—(T. H. S.)

Branca, Antonio. The inventor of the "Italian" method of rhino-
plasty—i. e., the method whereby the skin which is transplanted to
the nose is taken from the upper arm. He is mentioned here, be-
cause so often confounded with his father. See Branca.—(T. H. S.)

Braun, Gustav. A well known Russian ophthalmologist. Born in
1824, he received his medical degree at Moscow in 1852. In 1856
he became a military physician, but, soon resigning, he turned his
attention to ophthalmology. In 1863 he was appointed Director of
the Moscow Ophthalmic Hospital, and, five years later, to the chair
of ophthalmology in the Moscow University. His most important
articles are: "De Corneae Fabrica ac Functione Quaedam" (Diss.
Moscow, 1858); "Structure and Function of the Retina" (Moscow
Medical Gazette), 1861; "On the Accommodation and Its Anomalies"
(Moscow Medical Gazette), 1861.

Braun died April 17, 1897, after more than 33 years of active
service in the University Ophthalmic Hospital.—(T. H. S.)

Braune Augenhaut. (G.) Sclerotic.

Braunschweig, Hieronymus. A celebrated surgeon and ophthalmol-
ogist, the first in all history to remove a foreign body from the eye
by means of the lodestone, or magnet. See Brunschwyck.—(T. H. S.)

Bravais's test for simulated blindness. This is one of a large number
of methods for detecting feigned blindness based on the use of dif-
ferent colored glasses and lenses before the sound and the alleged
amblyopic eye. It resembles somewhat the method of Snellen (q. v.).

Bread. White bread soaked in wine is stated by Celsus to be of
value in excessive secretions from the eyes, if applied at night. Bread
was also very commonly employed as a menstruum for more active
substances.—(T. H. S.)
BREAD-NUT BERRY

Bread-nut berry. See Cali.

Breadth of accommodation. Another name for range of accommodation.

Brechkraft der Linse. (G.) Refractive power of a lens.

Brechmittel. (G.) Emetic.

Brechpunkt. (G.) A point of refraction.

Brechung. (G.) Refraction.

Brechungsametropie. (G.) Ametropia due to the refractive condition.

Brechungsebene. (G.) The plane of refraction.

Brechungsexponent. (G.) The index of refraction.

Brechungsgesetz. (G.) Law of refraction.

Brechungshypermetropie. (G.) Hyperopia due to refractive conditions.

Brechungsmyopie. (G.) Myopia due to the state of the refraction.

Brechungsverhältniss. (G.) State of the refraction.

Brechungsvermögen. (G.) Refractive power.

Brechungswinkel. (G.) Angle of refraction.

Brechweinstein. (G.) Tartar emetic.

Breech-pin in ophthalmology. See Injuries to the eye.

Breiumschlag. (G.) A poultice.

Bremer's reaction for diabetic blood. The blood is prepared as in ordinary staining methods, and, after drying in a hot-air sterilizer, stained with methylene-blue and eosin. The red blood-corpuscles of diabetic blood are stained greenish-yellow, whereas in normal blood they assume a brownish color. (Gould).

Bremse. (G.) A gadfly.

Brennebene. (G.) Focal plane.

Brennlinie. (G.) Focal line.

Brennpunkt. (G.) Focus.

Brennstrecke. (G.) Focal area.

Brennweite. (G.), n. The focal distance of a lens.

Brenzcain. Guaiacolbenzyl ester. This remedy occurs in colorless crystals soluble in alcohol, ether and vasogen, (q. v.). It is a local anesthetic of doubtful utility in ophthalmology, said to be useful in the cataphoresis of cocaine (hydriodide) (q. v.).

Brevisissimus oculi. (L.) The inferior oblique muscle; the shortest of the muscles that rotate the eyeball.

Brewer's torsiometer. This is a modification of the instrument first exhibited by Price, in 1893. Its purpose is to measure certain forms of heterophoria. The original instrument consisted of a double prism (line of bases horizontal) and a rod at right angles to this line of union, placed in a circular disc to fit the rim of a trial frame.
and a Maddox rod (placed vertically) in the other side of the frame. **Looking** at a candle, the patient sees two horizontal and necessarily parallel lines of light with the one eye, as well as a single horizontal line of light with the other. The latter appears between the other two, and parallel with them in orthophoria of the obliques. This was for testing the obliques when the visual axes were approximately parallel. It was faulty in that there was no adjustment by means of which the frames holding the rods could be leveled. A little later, Baxter, of Boston, and Brewer, of Connecticut, each independently, invented a cyclo-phantometer, with the error in the Price instrument eliminated. Brewer named his instrument the torsiometer. Later than this Stevens brought out his prism *clinoscope* (q. v.), the construction of which is not very different from the instruments of Baxter and Brewer. The *cyclo-phantometer* (q. v.), made for use in connection with the monocular-phantometer stand, or the Wilson phorometer holder, consists of a base on which rest two graduated cells, in each of which is to be placed a triple Maddox rod with the axis vertical. Behind each of these circular cells is a rectangular cell for a displacing prism. There is an arrangement by means of which the pupillary distance can be easily regulated so that the one streak of light may be brought directly under the other. There is beneath the base of the instrument, a spirit level for regulating the adjustment of the instrument. On each disc containing the rods is marked below a line continuous with the axis of the central rod. The rods placed vertically, with a prism of 5° base up behind one of them, will show two horizontal lines of light, when a candle is looked at. The lower one will be seen by the eye before which is the combination rod-and-prism. The lines should be parallel, and their ends even. The latter can be regulated by turning the screw that controls the pupillary distance. The slightest movement of either disc will cause a loss of parallelism of the streaks of light. If not parallel, there is want of orthophoria of the obliques, the kind and quantity of the error being shown by the rotation of either disc. By removing the displacing prism, the intrinsic power—the cyclo-duction—of each oblique muscle can be taken alone, and then the combined cyclo-duction of either both superior or both inferior obliques. This is done, when only one muscle is being tested, by revolving the one rod in the temporal arc for a superior, and in the nasal arc for an inferior oblique. If both superior obliques are under the duction test, then both rods must be revolved in the temporal arc; if both inferior obliques, then both rods must be revolved in the nasal arc. The moment the two streaks separate, the rotations must stop. On the arc
of the cell the extent of cyclo-duction can be read. The normal cyclo-duction for a single oblique muscle is somewhere between $7^\circ$ and $14^\circ$. The combined cyclo-duction of either pair of obliques is somewhere between $12^\circ$ and $22^\circ$.—(G. C. C.)

**Brewer’s yeast.** See Cerevisine.

**Brewster, Lens-stereoscope of.** This instrument, devised by Sir David Brewster, has the advantage (*System of Diseases of the Eye*, I, 547) that it is far more handy than Wheatstone’s, that the pictures lie side by side and so can be fixed upon a cardboard, and that a good illumination can be more readily obtained. This is the form of stereoscope that is found in common use.

**Brewster, Sir David** (1781-1868), eminent natural philosopher, was born at Jedburgh, Scotland. He was educated at the University of Edinburgh. In 1802 he became editor of the *Edinburgh Magazine*, and in 1808 of the *Edinburgh Encyclopedia*, to which he contributed many important scientific articles. Previous to this he had entered deeply on the study of optics, with which his name is now enduringly associated. In 1819 the *Edinburgh Philosophical Journal* took the place of the *Magazine*; and in 1831 Brewster was one of the chief originators of the British Association. In 1832 he was knighted, and had a pension conferred upon him; in 1838 he was appointed principal of the united colleges of St. Salvator and St. Leonard, St. Andrews; and in 1849 he was elected one of the eight Foreign Associates of the French Institute. He became principal of Edinburgh University in 1859, and filled this post until within a few months of his death. He made important discoveries in every branch of the great subject of polarization, and in most departments of optics. The most immediate practical result of Brewster’s discoveries was the introduction to British light-houses of the dioptric system, the honor of having elaborated which he shared with Fresnel. Among his many published works are his interesting *Letters on Natural Magic*, addressed to Sir Walter Scott; *More Worlds than One* (1854); his treatises on the Kaleidoscope and on Optics (*Cabinet Cyclopedia*); his * Martyrs of Science*; and his treatises in the 7th and 8th editions of the *Encyclopedia Britannica* on Electricity, Magnetism, Optics, the Stereoscope, etc. He also contributed largely to the *Edinburgh* and *North British Reviews*, and communicated hundreds of papers on scientific subjects to the *Transactions* of learned bodies and to scientific journals.—(*Standard Encyclopedia.*)

**Bribosia’s operation.** This is a procedure for the extraction of cataract that involves a preliminary laceration of the capsule by a stop-needle. The knife is then passed across the anterior chamber, the
iris is caused to prolapse upon the knife as the incision is made and the iridectomy is simultaneously performed. The remainder of the operation does not differ from the usual extraction methods.

**Bridge, Adjustment of spectacle.** Every part of the frame must give entire comfort; the bridge must fit all around the curve of the nose like a saddle on a horse’s back, and the temples must be just the right length. Bear all the foregoing in mind when fitting spectacles and the results will invariably be decidedly better than when some of these points are ignored.

There are pliers that are specially designed to do particular kinds of work, and it will be advantageous to be supplied with the proper tools and to know their respective uses, for you cannot accomplish satisfactory results when you are not properly equipped in this regard. The following styles of pliers are necessary in adjusting spectacles: Snipe-nose (half round), full round, concavo-convex, bridge angling, and stud pliers. There are other styles that will facilitate the work, but these just enumerated are absolutely needed.

Much practice will be required before you will be able to do justice to a bridge in the matter of bending, and it is suggested that you make use of all available old frames or even buy some cheap frames to practice bending, etc.

If the lenses are too high and it is desired to lower them bend the shanks of the bridge downward, but remember that in doing this you will lower the angle of the bridge and allowance must be made for this. If the lenses are too low bend the shanks upward, remembering that this will also alter the angle of the bridge.

The angle of the bridge may be varied by angling the crest with ordinary snipe-nose pliers or by curving the shanks upward or downward at the eyewire or strap, but the best way is to use pliers that are especially made for angling, for instance, the Berg pliers, by means of which the angle can be changed properly in a very short time.

The shanks may be lengthened or shortened to control the distance of the lenses from the eyes by changing the relative position of the point at which the bridge curves to make the shanks. First, with a pair of snipe-nose pliers flatten out the curve in the shank, then with a pair of full round pliers put the bend in the bridge just where you want the shanks to begin and continue to bend the shanks over until they are brought into the proper position. It is quite essential that pliers with full round jaws be employed for making these curves as the other pliers will mark and cut the covering of the bridge.

The pupillary width of the glasses should be controlled by the
direction taken by the shanks without disturbing the width of the base of the bridge.—(R. D. P.)

Bridge coloboma. A variety of coloboma (usually congenital) of the iris in which the pupillary fissure-margins are bridged by a narrow membrane or small transverse band of fibres.

Bridge, Eyeglass. This is the same in optical mechanics as the bridge in spectacles. See Eyeglasses and spectacles, mechanical adjustment of.

Bridge, Spectacle. This is an important consideration in the adjustment of glasses.

There are two ways of expressing the dimensions of a bridge: By giving each dimension in figures or by using the size letter and number. The dimensions considered are height, inclination of crest, angle and width of base. The following letters are used to designate the width of bridges, beginning with the smallest: L, M, N, O, P. The heights are expressed in combination with the letters by numbers, as 1/2, 1, 1 1/2, 2, etc. The shanks are called regular, long and extra long. With the regular shanks the lenses are held a trifle closer to the eyes than the crest of the bridge; with long shanks the lenses and crest of bridge are on the same plane; with extra long shanks the lenses are further from the eyes than the crest of bridge is. Thus to set the lenses away from the eyes to escape the lashes, etc., we use long and extra long shanks. When no length shank is stated “regular” is understood. This is the way the different sizes of bridges are expressed: M, M1/2, N2 extra long shanks.

When the sizes are not specified as above it is necessary to give all the dimensions in figures. The height of bridge is the distance above or below a line running through the center of the lenses to the lower edge of the center of bridge; the inclination of the crest is the distance from the inside plane of the lenses to the upper edge of the middle of the bridge and is specified “in” or “out,” meaning in back or in front of the lenses, respectively. The angle of the bridge is considered with respect to the plane of the lenses, the latter being 90 degrees. The angle is measured at the center or crest of the bridge.—(R. D. P.)
Briggs, William. This ophthalmologist was born at Norwich, England, in 1641. He became a pupil of Vieussens, Superintendent of St. Thomas's Hospital under Charles II., and physician-in-ordinary to William III. In 1676 he published a book, *Ophthalmomographia*, in which he described "optica papilla." In this portion of the ocular fundus, according to his view, occurs the sharpest vision. The structure in question is, of course, spite of its name, not a papilla at all, yet the terms "optic papilla" and "papillitis" are still employed and almost universally.—(T. H. S.)

**Brightique.** (F.) Pertaining to Bright's disease.

**Brightism.** Chronic nephritis.

**Brightness of color.** Every color has three distinguishing characteristics; hue, tint and brightness. The intensity or brightness of a color depends upon the illumination, that is, upon the quantity of light that falls on it.

**Brightness of image.** In *optics*, the intensity of illumination of the surface-element $d\delta'$ of the retina that is affected by the given radiations element $d\delta$ of the luminous body. If $dL$ denotes the quantity of light which is radiated per unit of time from the element $d\delta$ into the eye, the brightness $B$ of this element is defined by the equation: $B = dL/d\delta'$. The brightness of an object which appears like a point is inversely proportional to the square of the distance from the eye, and directly proportional to the size of the ocular pupils. (Southall, *Principles of Geometrical Optics.*)

**Bright, Richard.** A general medical practitioner, who, because of his discovery of the disease which bears his name, should be remembered by ophthalmologists. He was born at Bristol, England, in 1789. In 1810 he made a trip to Iceland, a scientific report of the journey appearing in Sir George McKenzie's book, "*Travels in Iceland.*" After a period of study at Edinburgh and two years at Guy's Hospital, London, he received his professional degree at Edinburgh in 1813. For several years he traveled on the continent of Europe, and, at Edinburgh, in 1818, published the results of his trip in a volume entitled, "*Travels from Vienna through Lower Hungary,*" etc. In 1820 he became Assistant Physician, and, in 1824, Physician to Guy's Hospital, and about this time began to devote himself to original investigations in pathological anatomy—investigations which, it is scarcely necessary to add, yielded the most astonishing results. Before his time, the presence of albumen in the urine had been demonstrated (by Blackall, Wells, and others) but Bright it was who first discovered the connection of this phenomenon with pathological alterations in the kidneys. Bright had also much to do with the begin-
nings of our knowledge about yellow atrophy of the liver and about pigmentation of the brain in miasmatic melanemia. His most important pathological communications occur in his "Reports of Medical Cases with a View to Illustrate the Symptoms and Cure of Diseases by a Reference to Morbid Anatomy" (2 vols., London, 1827, 1831).

In 1837 he became Physician Extraordinary to Queen Victoria. In 1858 he died.—(T. H. S.)

**Bright's disease, Ocular symptoms of.** This is one of the most important of the systemic conditions that can fix the attention of the ophthalmologist. Not only are the eye symptoms of Bright's disease important to the internist from the view-point of diagnosis (since the earliest alterations in the vascular system are most definitely shown in the eye grounds) but the use of the ophthalmoscope is of importance in prognosis. Indeed, in many instances the fate of the patient is pictured on the ocular fundus; and the extent to which the retina, optic nerve and their blood vessels is involved reflects the probable condition of the cardio-vascular supply of other organs of the body. An exhaustive statement of the effects upon the ocular apparatus of the varied and complex conditions commonly called Bright's disease is found in a paper by A. E. Bulson, Jr. (Jour. A. M. A., Sept. 21, 1912) in which the present status of the ocular pathology is clearly stated. The writer reminds us that the controversy that exists as to the identity of distinct types of chronic Bright's disease, such as chronic parenchymatous nephritis and chronic interstitial nephritis, continues, and by some it still is considered a debatable point whether the arteriovascular changes are primary or secondary to the renal changes.

McCrae says that neither chronic parenchymatous nor chronic interstitial nephritis ever exists alone inasmuch as "interstitial change never exists without an accompanying parenchymatous change, and parenchymatous change cannot exist long without interstitial alteration following or accompanying it." He doubts the development of a primary contracted kidney.

Strumpell considers chronic interstitial nephritis as an atrophy of the renal parenchyma which begins in a previously healthy kidney and is not necessarily the ultimate termination of a chronic diffuse nephritis, though he describes a secondary contracted kidney which he considers simply a more advanced form of chronic diffuse nephritis.

Concerning the relationship of general arteriosclerosis to Bright's disease, much has been written. Sutton and Gull advanced the theory that lesions of the small contracted kidney are due to a local form
of general arteriosclerosis, and to this morbid state they gave the name of arterio-capillary fibrosis. Dieulafoy says that this theory of general arteriosclerosis, which has been confirmed by many post-mortem examinations, does not explain all the cases of nephritis in which the arteries are chiefly affected, and he quotes Brault to this effect.

Instead of subordinating the lesions of the kidneys to the general arteriosclerosis, it is more rational to subordinate the lesions both of the kidneys and all other organs to one prime cause (gout, lead, old age, heredity, etc.). Besides, the importance of the arterial lesions in their relation to the contracted kidney has been much exaggerated.

Herrick considers the cardiovascular changes of great importance from the standpoint of the diagnosis, and says that it is a rare thing to find a case of chronic interstitial nephritis permitting of diagnosis in which the cardiovascular changes are not more or less well pronounced. But he further says that "differentiation between the primary nephritis and the secondary arteriosclerotic vascular and cardiac changes may not be possible."

Herrick says that morbid anatomists and pathologists are far from unanimous in their descriptions of the various types or groups of chronic nephritis, and that physicians are not always able to make a differentiation that is satisfactory from the clinical point of view, or that holds good in the light of post-mortem revelations. While admitting the coexistence of parenchymatous and interstitial changes in every case of chronic nephritis, and that the process in every case of chronic nephritis is really a diffuse one, he says:

There are two groups of chronic inflammations of the kidney whose clinical features present such striking contrasts that one feels warranted in making separate classes of these groups, and the justification of this seems apparent when one sees that corresponding to these two types kidneys are found differing as markedly as do the clinical manifestations. To the one form, characterized by edema with abundant albuminuria and cylindruria, the name chronic parenchymatous nephritis has been most often applied; and to the other, with its marked cardiovascular changes, its relatively slight albuminuria and cylindruria, with its abundant urine of low specific gravity, its frequent uremia, the term chronic interstitial nephritis is given. Often, however, the disease refuses to conform to the picture of a classical type, though there are enough of the fairly typical cases to justify the classification that has been made.

Between these two extreme types described by Herrick and many others, we have numerous varieties of intermediate types which
Dieulafoy calls mixed nephritis, and these constitute the most frequent form of Bright's disease. Dieulafoy has also coined the word "Brightism," which he applies to the mild form of chronic Bright's disease in which the urinary depuration is insufficient, and mild symptoms only are present.

Anders says that arteriosclerosis and Bright's disease may develop independently of one another, and yet simultaneously in consequence of the action of a common cause. He considers chronic interstitial nephritis as but one lesion of a generalized process of fibrosis.

Kelly says that chronic interstitial nephritis should not be considered as a disease of the kidneys alone, not even primarily, but a disease of the cardiovascular system, and that there is always a more or less wide-spread arteriosclerosis, hypertrophy and later dilatation of the heart.

Strumpell says that the theory advanced by Gull and Sutton and others that the vascular disease always represents the primary process to which the renal atrophy is only secondary, is untenable, and says that we often find a most pronounced contraction of the kidneys without any vascular changes sufficient to explain the atrophy.

Roderer says that chronic interstitial nephritis is an inflammatory disease of the arteries. He further says that when the inflammation of the blood-vessels in the kidneys extends to the parenchyma of the kidneys, then an examination of the urine will show casts and albumin. The fact that the examination of the urine shows disease, he believes to be the reason that chronic interstitial nephritis has been called a disease of the kidneys.

Ophiils, in discussing subacute and chronic nephritis, as found in 1,000 selected necropsies, says that Gull and Sutton deserve great credit for having first suggested that there is a disease in which the arterioles throughout the body are altered, which constitutes the general morbid change of which contraction and atrophy of the kidneys are part and parcel. He concludes with the statement that a careful study of his necropsies cannot leave room for doubt in regard to the fact that the ordinary red granular, contracted kidney is the result of general arteriosclerosis, and that in many of these cases the general arteriosclerosis is much more important in regard to the condition of the patient than the renal lesion which he may have at the same time. He further says that general arteriosclerotic lesions develop coexistently with arteriosclerotic lesions of the kidneys, but that there is no strict interdependence between the two processes. His conclusions are as follows:

At the present time in many cases too much attention is paid to
the kidneys clinically and anatomically. The so-called primary or genuine contracted kidney represents a disease of the kidney which is the result of arteriosclerosis in the terminal arterioles in this organ, is closely associated with general arteriosclerosis, and cannot be properly understood without due consideration of this fact.

The relation of hypertension of the arteries and enlargement of the heart to arteriosclerosis and chronic Bright’s disease has also been the subject of extended study. Thus Dieulafoy says that cardiac lesions may exist in all forms of chronic nephritis, but that the lesions do not always show themselves by hypertrophy of the heart, and he lays great stress on this point because it is too often said that the heart is always enlarged. The heart may be smaller than normal and may at first sight appear to be healthy, yet histologic examination shows advanced arteriosclerotic changes. “Very marked hypertrophy may coexist with very moderate arteriosclerosis, and reciprocally the arteriosclerosis may be advanced while the heart is not hypertrophied.”

He concludes with the theory that the cardiac hypertrophy is not due to the sclerotic lesions but to the increased arterial tension caused by the more or less general arteriosclerosis and the contraction of the small vessels due to toxic influences, a view also entertained by Strumpell.

Kelly says that increased blood-pressure is an early and valuable sign, and that arteriosclerosis, accentuation of the aortic second sound and hypertrophy of the heart, especially the left ventricle, may be found in all forms of Bright’s disease, but in none of the forms do they so dominate the clinical picture as in primary chronic interstitial nephritis.

Jones maintains that hypertension is the primary trouble that leads to both cardiac hypertrophy and general arteriosclerosis, and that hypertension of the arteries, such as sometimes exists in valvular disease, does not apparently lead to arteriosclerosis but to hypertrophy of the media of the small arteries. He also contends that general arteriosclerosis cannot be the direct cause of the hypertension which produces the cardiac hypertrophy. He believes that general arteriosclerosis is invariably of toxic origin, which explains the evidences of inflammation of the larger arteries and in the kidneys.

Taussig, in discussing arterial blood-pressure, says that it is astonishing how often we find pressures normal or subnormal in patients with greatly thickened or even calcareous arteries. He gives as one of the conditions responsible for the occurrence of hypertension, toxins that directly raise blood-pressure and at the same time have an injurious effect on the arterial wall. Where the action of
these toxins is long-continued, the persistent hypertension caused by them will lead to general arterio-capillary sclerosis.

While opinions may differ as to the exact relationship existing between general arteriosclerosis and chronic Bright’s disease, the fact remains that there are certain manifestations and signs more or less common to the two conditions, and evidence seems to be accumulating in favor of the theory advanced by Gull and Sutton that chronic Bright’s disease, and in particular that type of the disease which has been termed chronic interstitial nephritis, is a manifestation of general arteriosclerosis in which the kidney symptoms are the predominating ones. Furthermore, as Dieulafoy and more recently Ophüls have pointed out, no advanced general arteriosclerotic changes exist without an inflammation of the kidney to a more or less extent. Whether the renal lesion will be a predominant factor depends entirely on the condition of the kidneys and their power to resist the effect of the toxin which is the causative factor in the production of the vascular alteration.

The hemorrhagic retinitis of a general arteriosclerosis, and the typical albuminuric retinitis of chronic Bright’s disease are familiar pictures described in text-books, but it is to the less-pronounced retinal lesions which may or may not attract the attention of the patient, and which appear early in the history of the disease, to which attention is especially directed. These lesions, frequently overlooked or misinterpreted, and often discovered by accident, are sufficiently suggestive to warrant a suspicion of general arteriosclerotic changes with accompanying kidney inflammation, and the propriety of more extended study of the case.

Some of these earlier retinal changes and especially those in a more advanced state have been described by numerous writers. Thus Alleman, in discussing the retinal symptoms of vascular degeneration, mentions spasm of the retinal vessels as shown by localized transient contractions, (also reported by Zentmayer and Greenwood), tortuosity of the smaller retinal vessels, and a multitude of minute glistening dots in the retina, which occur during the period of high pressure and disappear with the return of the normal arterial pressure. Weeks, in describing arteriosclerosis of the retinal vessels, mentions the delicate white lines at the borders of the arteries in the greater number of cases, loss of transparency of the vessels, and the appearance of hemorrhage and exudation. In discussing albuminuric retinitis, he divides the condition into two classes: (1) those cases not preceded by thickening of vessel-walls, which will include cases occurring as a result of acute parenchymatous nephritis in which
the changes in the kidneys precede those that occur in the retina; (2) those cases in which the hemorrhage and exudation are preceded by changes in the walls of the vessels (arteriosclerosis), and in this class are those cases accompanying chronic interstitial nephritis in which the changes in the retina may precede the appearance of albumin in the urine.

In discussing the retinitis of Bright's disease, deSchweinitz says that small, discrete and sharply separated white spots, which appear most numerous in the region of the macula, are among the early signs. Again he says, in the consideration of high arterial tension, that if the cause of persistent high arterial tension is sufficiently prolonged, retinal alterations will occur at any age at which the pathologic condition necessary to excite them may arise. He describes three early indications, viz., (1) a markedly cork-screw appearance of certain arterial twigs; (2) a flattening of a vein where it is in contact with an artery; (3) an appearance of the nerve-head often loosely described as congested. Concerning the significance of the signs, he says that they have more than a local significance, and one of the most important indications is that which refers to arteriosclerosis. He calls especial attention to the increase of the blood-pressure as an early symptom, and says that hypertension is not infrequently the first sign of beginning renal or vascular degeneration.

While the more pronounced retinal lesions in general arteriosclerosis and chronic Bright's disease have been frequently described, but little reference, other than that here quoted, has been made to some of the very earliest manifestations, and in particular to the diagnostic importance of these early lesions when associated with hypertension of the arteries. While deSchweinitz apparently makes a distinction between the retinal lesions of general arteriosclerosis and chronic Bright's disease, he describes lesions that are common to both and which are accompanied by hypertension which seems to be an etiologic factor. In the conclusions on which this article is based emphasis will be placed on the supposed fact that the very early retinal lesions are always due to toxic influences and attending, persistent, comparatively high blood-pressure, whether the process is eventually to show the nephritic symptoms to be predominant or not; and further, that the very earliest retinal manifestations do not give any decisive information as to what direction the disease will take later.

Particular attention is here directed to the almost indistinguishable small white dots, few or perhaps many in number, which appear in the neighborhood of the disk, and most frequently in the macular region; the haziness and often a delicate hyperemia of the disk;
isolated, faintly milky colored areas in the retina; the beaded appearance of some of the larger vessels and alteration in the character of terminal vessels (the corkscrew appearance described by deSchweinitz), and, as important as any indication, the appearance of scotomas either with or without visible retinal alteration. Any two or all of these lesions may coexist, and any one or all may exist with but little or no alteration in the vision as detected by the patient. Usually, however, the patient detects a slight impairment of the vision which prompts him to seek relief, or, as is frequently the case, the condition of the retina and its effect on vision are discovered by accident, as in the routine examination for glasses.

As has been pointed out by Ophüls and others, it is difficult, if not impossible, to draw any distinct line of demarcation between general arteriosclerosis and chronic interstitial nephritis, for while clinically one or the other may seem to be of most importance, autopsy seems to show that the two conditions are present together, and that they both come under the heading of arteriovascular change, due to some toxin. It is equally difficult to say whether the eye lesions under consideration should be considered as a manifestation of general arteriosclerosis either in which the nephritic symptoms are to be more or less pronounced, or in which the nephritic lesion is secondary and of minor importance, inasmuch as the early retinal lesions are common to both types of cases. That these eye lesions, perhaps, are not always present is admitted, but from the facts that arteriosclerosis is generally found to involve the terminal arteries, and that the retinal tissue is particularly susceptible to toxemias, it is quite possible that the lesions may be found in a large percentage of cases of arteriosclerosis if they are looked for by a painstaking ophthalmoscopic examination by the direct method with the patient’s pupils fully dilated. When found, as they often are accidentally, they are of much diagnostic and prognostic importance and should lead to such attention of the patient as will tend to retard the progress of the general process.

The coexistence of a relatively persistent high arterial tension is especially significant, as pointed out by deSchweinitz, for the retinal signs under consideration go hand in hand with the continuous high arterial tension of arteriosclerosis, and when coupled with such urinary findings as a low specific gravity and even the occasional appearance of casts, the diagnosis is more complete. Cardiac hypertrophy and accentuation of the aortic second sound are manifestations which occur late, as a rule, and only add to the significance attached to the earlier findings.
BRIGHT'S DISEASE, OCULAR SYMPTOMS OF

Stengel recognizes the importance of ophthalmoscopic examinations in high blood-pressure cases when he says that the ophthalmoscope may reveal positive evidence of vascular disease.

The importance of noting the condition of the retinal vessels is also emphasized by Coates, who says that retinal change remains the best indication of the state of the vessels generally which we possess.

We must not, however, forget that similar lesions arise from other causes. Thus Bichelonne reports a case of neuro-retinitis (without hypertension) simulating albuminuric retinitis, occurring in a healthy man, aged 22, after almost continuous writing for two days and nights. The case ended in steady and complete recovery, but the suggestion is made that we should bear in mind that in renal retinitis eye-strain may be a very important causative factor. With due propriety it may be added that the eye lesion, even though significant, should not be considered alone in arriving at an opinion as to the etiology and pathology of the condition.

The part played by high blood-pressure in the production of these lesions is attested by deSchweinitz, who calls attention to the increase of blood-pressure which always accompanies the early stages of arteriosclerosis, and he emphasizes the utility of the sphygmomanometer. Barrett, in discussing the ophthalmoscopic appearances with high blood-pressure, relates the case of a woman of 23 years with a blood-pressure of 240 mm. of mercury, and entire absence of ophthalmoscopic changes, who many months later showed abundant evidences of albuminuric retinitis, which would seem to indicate that the retinal lesions occur only after persistent high blood-pressure.

The theory that hypertension may precede the general arteriosclerotic changes seems borne out by the findings of Ophils, who considers the increase in the blood-pressure as due to toxic influences, a view that is also entertained by Jones. In support of this view, Widal considers the retinitis as being ureic, and zur Nedden accounts for an involvement of the retina in nephritis through cytotoxins developed in the kidney. Schieck, in discussing renal retinitis, says that he has found marked changes in the nervous elements of the retina but no trace of alteration in the blood-vessels; and Shiba contends that the condition is due to some alteration in the state of the blood.

Concerning the effect of the earlier retinal lesions of arteriosclerosis on vision it is readily understood that the size and the location of the lesions have much to do with the extent of visual disturbance. In those cases in which there are spots or milky patches in the region of the macula there is usually some failure of vision, whereas in those cases in which the lesions are small and away from the macular region
there may be no disturbance of vision noticeable to the patient or determinable by chart tests, though the perimeter will disclose scotomatæ. In fact, relative scotomatæ, varying in shape and size, often may be discovered in those cases in which there are persistent high blood-pressure and but faint ophthalmoscopic signs in the retina to account for the lesion. It is assumed that the scotomatæ are produced by the same toxic influences, acting through the blood, and affecting the nervous elements of the retina, which are responsible for the hypertension and later the arteriosclerotic changes. It is also quite probable, as Garrod says, that the toxin, in a sense, is of uremic origin, for there need be little hesitation in asserting that high arterial tension is a natural outcome of uremic poisoning.

While the retinal lesions, coupled with a persistent, relatively high blood-pressure, alone are significant of arteriosclerosis, the urinary findings add materially to the certainty of the diagnosis. The presence of albumin and casts in the urine has long been recognized as of great diagnostic importance when associated with other symp-
toms, though Dieulafoy thinks that their importance has been exag-
gerated. He further says that hyaline casts are unimportant, though granular casts always indicate a lesion of the kidneys. McCrae says that a hyaline cast is an indicator of disease, and Garrod contends that hyaline casts indicate the slightest degree of renal mischief. The retinal lesions under consideration frequently occur before there are urinary findings of significance, and it is only later that albumin-
uria and casts, specially granular, are found in the urine, and then the retinal lesion is also advanced so that the picture is quite charac-
teristic and in keeping with classical text-book descriptions.

The value of the sphygmomanometer in determining the blood-pres-
sure in eye cases has been emphasized by numerous writers including deSchweinitz, Dunn, Black, Barker and Haines, Semple, Veasey and others. Jackson, in discussing blood-pressure from the standpoint of the ophthalmologist, says that not only should ophthalmoscopic symptoms of increased blood-pressure lead to the use of the sphyg-
momanometer, but an elevated reading with the sphygmomanometer should call for an ophthalmoscopic examination.

The fact that eye signs are often detected during the course of an examination for the correction of refractive errors, or may be dis-
covered otherwise in an accidental manner, shows the importance of giving all cases coming into the hands of the ophthalmologist a care-
ful ophthalmoscopic examination, and many general physicians may obtain corroborative evidence in their arteriosclerosis cases by obtaining a report as to ophthalmoscopic findings. The further fact that
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these ocular signs are among the very earliest symptoms, susceptible to detection by careful examination, is important from a prognostic standpoint, because the earlier the diagnosis can be made the more probable it is that good results will be secured from treatment.—(A. E. B.)

The treatment of the ocular symptoms of chronic nephritis depends, of course, upon the conduct of the underlying lesions.

In all forms of chronic nephritis cardio-vascular signs develop sooner or later; and it is often a difficult matter to determine whether the changes about the heart and arteries are the primary event that produces the nephritis, or whether the nephritis causes retention of excrementitious bodies that poison the heart and arteries or, finally, whether the same primary cause simultaneously affects both the cardio-vascular apparatus and the kidneys. From a therapeutic point of view it is very important to decide this matter. In Bright's disease we seem to be dealing with a toxemia that involves simultaneously the heart, the arteries and the kidneys. Bright's disease in the modern sense is a systemic disorder that usually produces nephritis, but does not invariably do so; whereas chronic nephritis while often due to Bright's disease may also be due to a great many other causes.

The most important point to remember is that in Bright's disease the determining feature is high arterial tension with resulting cardio-vascular changes and nutritional disorders in various parts of the body and particularly in those organs that are supplied by end arteries, namely, the kidneys, the brain and the retina. The proper treatment of this so-called vascular type of nephritis is, therefore, practically synonymous with the treatment of the cardio-vascular apparatus; for cardio-vascular disorders generally usher in these forms of nephritis, manifesting themselves often in high tension, cardiac hypertrophy, retinitis before albumen appears in the urine; or they appear soon after the nephritic signs become apparent; and cardio-vascular complications generally produce the death of these patients. Cases of this type of nephritis should be treated, therefore, more as heart cases than as kidney cases.

The most important element in all these cases is to combat or prevent the toxemia that, in all probability, produces both the cardio-vascular changes and the nephritis. Whereas the exact character of this toxemia is still obscure, the preponderance of clinical and experimental evidence points to a disordered gastro-intestinal tract and liver as the source of these poisons. Treatment should, therefore, in most cases be directed towards correcting any digestive or hepatic disorders that may exist. Here intestinal antiseptics and all the means
intended to correct perversions of the functions of the stomach and bowel have their place.

In arranging a diet for any case of Bright's disease three conditions must be fulfilled. First, the diet must contain qualitatively and quantitatively all that is needed to maintain general nutrition (nutritive equilibrium). Second, the diet must contain as little as possible of materials that in their ultimate passage through the kidneys can irritate the renal epithelia or the glomeruli. Third, the diet, while sparing the kidney function, must not overtax or otherwise injure the functions of the digestive or circulatory organs.

A word may be said in this place in condemnation of excessive milk feeding in chronic nephritic cases. Unless enormous quantities are given, nutritive equilibrium cannot be maintained with milk alone, for if sufficient milk is given to satisfy the caloric requirement, then a large excess of albumin is always administered. Milk, moreover, is greatly deficient in iron. Finally, the administration of the enormous quantities of water that must be administered with milk given in sufficient quantity is decidedly bad practice; for it is manifestly a precarious matter to persistently flood the circulation with immense quantities of fluid, thereby overtaxing precisely those organs that it is intended to spare, namely, the heart and the arteries. Excessive milk feeding, moreover, gradually becomes disgusting and deprives the patient of that normal psychic stimulus of appetite and enjoyment of meals that is necessary to perfect digestion.

In selecting a diet for a nephritic case, only a few articles of food need be permanently excluded. Some reduction should be made in the administration of albumins, but care should be taken never to go below the necessary daily albumin requirement equivalent to about 60 to 80 grains in the 24 hours. Certain meats should be excluded altogether from the diet on account of the extractives and toxic principles that they contain. To this class belong all raw, rare, smoked, cured and corned meats, because they still contain the extractives. Soups, bouillons and meat extracts, as well as most gravies, also contain the extractives in solution. Internal organs like liver, spleen, kidney, brain, pancreas contain very abundant nuclein; and, as nuclein in process of digestion is split up into purin or alloxuric bodies, a group of substances that are distinctly toxic and can both irritate the kidneys and the cardio-vascular apparatus, these articles, too, should be excluded. All spices and condiments should be forbidden. In the selection of other articles of food, the idiosyncrasies of the patient and the condition of the gastro-intestinal tract should be taken into con-
sideration in each individual, so that it is impossible to formulate any fixed diet rules applicable to every case.

As to beverages the amount of liquids should, as a rule, be restricted, particularly if evidence of myocardial degeneration or of arterio-sclerosis has become apparent. An occasional "drinking day," on which abundant water drinking is permitted is at times useful, because it aids in ridding the body of excrementitious material that accumulates. Alcohol should be completely forbidden, especially in the form of cordials, liqueurs, absinthe, because these beverages contain essences and flavors (aldehydes) that are excessively irritating to the liver and the kidneys. Tea and coffee are theoretically contraindicated in chronic nephritis. Rather than have the patient, however, suffer from the hardship that the withdrawal of these accustomed stimuli entails, a little weak tea or coffee had generally better be allowed.

An important rule in feeding nephritics of any type is the reduction in the amount of table salt. In edematous cases it will be found that this practice, especially when carried to the complete withdrawal of chlorides, frequently leads to the disappearance of all puffiness.

The medicamentous treatment of Bright's disease is a matter of very subordinate importance. What drug treatment is used should be directed towards improving the condition of the cardio-vascular apparatus. There is no remedy that can exercise any healing influence upon the kidneys; per contra, most drugs decidedly irritate these organs. The less medicine, therefore, one gives in Bright's disease the better. Here and there it may become necessary to stimulate catharsis and diaphoresis, but these are emergency measures and must be considered means of last resource. What symptomatic treatment it is intended to carry out is best undertaken by means of hydrotherapy; here a large and useful field opens up, but it is impossible here to enter into any of the details. The selection of a proper climate and altitude is, of course, of the greatest importance in all very chronic types. Here similar principles should govern the choice of a resort as in heart cases. The so-called surgical treatment of Bright's disease is mentioned merely to be altogether condemned.—(A. C. C.). See, also, Albuminuric retinitis.

Brille. (G.) A lens; also a pair of spectacles.
Brille, Heilwert der. (G.) Therapeutic value of spectacles.
Brillenbestimmung. (G.) Ordering of glasses.
Brillenkasten. (G.) Trial case.
Brillenschlange. (G.) Cobra di capello.
Brillenwahl. (C.) Choice of lenses.
Brilliancy. A term applied to photographic negatives to denote harmony of light and shade in the image and absence of fog.

Brisseau, Michel. Born at Tournay, France (then, however, within the boundaries of Germany), he practised at Douay as a physician in the Royal Hospital, and was for a time a professor of medicine. But little is known about his personal life. He was never an ophthalmologist, or even a surgeon; in fact, he expressly declares in one of his books that, in all his life, he never made use of the knife excepting upon the cadaver only. He died in March, 1743.

He is often supposed to have been the discoverer of the true nature and location of cataract. This, however, is a great error. Quarré seems to have been the first to teach the correct doctrine, Rolfinck the first to demonstrate that doctrine anatomically (1656). Furthermore, others than these two "way-breakers" propounded the correct idea before the time of Brisseau. But to Brisseau belongs (together with Antoine Maitre-Jan) the credit of re-discovering the truth in regard to the point in question and of directing, one might almost say compelling, the attention of the scientific world to the actual demonstrable fact. No doubt Maitre-Jan brought to bear a far more powerful influence with regard to this matter than did the young Brisseau, but, all the same, Brisseau fought the good fight valiantly, and to him as well as to the older man, must be assigned a portion of the credit.

Brisseau wrote three ophthalmologic books, all small in size, but mighty in consequences. These were: "New Observations Concerning Cataract" (Tournay, 1706), "Sequel to the Observations Concerning Cataract" (Tournay, 1707), and "A Treatise on Cataract and Glaucoma" (which included his former "Observations") (Paris, 1709).

A passage from the introduction of the last-named work will serve to show the things for which this brilliant young Frenchman will always be remembered: "Nothing was less in my mind than an investigation into the nature of cataract: when I learned that, in the Governor's residence at Tournay, a thief, taken in the very act, was being prosecuted, and that, in order to mask his business, he had falsely pretended to be an oculist and therefore had upon his person a number of cataract needles. I requested and received these needles, which were wanting to my box of instruments. This occurrence set me reflecting again over certain doubts, which I had already felt concerning the view about cataract. I made a number of experiments on animals' eyes, and found every time that, when I sunk the needle into the bulbar conjunctiva in the customary way, I could
not shove it on into the vitreous without perforating the lens, which, instead of restoring sight, must, of course, have the effect of destroying it. [Brisseau still harbored the view, even then somewhat antiquated, that the crystalline lens (and not the retina) is the essential organ of vision.] At least this, according to the current view which considers the crystalline humor as a structure necessary to vision. I waited for an opportunity to clear up my ideas about this. Then came a soldier, who had a cataract, into our hospital at Tournay, to die. After his death, I performed upon him the cataract-operation; then dissected his eye and found the crystal clouded and hardened beneath the vitreous, whither I had sunk it. So I came to the conviction that a genuine cataract was, in no case, a membrane which had been produced in the vitreous, but, rather, a hardening and clouding of the lens.

"A short time afterward, a person of quality, who had been treated by my father and me, desired that I might accompany him to Paris. There I laid my discovery before M. Duverney, who, however, would not believe it. On the following day I called together M. Duverney with M. de Carlion, Physician of the Faculty, and M. Bessière, Surgeon to the King, to consult about the patient, who kept us to dine with him. Here I once again propounded my view concerning cataract. M. Duverney opposed that view with heat, saying before the others that he advised me as a friend not to make it public, if I did not wish to endanger my calling. Thereupon, I replied that those who opposed the view had more at stake.

"I honor M. Duverney, under whom I learned anatomy; but he cannot take it ill that his pupil should estimate the truth above all else.

"I spoke then concerning this discovery with (in the meantime deceased) M. Dodart, who found it both remarkable and acceptable, advising that I set it down in writing and support it with as many experiments as seemed to me to be at all possible. After my return I wrote a treatise on the subject, which I sent to him and which he read in the Royal Academy of Sciences, Nov. 18, 1705. He sent it back to me, with the signature of the permanent secretary of the Academy, and informed me that the new doctrine had caused a few of the gentlemen to vacillate, while, upon the others, it produced no kind of impression.

"Toward the end of the same year, while I was busy with the printing of this discussion, under the title, 'New Observations Concerning Cataract,' the same M. Dodart informed me in a letter dated Dec. 18, that M. Antoine, surgeon at Mery-sur-Seine, had discovered
and discussed the same thing as I, although with a certain difference. In the History of the Academy of the year 1707, this teaching is mentioned ‘when occasion offers,’ as it is said, of the book of M. Antoine, which appeared in this year. I was astonished that none seemed to have recalled that my ‘Discussion’ had been read 18 months previously: especially as, according to the letters which I possess from M. Dodart (who meanwhile had died) it had made a great noise, and evoked a number of replies, and especially M. Woolhouse, Oculist to the King of England, and M. Antoine had transmitted a number of papers against mine, before the publication of the latter’s work.

‘It is manifest that I have borrowed nothing from M. Antoine, and I concede that he, in his turn, has got nothing from me, and that we both should share in the honor of the discovery. Moreover, we two are not the first who have spoken of this matter. One knows, since then, that M. Lasnier, a skilful physician and oculist at Paris, made the same discovery more than forty years ago and that both Gassendi and Rohault, to whom he mentioned it, incorporated it in their writings. We, however, are none the less discoverers, because the former discovery had lapsed into oblivion, because, that is to say, no mention of the matter occurs in any text book or course on anatomy or surgery, and because the Academy itself has regarded the matter as an innovation.

‘In the beginning of the year 1708 I printed a second discussion, in which I described the operation on a very difficult cataract, which I myself—for the first time in my life—declined; and in addition four new dissections of cataracts on the dead, wherefrom arises the only possible inference—namely, that our teaching is true.

‘To these I now add a third discussion, in which are included several new and similar dissections, among them also the description of the two cataract operations on one patient, which I performed in the presence of a number of very skilful fellow-specialists, and thereby have demonstrated that this disease consists solely in clouding and hardening of the crystal.

‘I had indeed the intention to fuse together these three treatises into one more consistent whole. But numerous patients claim nearly all my time. I hold, however, the hope that the Academy will grant to me a certain justice.’—(T. H. S.)

Broca’s lobe. By this term is generally meant what the anatomists called the grande lobe lymbique, the convolution of the cerebral cortex that forms the continuation of the gyrus hippocampi with the gyrus fornicatus.
BROCA'S ORBITAL INDEX

Broca's orbital index. As is well known the size, shape and relations of the base of the orbital cavities vary greatly. For the purpose of definitely measuring these Broca introduced an orbital index, which is the ratio of the height to the breadth of the base. In other words, this index equals the height of the orbital base multiplied by 100 and divided by its width. As Dwight points out, "if the index is below 84 it is microsene, from 84 to 89 mesosene, and above 89 megasene. A large index means a high orbit. The index of English skulls is given as 88.

The height of the orbital opening is easily measured. Unfortunately, there is a vagueness and discrepancy in the directions for measuring the breadth. Flower gives the inner point as that where the crest bounding posteriorly the lachrymal groove strikes the suture below the frontal bone. This has the great fault of excluding the lachrymal canal from the orbit, in which it certainly belongs. Broca takes the daeryon,—i.e., the point at which frontal, inferior maxillary, and lachrymal bones touch. This would include the groove, and yet he states that it is not in the orbit."

Brocklesby, Richard. Born at Menehead, Somerset, England, Aug. 11, 1724, he became a well-known military surgeon, and wrote, in addition to other volumes, "Economical and Medical Observations," in two parts, from the year 1758 to the year 1763 inclusive, tending to the improvement of military hospitals and to the cure of camp diseases incident to soldiers," etc. (London, 1764.)

Brocklesby is of interest to ophthalmologists only because of having communicated to the Royal Society the very important "Observations on Vision" by Thomas Young. (—T. H. S.)

Broad-sighted. Having a wide angle of view.

Brodun's photometer. See Photometer.

Broiement. (F.) Breaking; laeration.

Broken telescope. A telescope, the tube of which is bent at right angles, a reflecting prism or mirror being inserted at about an equal distance from the object glass and its focus.

Bromacelanilid, Ocular symptoms from. One reference is made by Lewin and Guillery to antisepsin, a trade-name for this antiseptic agent, derived from acetalanilid by means of bromine.

A toxic dose of 0.30 gram induced a bluish cast over objects, vertigo, muscular weakness and squint. The ordinary dose is 1 to 8 grams (0.06—0.50 grm.) in rheumatism, typhoid fever, and neuralgia. It is also used locally.

Bromäthyl. (G.) Ethyl bromide.
Bromatotoxin. A basic poison developed in decayed or musty food by the growth of microorganisms and the toxins generated by them.

Brombeerspinner. (G.) Gastropacha rubi; one of the caterpillars whose hairs set up an ophthalmia nodosa.

Bromelain. This remedy has been recommended for internal exhibition by Motolesse (Annali di Ottal, 1911, p. 852) in alcohol and tobacco amblyopia.

Bromide of lithium. LiBr. This bromide is a white, deliquescent and slightly bitter salt, freely soluble in water and alcohol. It is antilithic and sedative; dose 10 to 30 grains. It resembles in action bromide of potassium (q. v.), and has been especially advised as an adjunct in the treatment of asthenopic symptoms, and retinal hyperemia.

Bromide of potassium. KBr. This useful ophthalmic remedy occurs mostly as a granular powder or as medium-sized crystals, with a decidedly saline, pungent taste. It dissolves in one and a half parts of water and 180 parts of alcohol. It is a valuable sedative and soporific and is to be recommended, for example, in combination with small doses of chloral hydrate as a soothing draught the night after ophthalmic operations. It is also useful in the treatment of hyperemia of the choroid, erythropsia (in combination with other bromides) in asthenopia, the nervousness of toxic amblyopia, etc. The dose is 20 to 60 grains.

Oculotoxic symptoms are occasionally seen as a part of bromism, especially in epileptics taking very large doses of the drug. Lewin and Guillery (Vol. 1, p. 112) speak of visual disturbances followed by blindness in a drunkard and epileptic who took 10 to 15 grains daily. The mirror showed small retinal vessels and pale disks. Potassium iodide was substituted for the bromide and in five weeks vision returned.

In addition to its effect on the optic nerve the excessive use of the bromide has been responsible for ptosis, chromatopsia and wide dilation of the pupils.

Bromide of sodium. NaBr. A white, crystalline powder with a saline and slightly bitter taste. It absorbs moisture from the air, but it is not decidedly deliquescent. It contains more bromine than bromide of potassium (q. v.), and is said to be less depressing. It is useful in intraocular hyperemias, ocular headache and the nervousness and insomnia incident to diseases of the eye. Dose, 5 to 60 grains. It has been accused (on slight evidence, however,) of producing cloudiness of the lens.

Bromidia. A trade name for an American nostrum, each fluid dram
of which contains, according to the proprietors, chloral hydrate, 15 grains; potassium bromide, 15 grains; cannabis indica, $\frac{1}{8}$ grain; hyoseyamus, $\frac{1}{8}$ grain. Although a dangerous mixture when used indiscriminately by the uninstructed public, yet the combination is a good one in post-operative and asthenopic insomnia and restlessness. The dose is from 30 to 60 drops.

Bromkalium. (G.) Potassium bromide.

Bromomethyl. Methyl bromide.

Bromoform. Formyl tribromide. Tribromomethane. CHBr$_3$. This heavy, colorless liquid has a taste and odor resembling chloroform. It is an anesthetic and nerve sedative.

Its employment in whooping-cough (dose 2 to 8 drops) has led to a number of serious intoxications with, occasionally, eye symptoms. These are mostly dilated and motionless pupils and nystagmus-like movements of the eyeball, all of which, as a rule, disappear with the general symptoms.

Bromvalidol. A trade name for a combination of one of the bromides and validol. It is obtainable only in the form of tablets, each said to contain sodium bromide 1.0, magnesia usta 0.1, and validol 5 drops. One tablet dissolved in a half glassful of water is the average dose. This mixture is said to be of use as a sedative after operations and for insomnia of ocular origin.

Bronchite. (It.) Bronchitis.

Bronchitis. Certain associated diseases of the eye are laid to the door of this pulmonary complaint. Although some of them are probably coincidences, yet very likely simple conjunctivitis, episcleral abscess, herpetic keratitis, iridochoroiditis, metastatic ophthalmia and acute attacks of glaucoma are sometimes set up by various forms of bronchitis, and this fact should not be forgotten in the conduct of these cases. Most of the ocular affections following pneumonia may attend a bronchopneumonia. It should be remembered, also, that cataract extraction and other operations that involve opening the eyeball should be avoided during the active stages of the disease.

Bronchocele. Goitre. About the only interest, apart from exophthalmic goitre (q. v.), that attaches to this disease is its alleged production of cataract. Just how they stand in the relation of cause and effect is, to say the least of it, somewhat difficult to understand.

Bronzé. (F.) Bronzed.

Bronzed glass. Glass rendered iridescent by superficial corrosion.

Brooke’s ointment. An ointment for the treatment of tubercular disease of the palpebral skin, or lupus. It is composed of oxide of zinc and powdered starch each $\frac{1}{4}$ ounce; white vaseline $\frac{1}{2}$ ounce; mer-
cury oleate (5 per cent.) one ounce; salicylic acid 20 grains; ichthylol 20 minims; oil of lavender q. s., with sufficient red Armenian bole and raw umber to match the color of the skin, and so to disguise the otherwise disagreeable appearance produced by the salve on the face. It should be thoroughly rubbed into the infected area two or three times daily, after removal of the epithelial débris.

Brossage. Swabbing. Brushing. Instrumental massage. This procedure, most frequently employed in the treatment of trachomatous and other forms of "granular lids" involves the cleansing of the parts by instrumental massage that stops short of the more radical method known as gratte (q. v.). The present popularity of brossage is largely due to the advocacy of Darier, who has supplemented the simple "brushing out" of the follicles by a number of additional operative procedures. If there is any reason to believe that eversion will be difficult, he begins by dividing the external angles. If the caruncle is very much involved, it is excised. Corneal pannus is curetted. The bulbar conjunctiva is then gently scrubbed with the brush, followed by lavage with sublimate. The lower lid is grasped with a special forceps (similar to a hemostatic forceps) with points on its surface for penetrating the tarsus. It is necessary to seize the lid 2 mm. from the marginal border to avoid tearing the tissues. The forceps thus placed roll the lid backward in such a manner as to stretch the conjunctiva without tearing it. All the granulations are then carefully scarified. If they are few and scattered, a bistoury or discission needle will suffice. If, on the contrary, the entire conjunctiva and the tarsal cartilage are infiltrated, Darier prefers the three-bladed knife, which renders it possible to make the scarifications more rapidly. The depth of the incisions should depend on the thickness of the granular infiltration, the aim being to bring to
the surface the contents, while sparing the conjunctiva as much as possible. This gelatinous débris must be carefully cleaned away from the wounded surface. Then follows the "brossage," which is done with a small tooth-brush with hard and short bristles, previously disinfected by immersion in alcohol and then in a warm solution of cyanide of mercury. During the operation the brush is frequently dipped into a solution of mercury cyanid 1 to 500. One should aim to scrub just vigorously enough to empty the infiltrated

tissue without bruising or tearing the little strips of conjunctiva between the scarification lines. After releasing the grasping forceps, the granulations which have been hidden by the instrument must be scarified and brushed out. The forceps are applied to the upper lid in a precisely similar manner and the lid rolled back. It is important to begin the scarification in the cul-de-sac because the conjunctiva, once scarified, retracts. The "brushing out" is performed as on the lower lid. The dressing consists of a cotton compress moistened with a 1 to 2,000 solution of cyanide of mercury kept on by means of a bandage. The following day the upper lid is carefully turned and gently douched, care being taken to avoid hemorrhage and to preserve the conjunctival tissue. If one cannot
evert the lid, a probe should be passed between the globe and the lid to prevent adhesions. The following days a 10 per cent. solution of argyrol is instilled. In a fortnight the patient is well on the road to recovery, but solutions of cyanide of mercury alternating with instillations of argyrol should be kept up several months.

The indications for brossage are, according to Terrien, (1) the presence of voluminous granulations occupying the cul-de-sac, whether associated with inflammation or not, and (2) when the infiltrated conjunctiva is being converted into waxy tissue. It has the advantage over massage that the granulations, even those hidden above the tarsus, are all reached. Improvement does not always last and repetition of the operation may be necessary. One positively unfavorable sequel is entropion, which occurred in fifteen cases out of one hundred and thirty operated on. It is probably due to too energetic brushing, which, in exceptional cases, is said to have led to the complete destruction of the conjunctiva. See, also, Grattage and Trachoma.—(J. G.)

Brosse. (F.) Brush.
Brouillard. (F.) Fog; mist.
Brouillard lumineux. (F.) Bunsen burner.
Browne's (Crichton) sign. This is a tremor of the labial commissures and outer angles of the eyes seen in the early stages of senile or paralytic dementia.

Browne's pupillometer. Edgar Browne invented one of the earliest forms of pupillometer, an ivory plate bearing a number of holes ranging in diameter from one-half to 7.5 mm. The patient fixes an object, and the instrument, placed close to the eye, permits of accurate measurement of the pupillary diameter by direct comparison of the openings in the scale with the near-by pupil. To secure accuracy of observation in recording the results, a note should be made of the amount and character of the illumination and the distance of the fixation point.

Brown ointment. For many years the Editor has employed this mixture—a name given by him to the dilute citrine ointment of the B. P. (ungt. hydrarg. nitritis., U. S. P.) when prepared with cod-liver oil instead of neat’s-foot oil of the British, or the lard of our own, pharmacopeia. When thoroughly mixed it should be exposed to the air in a protected jar at least three weeks, stirring it every day or two, until the yellowish-white-brown ointment turns almost black-brown. In the course of a month after preparation mercuric iodide (or still more complex organic compound) is formed which joins with some constituent of the oil to convert the original mixture into a smooth, oily, seal-brown mixture of the consistence of
molasses and a decided odor of fish. In winter, or if in full strength it proves too irritant, I am in the habit of reducing it with additional cod-liver oil. For all these purposes I generally keep on my treatment table three strengths of brown ointment, the strong, undiluted; a weaker, reduced with 10 per cent. of its bulk of cod-liver oil; and a very weak mixture made with 20 per cent. of cod-liver oil.

This salve I almost always use myself as an office application in most forms of chronic blepharitis and blepharo-conjunctivitis and invariably in conjunction with massage (q. v.). I find that the act of rubbing it into the sac with the fingers prevents the pain and smarting that follows its use without massage. After a thorough massage, during which the expressed strings of mucus should be coaxed out of the sac, the excess of ointment must be wiped from the lid edges with cotton and the patient ordered to bathe the eyelashes clean of remaining ointment with hot water an hour or two after the treatment. Care should at the time be taken to prevent any of the ointment from touching the clothing, as it makes an almost indelible stain. Most cases of simple hypertrophy of the lid tissues and chronic blepharitis begin to improve after the daily use of this agent for a week or two.

Brown collyrium. An ancient eyewater made by boiling 1 drachm of (hepatic) aloe in 1 1/2 oz. of white wine, and then adding to the decoction 1 fluid drachm of rose-water and 30 drops of tincture of saffron.

Bruch, Clusters of. Aggregated gland of Bruch. A number of follicles in the conjunctiva, mostly congregated within the folds of transmission. See Histology of the eye; Anatomy of the eye.

Bruch, Membrane of. Bruch's layer. This choroidal layer—the lamina basalis—was first fully described by Bruch (Zur Kenntniss des körnigen Pigments, Zurich, 1844) as composed of delicate epithelial cells from which were derived the retinal pigment. It later was shown to be the condensed connective-tissue stroma of other layers. It was also long believed to be a homogeneous basement layer, a secretion-product of the pigment epithelium of the retina and really a part of that coat. Parsons (Pathology of the Eye, p. 478) believes that "the membrane of Bruch, which seems homogeneous when stained with eosin, can be resolved into two layers by special staining. It seems highly probable that the difference represents a difference in origin. The fine elastic fibres of the outer layer are in all respects similar to the elastic fibres found in the neighboring choroid, and must, therefore, be looked upon as contributed by the choroid, since it is difficult to believe that definite
Brucine. This is one of the strychnia-like alkaloids derived from the nux vomica and ignatia, but said to be only one-tenth as poisonous as strychnia. It occurs as white crystals. There are several salts, more soluble in water than the pure alkaloid, on the market. These are, chiefly, the hydrobromide, hydrochloride, nitrate and sulphate.

As the ophthalmologist relies on the hypodermic use of nerve tonics and stimulants, this rival of strychnia should not be forgotten. Skorjuchow prefers a preparation which contains less than 0.1 strychnin. It is injected under the skin of either the temporal region or of the arm in quantity varying from 0.005 to 0.02 grm. When the injections are made daily he generally uses 0.01, and if the intervals are greater he uses 0.02. The number of injections in cases of optic nerve atrophy were twenty-six, and from forty to fifty in cases of retrobulbar neuritis. In employing this treatment one must be careful to keep a close record of the visual field and to stop the treatment if there appears the slightest evidence of retinal irritation. He has employed the treatment in forty-six cases (eighty-nine eyes) and in sixty-seven eyes improvement was noted. In eighteen no result was obtained, while in four eyes the process grew progressively worse. All in all, he thinks that this drug increases the intensity of the central and peripheral vision of both healthy and diseased eyes, stimulates the action of the eye-muscles, diminishes the grade of the paresis, and frequently produces dilation of the vessels of the fundus. He advises its use in various forms of amblyopia, in acute and chronic retrobulbar neuritis of either alcoholic or other origin, in ordinary optic nerve atrophy, in retinitis pigmentosa and in various forms of ocular paralysis. It is to be preferred to strychnia in the treatment of optic nerve atrophy, inasmuch as it produces a dilation of the vessels of the retina, and in this way promotes the absorption of the pathologic products, while assisting the nutrition of the part. The treatment is contraindicated in all acute inflammations.
Oculotoxie symptoms have been recorded—clouded vision especially—but no serious amblyopia.

**Brücke, Ernst Wilhelm, Ritter von.** A celebrated physiologist of the early 19th century, who paid considerable attention to the physiology of the eye. Born at Berlin, June 6, 1819, as the son of a portrait painter, Johann Gottfried Brücke, he received his general education at the Stralsund Gymnasium and then studied medicine at Berlin and Heidelberg. At the latter institution he graduated in 1842. In 1844 he was made privat-docent for physiology in Berlin. In 1848 he became extraordinary, and, in 1849, ordinary, professor, of the same subject at the same institution. He was a very brilliant teacher, investigator and writer. Honors, therefore, came upon him thick and fast. Numerous orders and honorary degrees were showered upon him. He was made a knight. Among his investigations those relating to physical and physiologic optics were probably the most important. His discoveries in this field, indeed, are declared by some to have paved the way for the discovery of the ophthalmoscope by Helmholtz. He discovered the ciliary muscle almost concurrently with Bowman. He made a number of discoveries regarding the chemical constitution of the vitreous and aqueous humors.

Among his numerous books we may mention the following: “*The Physiology of Colors, for those Engaged in the Fine Arts*” (Leipsic, 1866); “*Fragments of Theory Concerning the Pictorial Arts*” (Leipsic, 1877); “*Lectures on Physiology*” (2 vols., Vienna, 1873-74), and numerous later eds.). Of his articles, those of most importance to ophthalmologists are: “*Anatomical Description of the Human Eye-ball,*,” “*Concerning the Asymmetric Refraction of Light in the Human Eye,*” and “*On Certain Consequences of the Young-Helmholtz Theory.*”—(T. H. S.)

**Brücke lens.** A component microscope lens, adapted for use in dissecting, and comprising a double convex and a double concave lens, so arranged as to secure the advantage of considerable working distance in combination with short focal length.

**Brückencolobom.** (G.) Bridge coloboma.

**Brücke’s muscle.** Tensor choroides. As stated elsewhere (See *Anatomy of the eye* and *Bowman’s muscle*) the ciliary muscle is properly divided into two parts, an outer, meridional one—Brücke’s muscle—and an inner, circular band of fibres known as Müllers’s muscle. These muscles are both of the unstriped variety and are variously developed in different eyes, Brücke’s being more prominent in myopes. Brücke’s muscle arises from the sclera behind and to the inner side of the canal of Schlemm and gradually mingles with and
is lost in the external layers of the choroid; hence the name given to it by the discoverer himself—the *tensor choroideae*.

**Bruecke's loupe.** Bruecke's dissecting spectacles. These lenses, constructed on the plan of the opera glass and intended for short-focus work, such as the examination of the eye, dissecting, operating, etc., magnify from four to six diameters and permit the observer to hold his eyes from 48 to 60 mm. from the object. However, their weight made the device difficult to handle and to keep in proper focus, and it has been superseded by more handy instruments.

**Bruit.** (F.) Bruit; sound; murmur. In suspected pulsating exophthalmus (q. v.) the stethoscope may be employed to elicit a cardiovascular sound which, though generally heard about the orbit or above the eye, is sometimes audible over the whole cranium. The patient, like the surgeon, may recognize it as a buzzing, roaring or hissing sound, not unlike an aneurysmal or valvular bruit murmur,

**Bruit de clapotement.** (F.) Splashing sound.

**Bruit de diable.** (F.) A continuous bruit heard in the jugular veins of anemic persons.

**Bruit de frôlement.** (F.) Rustling sound.

**Bruit de frottement.** (F.) Friction sound.

**Bruit de glou-glou.** (F.) Splashing sound.

**Bruit de pot fêlé.** (F.) Cracked-pot sound.

**Bruit de souffle.** (F.) Bellows sound.

**Bruits du cœur.** (F.) Sounds of the heart.

**Brûlant.** (F.) Burning; hot; ardent.

**Brûlure.** (F.) Burn; scald.

**Bruns’ advancement operation.** This procedure is concerned with a modification of the hook invented by Clark. (See *Muscles, Ocular, Operations on*). This latter surgeon devised an instrument in which a central movable hook placed between two fixed hooks can be made to project, or can be drawn up by means of a milled screw and rachet. The handle is made detachable, so that in the absence of an assistant it may be removed, leaving the hooks as a clamp holding the tendon in position for introducing the sutures. Clark prefers to include as much of the capsule as possible in the fold. Three stitches are used, the lateral sutures interlocking with the central one. Clark at first suggested excision of the loop, but later stitched it down anterior to the tendon insertion.

Bruns modified the instrument of Clark by giving the central movable hook a longer bearing in the milled screw collar. To secure the loop he uses a double suture which transfixes the center of the tendon. The needle being cut off, each half of the suture is tied
around the corresponding half of the tendon. Bruns also had a hole drilled in the tip of the movable hook. After securing the tendon a ligature is threaded through this hole. As the hook is withdrawn it carries the thread through the loop. This is armed with a needle at each end, and these needles are carried beneath the conjunctiva, one towards the upper, the other towards the lower corneal margin. They are brought out at the limbus near the vertical diameter. One end is then carried back to the posterior flap of the conjunctiva and

Clark's Double Hook for Advancement by Folding the Tendon.

passed through it. The tying of the two ends together, and the tightening of the loop of the suture, spreads the tendon flat upon the sclera towards the cornea, and brings forward the posterior flap of the conjunctiva. This "guy suture" becomes slack and should be removed in a week. The sutures in the tendon can be left for months or permanently.—(E. J.)

Brunschwig, Hieronymus. A celebrated surgeon and ophthalmologist, the first in all history to remove a foreign body from the eye by means of the lodestone, or magnet. See Brunschwyck.—(T. H. S.)

Brunschwyck, Hieronymus. He was also called Braunschweig, Brunschwig, Brunswick, and Brunswyck. Born about 1424, he is said by Malgaigne to have lived 110 years. He studied at Bologna, Padua, and Paris, and became a very distinguished surgeon. As to his personal character we know very little, except that he was said to have been a hard student and a man of great honor.

Brunschwyck is chiefly memorable in ophthalmology because of the fact that he was probably the first in all history to employ the magnet, or lodestone, for the extraction of magneto-attractable foreign bodies from the eye.

The ancient Egyptians and the Greeks knew about the lodestone and its iron-attracting properties, but employed the substance in ophthalmology only as a casual ingredient in eye-salves. The physicians of ancient India, as recorded by Susruta, in his Ayud-Veda, made use of the magnet for the purpose of extracting foreign sub-
stances which had entered the body via a wound in the skin, but, so far as known, they never employed the magnet in ophthalmology. There is very much doubt about the time when Susruta flourished, different attempts to fix his period varying by nearly as much as a thousand years. Most likely it is, however, that he lived about the commencement of the Christian era. The passage in question runs as follows: "An iron arrow-point, which lies in the direction of the fibres of the tissues, is not tightly imbedded, and has no barbs, and with a wide opening in the skin, can be drawn out with the lodestone."

Then, for about a millenary and a half, there was not the slightest progress in the use of the magnet medically. The long period of torpor was broken into at least by Brunschwyck, who, for the very first time in history, so far as records show, removed a foreign body from the eye by means of the magnet. The passage in which this notable event finds earliest mention is Brunschwyck's own book, entitled "Das ist das Buch der Cirurgia, Hantwirkung der Wundartznei." This book, written in 1462, was not published till 1497. The passage in question runs as follows: "Ob es aber weber von eyezen figelot (Peilicht) so sper das Aug etwas auff unnd heb dar für ain magneten stain der Züuhet das ansich."

We may add, for the sake of completeness, the following: Fabricius Hildanus, in 1624, repeated the performance of Brunschwyck.

That Nikolaus Meyer, in 1842, was the first to remove by means of a magnet a foreign body applied through a wound in the sclera—in other words, to remove by the magnet-operation a foreign body from the ocular interior.

That, in 1874, MacKeown first made a surgical incision through the ocular tunics for the purpose of performing the magnet-operation.

That, finally, in 1875, Julius Hirschberg invented the electro-magnet for the removal of attractable substances from the eye.—(T. H. S.)

**Brushes of Haidinger.** This is an entoptic phenomena which may be demonstrated by looking at the sky through a Nicol prism. When this is done an indistinct cross, one arm of which is yellow and the other blue, is perceived.

**Brushing of the lids.** See Brossage.

**Brut, -te.** (F.) Not organized.

**Bubikir.** See ar-Rhazi.

**Bubone preauricolare.** (It.) Swelling or inflammation of the preauricular gland.

**Bubonic plague, Bacillus of the.** This bacillus of the bubonic plague is
a not uncommon cause of eye diseases, as well as of other organic lesions. Of 601 cases during an epidemic, 4.3 per cent. exhibited ocular changes ranging from keratitis to retinal hemorrhages.

The bacilli from infected tissues, are short thick rods with rounded ends. They appear mostly single or in pairs, and are characterized by exceptional variations. This bacillus stains well with the aniline dyes and is negative to Gram’s stain.—(S. H. M.) See Bacteriology of the eye.

Bubophthalmia. Keratoglobus or buphthalmia (q. v.). Infantile glaucoma.

Bucasis. A distinguished Arabian physician and ophthalmologist. See Abul Kasim ben Abbas al-Zarawi.

Buccal fistula. This condition is occasionally mistaken for true lachrymal fistula especially when it opens, as it usually does, at the lower margin of the orbit in a locality that gives rise to a suspicion of the former disease. However, in buccal fistula a sound will pass in all directions except upward.

Bücherdruck. (G.) Print (of books).

Budge’s ciliospinal center. This name has been given to the neuronic collection of cells that constitute the origin of the pupil-dilating fibres. It is situated in the cord between the exits of the fourth dorsal and sixth cervical nerves.

Buffon, George Louis Leclerc, Comte de (1707-88), was born at Montbard, in Burgundy. After studying law at the Jesuit college in Dijon, he devoted himself wholly to science. He soon gained distinction as a writer on scientific subjects, and after being admitted to the Academy was in 1739 appointed director of the Jardin du Roi. He then formed the design of his Histoire Naturelle, in which all the known facts of natural science were to be embodied and discussed in what he believed to be language of the loftiest eloquence. In producing the fifteen volumes of the Histoire, which appeared between 1749 and 1767, he was assisted by Daubenton, the Abbé Bexon, Guesneau de Montébliard and others. The work brought him an immense reputation, and was translated into most of the languages of Europe. After receiving various high honors, he was made Comte de Buffon by Louis XV. He was rash and over-confident in his speculations; his book has no longer any scientific value: but he was inspired by a genuine love of knowledge. He sought to invest natural science with new dignity and interest in the eyes of the world at large, and he undoubtedly achieved his object. (Standard Encyclopedia.)

The modern ophthalmologist is very properly interested in this
scientist because nearly two centuries ago he sought to explain squint (Sur le cause du strabisme ou des yeux louches, in Memoires de l'Academie, 1743) by a difference between the two eyes. He referred distinctly to a difference in refraction, although he confounded it with a difference in the visual acuity. According to Donders (Accommodation and Refraction of the Eye, p. 413), Buffon especially endeavors to show that unequal impressions of the same objects on corresponding parts of the retina are more disturbing than those of wholly different objects. The one eye would therefore instinctively deviate where there is a great difference between the eyes. In this he has had in view chiefly, one might almost say exclusively, strabismus convergens; but at the close of his essay he speaks also of some cases, "where one eye is used in looking at distant, the other at near objects, while the unused eye deviates either inwards or outwards." Besides this, Buffon believed that, so far as the regions of accommodation for the two eyes coincide, even when the boundaries of those regions differ, both eyes may receive sharp images of the same object, and that thus the tension of accommodation in each eye, independently of the other, can regulate itself according to the distance of the object.

**Bufidin.** A poisonous alkaloid from the venom of the toad, said to resemble digitalin in its action; it is the same as phrynin. See **Bufo vulgaris**.

**Bufotalin.** A poisonous agent discovered and isolated by Phisalix and Bertrand from the parotid gland and skin of the toad, **Bufo vulgaris.** It is a transparent resinoid, soluble in alcohol, chloroform, and acetone. It has a special and direct action on the heart. It affects the eye as a corneal and conjunctival anesthetic. See **Bufo vulgaris**.

**Bufo vulgaris.** COMMON TOAD. Toad poison has on several occasions affected the eyes. Under the name of phrynin, bufonin, and bufidin a poisonous alkaloid, extracted from the venom of the animal, has been found to resemble digitalin in its action.

**Buftalmia.** (It.) Buphthalmia.

**Bulbar and pseudo-bulbar diseases.** When a primarily degenerative lesion, whatever its cause, is located in any part of the cerebral axis, it gives rise to a combination of symptoms referable to the cranial nuclei involved in the compass of that lesion. The great functional importance of the medulla oblongata, in whose substance reside the nuclei of glosso-pharyngeal, hypoglossal, vagus and spinal accessory nerves, has led to a somewhat elaborate clinical classification of the disease processes affecting it.
Chronic progressive bulbar paralysis. Labio-glosso-laryngeal paralysis. A disease of chronic and progressive type, characterized by paralysis involving the lips, tongue, throat and often the larynx, and more rarely the motor parts of the trigeminus, facial and ocular nerves.

No form of treatment can appreciably influence the course of this disease, which is commonly fatal within three years after onset. Neither syphilis nor alcohol has any direct bearing on this malady, consequently specific treatment is not indicated. Hypodermatic injections of strychnine in increasing doses from gr. 1/60 to gr. 1/10, as given in progressive muscular atrophy, may be tried, but will be found disappointing. Efforts, therefore, must be directed at the physical comfort of the patient. Diet of the proper sort, especially in the latter stages, is of great importance. Food of good quality should be given in liquid or semi-solid form, consistent with the difficulty in swallowing, and when aspiration symptoms threaten, stomach-tube-feeding becomes a necessity. Large quantities of milk, eggs and broth may be taken in this manner for months at a time. Nutrient enemata are also indicated.

Electricity has been recommended, especially by Remak and Kussmaul (galvanic current with anode placed at nape of neck and cathode applied over muscles at either side of trachea), but is of doubtful value. When aggravating symptoms of coughing, dyspnea, syncope and drooling arise, they require special treatment. Forchheimer says of the use of atropine, grs. 1/130 quite commonly administered to check saliva, that the drooling of paralytics is not controlled by it, and adds, "the drooling is largely due not to increased flow of saliva, but to the impossibility of swallowing the normal amount secreted."

Bromides improve the dyspnea at first, and in the later stages tracheotomy may become imperative. Coughing cannot be controlled by ordinary sedatives, and only the utmost care in breathing and swallowing can prevent it. General tonics, strychnine, arsenic and the hyphosphitics, an out-door life, and other measures to improve hygiene are useful.

Acute (apoplectiform) bulbar paralysis. Hemorrhage, embolism, thrombosis of the arteries of bulb and pons. An affection of the medulla and pons mainly of vascular origin, acute in onset, and immediately fatal, or, as the underlying vascular pathology would suggest, capable of improvement with more or less permanent defect.

The prophylaxis and treatment of the acute stage cited under Arteriosclerosis and Apoplexy is here indicated. In young individuals syphilis is to be thought of as a possible cause, and energetic
specific treatment instituted. As in chronic progressive palsy, the difficulties in swallowing and respiratory embarrassment must be guarded against by proper diet. Nothing is to be gained by use of strong drugs.

_Pseudobulbar paralysis._ An affection characterized by the symptoms of bulbar disease, in which, however, the underlying pathological changes occur not in the medulla oblongata, but in the cerebral hemispheres. Associated with the bulbar symptoms there may be aphasia, progressive mental impairment, hemianopsia, and various paralyses of the extremities. Optic atrophy or neuritis may occur as one of the less constant findings.

This disease, although characterized by frequent remissions, is progressive and ultimately fatal, and treatment is discouraging. The advice previously given in the matter of feeding, hygiene and tonics is pertinent here.

_Myasthenia gravis._ Asthenic bulbar paralysis (Strumpell); Bulbar paralysis, without discoverable anatomical lesion; Myasthenia gravis pseudoparalytic (Solly). A disease of gradual and insidious onset, characterized primarily by extreme general exhaustion following the slightest exertion, and in about one-half the cases associated with symmetrical ocular palsies, chiefly giving rise to double ptosis.

The chief concern in the treatment of this disease should be the evidence of fatigue from muscular exertion of any kind. Absolute rest is most desirable even in the cases of moderate severity. Patients should be advised to do little or no talking, and submit to being slowly fed, in order to conserve muscular strength and energy. Liquid or semi-solid food is to be preferred, as it reduces the effort of swallowing. The use of stimulating degrees of electricity to the muscles, is, according to Oppenheim, absolutely dangerous and to be deprecated. Central galvanization has been advised by some, who claim to have found it useful.

I have observed the action of daily increasing doses of strychnine hypodermically given, and found it of little or no value, except when the patient was receiving at the same time an almost complete rest cure. Fatigue of the upper lids (ptosis) is best overcome by placing a bandage over the eyes for some minutes at a time.—(D. H.)

_Bulbar conjunctiva._ Conjunctiva bulbi. This is the mucous membrane covering the anterior third of the eyeball, from the fornix (folds of transmission or retrotarsal fold) to the corneal margin. It is loosely connected with the underlying sclera, is much thinner than the conjunctiva covering the retrotarsal fold, and no longer
retains its papillary structure. The epithelium of the ocular conjunctiva is continuous with the anterior epithelium of the cornea. See Anatomy of the eye and Conjunctiva.

Bulbare (paralisi). (It.) Bulbar pareses or paralyses.

Bulbar fascia, The. A name for the capsule of Tenon. Inasmuch as the capsule of Tenon is really the lining membrane of a lymph-cavity and has many communications with the intraocular space between the choroid and sclera, as well as the perineural space around the optic nerve and thence onward through to the dural sheath and sub-dural interspaces of the cerebral envelopes, it has received the general name of bulbar fascia.

Bulbar paralysis, Progressive. Glosso-labio-pharyngeal paralysis. Ocular symptoms. In rare cases the progress of the disease upwards affects one or more oculo-muscular centres, above all the rectus externus and the levator palpebræ superioris. Sometimes other muscles are involved and the paresis may even go so far as a complete ophthalmoplegia externa (q. v.). As a rule, the intrinsic muscles are not affected; moreover, the orbicularis, in contrast with asthenic bulbar paralysis, is very seldom affected. In the infantile form the upper facial and the eye muscles are always involved. The prognosis, pathology and treatment are mainly those of the underlying affection. See Neurology of the eye; also, Bulbar and Pseudobulbar diseases.

Bulbe oculaire. (F.) The eyeball.

Bulb of the eye. The eyeball.

Bulborrhesis. (L.) Rupture of the eyeball.

Bulbus. Eyeball.

Bulbus oculi. (L.) The globe of the eye.

Bulbus quadratus. Another name for phthisis bulbi, i. e., an eyeball so shrunken through atrophy that the spherical form is entirely lost and the eye looks like a ball of cotton quartered by being tied around with a string. The four (hence the adjective quadratus) straight muscles press the eye from the four sides and so cause it to take on the form mentioned. See Phthisis bulbi.

Bulging cicatrix. Especially after cataract extractions and in connection with other penetrating wounds of the eyeball we may encounter, instead of a smooth-healing scar, one that bulges at some portion of the wound. Sometimes this bulging involves the whole length of the cicatrix, but in either case it forms a well-rounded, semi-transparent elevation in which is generally entangled the iris. When this incarceration of the iris takes place a uveitis is likely to occur, especially if the bulging increases in size. These cystoid scars, particularly
if prominent, should be cut off and the opening closed either by the cautery or by catgut stitches, or by both means.

**Bullæ.** Bullous diseases of the eye may mean certain forms of herpes of the conjunctiva or cornea, papular conjunctivitis, or pemphigus of the conjunctiva or cornea, or both. These lesions will all be described under their proper headings.

**Bullæ of the cornea.** Keratitis bullosa. Pemphigus of the cornea. Keratitis vesiculosa. This rare variety of vesicular corneal inflammation occurs chiefly in middle-aged or elderly persons. It may be found in eyes which previously have been normal, but more often it occurs in those which are affected with glaucoma, irido-cyclitis, or corneal cicatrix. A few cases are due to trauma, such as abrasion of the cornea by the finger-nail. The characteristic feature of the disease is the formation of a large vesicle, or bulla, which involves the outer part of the corneal surface and is tremulous. After a few days the vesicle ruptures, and coincidently there is great pain. The anterior wall of the vesicle, consisting of the epithelial layer (sometimes the deeper layers) of the cornea, is not shed, but remains in situ. After a variable time it is lifted up by fluid, bursts again, and this process is often repeated for many weeks. Ciliary injection, photophobia, lacrimation, increased tension, and pain are prominent symptoms during the development of the vesicle. Often these symptoms subside after the vesicle bursts. Fuchs explains the origin of corneal bullæ as follows: In glaucomatous eyes lymph-stasis causes an interstitial edema and results in lifting up the epithelial layer; if the fluid penetrates Bowman’s layer, the latter also is lifted up.

Prognosis in bullous keratitis is unfavorable. During the height of the disease the eye is painful, the vision is much reduced or entirely lost. After recovery the cornea remains opaque. There seems to be no tendency to the involvement of the second eye. Under the most skillful treatment the disease will continue for weeks or months.

*Treatment* should aim to relieve pain and irritation and reduce increased tension. The use of collyria of holocain and cocain gives only temporary relief. Removal of the anterior wall of the vesicle and the application of strong solutions of silver or burning with the galvano-cautery may be followed by improvement. If the intraocular tension is increased and does not yield to arecolin or eserin, an iridectomy should be made. Attention should be given to the general health. In some cases tonics and antiseptics can be used with benefit. If vision is lost, and recurring crops of vesicles make the patient miserable, enucleation for the relief of pain may be a justifiable operation—(J. M. B.)
Bullæ of the eyelids. Bullous affections of the eyelids, such as *dermatitis herpetiformis* and *pemphigus*, are occasionally seen. In the former the lesions are small and grouped; in the latter they are large and scattered. Being diseases subject to frequent relapses, care must be exercised in formulating a prognosis. The treatment of these conditions is outside the domain of ophthalmology. Essential shrinking of the conjunctiva sometimes accompanies pemphigus. Contagious impetigo and various septic conditions may occasion acute processes attended with the formation of bullæ about the lids.— (J. M. B.) See *Pemphigus, Ocular*.

**Bull, Charles Stedman.** A celebrated New York ophthalmologist. Dr. Bull was born in the City of New York, of colonial ancestry, April 21, 1844, and there died April 17, 1911. Aside from his merely preliminary education (received at the French Institute of Prof. Elie Charlier, New York) his general and special training alike were had at Columbia. He there received the Bachelor of Arts in 1864, the Master of Arts in 1867, and the Doctor in Medicine in 1868. For the next two years he served as interne in the Bellevue Hospital, then he studied in England, Germany, France and Holland, his teachers in pathology and ophthalmology being Arlt, Graefe, Jaeger, Helmholtz, Virchow, de Wecker and Donders.

Returning to New York in 1871, he engaged in general practice. Being unsuccessful, he removed to St. Louis, where he spent the year of 1872. Not finding the conditions in St. Louis to his liking, he returned to New York, and engaged in the practice of ophthalmology. His general practice, however, he never relinquished entirely until 1881. After that time he practised nothing but ophthalmology.

His lectureships, professorships, and positions in hospitals were very numerous. He was at different times connected with the City Hospital on Blackwell’s Island, the New York Polyclinic, the Nursery and Child’s Hospital, St. Luke’s Hospital, and the Manhattan Eye and Ear Hospital. He was professor of ophthalmology at the New York University, at the Bellevue Hospital Medical College, and at the Cornell University.

In medical society work he was very prominent, especially in that of the American Ophthalmological Society.

He was an early and voluminous contributor to ophthalmologic literature. Nearly all his journal articles are to be found in the various volumes of the *American Journal of the Medical Sciences*. In collaboration with Dr. D. B. St. John Roosa, he translated Stellwag’s "Diseases of the Eye" (4th Amer. from 4th Ger. ed.).

Physically, Bull was a small, nervous man, and very restless in his
manner. He wore a short moustache, but was otherwise quite clean shaven. He was very impulsive, but, withal kind-hearted. He possessed a keen and ready wit, made many friends, however, in spite thereof, and was much in request as a charming companion. His laugh is declared by a former friend to have been "one of the happiest I ever heard."

He died very suddenly. At the necropsy, the cause of death was found to have been an aneurism of the common iliac artery, the presence of which had never been suspected.—(T. H. S.)

Buller, Frank. One of the most celebrated ophthalmologists of the New World. Born at Campbellford, Ontario, as the son of Charles G. and Frances Elizabeth Buller, he was educated at Petersborough High School and Victoria College, receiving his medical degree at the
latter institution in 1869. He then proceeded to Germany, where he spent two years in the study of the eye, ear, nose and throat. At Berlin he received the close personal instruction of von Helmholtz and von Graefe. During the Franco-German war he served as surgeon in a number of the military hospitals of North Germany.

In 1872 he went to London, and studied for some years in "Moorfields"—The Royal London Ophthalmic Hospital. For two years he was Chief House Surgeon to this hospital. He it was who introduced into London the "direct" method of ophthalmoscopy. He became a member of the Royal College of Surgeons of England.

In 1876 he returned to Canada, settling for the practice of his profession in Montreal. Here he remained until his death, in the constant enjoyment of a large practice and an ever-widening reputation. He was the first ophthalmologist ever appointed to the General Hospital: so remarkably recent is the development of ophthalmology in the New World that, prior to that time, every physician and surgeon was supposed to treat his own eye cases in his own general clinics. In 1894 Dr. Buller was appointed ophthalmologist to the Royal Victoria Hospital. Dr. Buller was also Professor of Ophthalmology and Otology in McGill University for twenty-two years.

Dr. Buller was a large, tall man, of the English type, with light brown hair, mustache, and, now and then, a beard. When he wore a
beard, he was very fond of stroking it. Indeed he was a restless, energetic man, who must forever be engaged in something—or, rather, in a number of things at once. His students used to say, "Buller is a great teacher, but he wears us out." He was frank, straightforward, and almost brutally kind. Those who knew him little, believed him to be rough, but, behind the unprepossessing manner, lay a warm, kindly and ever-loyal heart.

Dr. Buller died of pernicious anemia Oct. 11, 1905. He was followed to the grave by the entire medical profession of Montreal and by numerous physicians from a distance. Also, many of the city's poor were present at the obsequies—a fact which, had he been able to know of it, would have touched that great heart which had felt so keenly for the sorrows of this class.*

Dr. Buller will be especially remembered because of three inventions: (1) the Buller eye-shield (composed of a watch-crystal and strips of sticking plaster, and oftenest employed to protect an unaffected eye when its fellow is afflicted with gonorrheal infection). (2) Temporary tying of the canaliculi for the prevention of wound infection in operations on the eye-ball. (3) The Buller trial frame. Yet his inventions and investigations were very numerous, and, for the most part, successful in every way. Thus, concerning his investigations into "Methyl Alcohol Blindness," conducted jointly with Dr. Casey A. Wood, de Schweinitz declares the work to be "by far the most important contribution to the subject and one to which too high praise cannot be given."

Dr. Buller's writings are so useful that we list them here in full. It is probably not too much to say that there is not one single article of all the number but contains some valuable point, expressed, as a rule, in terse, clear, and oftentimes memorable, language.


*A colleague of Dr. Buller's writes as follows: "In very delicate cases, where he feared to trust patients in the hands of untrained attendants, and they were too poor to hire professional nurses, he has been known to stay with the patients all night, after an operation, and attend to the dressing himself, lest the eye, so tender and in such a precarious condition, might suffer needless pain or be injured through a slight mistake."
BULLER, FRANK


Reference to cases presented by Dr. Buller before the Montreal Medico-Chirurgical Society and to parts taken by him in different discussions are to be found in the Transactions of the Society in the pages of the Montreal Medical Journal, as follows:

BULLER'S SHIELD


Buller's shield. When it is necessary to protect an eye from virulent infection as, for example, in gonorrheal ophthalmia, it is of much importance to seal the eye by some such device as the so-called Buller's shield. This consists of a watch glass adjusted to a square piece of adhesive plaster. The shield is snugly applied to the margin of the orbit, nose, brow and temple, the whole being kept in place by additional strips of adhesive plaster. It is also well to paint over every possible point of contamination with collodion.

Knowing that the non-infected eye sometimes becomes infected with gonococcus-laden pus through a badly fitted Buller's shield of the usual type, B. J. Knapp believes his modification of this device to be worthy of description.

It is built up of flexible collodion, cotton and a large, deep watch crystal. The bridge of the nose, side of the nose, and infra-orbital ridge are built out with superimposed layers of collodion and small pledgets of cotton until a circular ridge is formed, upon which the watch crystal rests evenly, and clear of the cilia when the eye is open.

The crystal is then fastened on by covering its edges with cotton and collodion. An opening is left at the temporal side for ventilation and through which applications may be made. If the collodion begins to curl at the edges, they may be bound down with a fresh application.

The freedom of movement afforded to the unaffected eye is a source of comfort to the patient, and the wall of collodion covered cotton seems to afford perfect protection.

Bull, George Joseph. A celebrated French ophthalmologist, of Canadian birth and education. Born at Hamilton, Canada, Feb. 16, 1848, he received the degrees of M. D. and C. M. at McGill University, Montreal, in 1869. For about eight years he was engaged in general practice at Worcester, Mass. He then removed to Denver, where he practised only ophthalmology. Soon, however, he went to New York, there becoming connected with the Manhattan Eye and Ear Hospital and the New York Post-Graduate Medical School. In 1886 he settled in Paris, where the greater portion of his excellent services to ophthalmology was performed.

In Paris he first proceeded to take the Parisian M. D. Then he became connected with the Sorbonne and, later, was associated in practice with the celebrated Dr. E. Javal. At this period of his life his scientific contributions were numerous and valuable. They related
chiefly to refraction, accommodation, and strabismus. His paper entitled "Lid Pressure on the Cornea" was read at the 8th International Ophthalmologic Congress, held at Edinburgh in 1894, and did a great deal to extend its author's already wide-spread reputation.

George Joseph Bull.

He was a member of the Ophthalmological Society of the United Kingdom, and of similar organizations.

His professional and social merits were about to receive substantial recognition at the hands of the French government, when, quite suddenly, he died, at Paris, New Year's Day, 1911. The funeral took place in the cemetery of Père Lachaise.—(T. H. S.)

Bullous keratitis. See Bullæ of the cornea.

Bull's cross. This is an object devised by Geo. J. Bull (Optometry by the Subjective Method, Ophthalmic Review, Vol. XIV, p. 275, 1895) to be used on the astigmatic chart for the determination of the greatest and least meridians of astigmatism. The inventor has also adapted the cross to the stereoscope, and has suggested it both for exercise of the eye-muscles and for the determination of heterophoria for the near-point.

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Bull's-eye condenser. A strong plano-convex or a bi-convex lens attached to a microscope or other instrument to aid, by concentrating the light, in illuminating an opaque object under examination.

Bull's (Ole) chromatoptometric scale. This table for the determination of the acuteness of color-perception, embraces a large number of different colored squares of equal size and of equal brightness, in diminishing shades. At a distance of one metre the person examined names the colors beginning with the lowest row, (most easily distinguishable). He is to be compared with a normal sighted person, who with good illumination of the squares, must pick out in the same way the highest (least distinguishable) row.

Bull's optometer. See Optometer, Bull's.

Bullular canal. Canal of Petit.

Bull-wort. This plant, made into a poultice with honey or milk, was highly recommended by writers of antiquity and the middle ages as a remedy for ocular traumatism, especially if attended either by hemorrhage or by ecchymosis.—(T. H. S.)

Bundle, Longitudinal. A bundle of fibres, outside of the optic radiations, passing from the occipital to the temporal lobe.

Bundle of rays. In optics, rays of light emitted from each separate point of a luminous body; a conic pencil of light of which the axis is called the principal or chief ray.

Bundle, Spitzka's. A tract of nerve-fibres passing from the cerebral cortex through the pyramidal region of the pes pedunculi to the oculomotor nuclei of the opposite side.

Bunioidè. (F.) Scirrhous; hard as a turnip.

Bunsen's photometer. Grease-spot photometer. Disc photometer. For measuring the intensity of various lights and colors, and especially for the purpose of comparing the illuminating power of the latter the experimental method has been found most practical. This generally consists of an apparatus for determining the relative distances at which two lights give equal illumination.

In the Bunsen apparatus, which is probably the best known instrument, a movable piece of stout paper constitutes a screen placed in a box between the lights whose intensities are to be compared. The center of the paper screen is rendered translucent by a spot of oil or grease which appears darker than the rest of the paper when the reflected light is in excess and lighter when the transmitted light is the greater. The screen is moved back and forth until the two lights give the same visual impression. The photometer of Brodhun and Lummer prisms take the place of the oiled paper.

In all photometers an index or scale is provided for recording the
illuminating power of the light under examination. See, also, *Photometer*.

**Bunter Staar.** (G.) *Cataracta variegata.*

**Buophthalmia.** (L.) *Buphthalmia*; infantile glaucoma.

**Buphthalme.** (F.) Affected with *buphthalmia*.

**Buphthalmia.** (L.) *Buphthalmus* or *Bupthalmos*. Infantile Glaucoma. Congenital Glaucoma. Hydrophthalmos. A disease characterized primarily by a uniform, spherical bulging of the whole cornea. It generally takes the form of infantile or congenital glaucoma. The increase of size extends to the neighboring parts of the sclera and often involves the whole eyeball. True buphthalmia is always congenital.

As Parsons points out, the most striking feature in buphthalmia is the large size of the cornea (hence the term "megalocornea") which may be opalescent, dull, bluish, or it may even be quite transparent. "The anterior chamber is very deep, the media clear. The distension of the globe is marked by more or less proptosis and by the blue color of the sclerotic, especially near the limbus, due to thinning. Sometimes there is nystagmus. The globe is much enlarged, usually oval and elongated, though the plasticity of the young tunics is shown by an unusual increase in diameter of the corneal base. The mean dimensions of twenty eyes gives the following results (Gros):

<table>
<thead>
<tr>
<th></th>
<th>Maximum</th>
<th>Mean</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antero-posterior</td>
<td>38.8 mm.</td>
<td>32 mm.</td>
<td>24.3 mm.</td>
</tr>
<tr>
<td>Vertical</td>
<td>28.6 mm.</td>
<td>26 mm.</td>
<td>23.6 mm.</td>
</tr>
</tbody>
</table>

The cornea is hemispherical or globular. In twenty cases the minimum horizontal diameter was 12 mm., the maximum 23.5 mm., the mean 16 mm. (Gros), as compared with 11.6 mm. of the normal adult (Merkel). These measurements can only be approximate, since the periphery is often opaque. The cornea is thinned, especially at the periphery. Gros gives the following measurements:

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centre</td>
<td>0.28 mm.</td>
<td>1.27 mm.</td>
<td>0.67 mm.</td>
<td>(12 cases) 0.90 mm.</td>
</tr>
<tr>
<td>Periphery</td>
<td>0.20 mm.</td>
<td>0.75 mm.</td>
<td>0.47 mm.</td>
<td>(8 cases) 1.10 mm.</td>
</tr>
</tbody>
</table>

The anterior chamber is very deep; Grahamer records a unilateral case in which it is said to have been seven or eight times as deep as on the normal side, but this is probably inaccurate. Of ten cases in which careful measurements were made the maximum depth was 12.8 mm. (Schiess-Gemuseus), minimum 3.0 mm. (Dürr and Schlegental), mean 6.3 mm. (Gros), normal 2.6 mm. (Merkel)."
As Abadie (La Clinique Ophtal., June 10, 1907) properly says congenital buphthalmos is without doubt among the most distressing of maladies; children who are attacked with it being doomed to almost certain blindness, while the deformity of their eyes is one of the saddest of objects. Iridectomy in buphthalmic glaucoma, says Abadie, furnishes more disasters than successes. Myotics, so useful in those forms of glaucoma in which iridectomy is not justifiable, do not help.

In fact, buphthalmos is essentially a condition quite different from most varieties of glaucoma. There is hypertension and a secondary excavation of the optic papilla, but there is also a chorio-retinitis which is generally overlooked because the cornea is less transparent than normal and deep exploration of the eye impossible. Later, when the fundus can be seen, there is found papillary excavation; more often no trace of chorio-retinitis is discovered, because in the equatorial, and especially in the ciliary, region the lesion escapes detection. If the pupil is sufficiently dilated and the patient's eye directed laterally, there may be seen atrophic, discrete spots, (sometimes confluent gray zones) bordered by pigment deposits so characteristic of the pathologic change. After a careful examination if the chorio-retinitis is not discovered it should not be concluded that it does not exist; Abadie believes in that case the disease is latent and as yet the ophthalmoscopic lesion has not appeared. Persuaded that in buphthalmos it is the chorio-retinitis which plays the fundamental rôle, Abadie directs his therapeutic measures against that disease, giving intramuscular injections, which he believes to be more efficacious than injections. Abadie claims that in all of his cases this treatment has produced beneficial results. One case especially, in which the right eye was the larger and on which several sclerotomies had been done with no other result than an iridic hernia, the mercurial injections improved vision and the tension became normal.

Posey believes the treatment of this condition is very unsatisfactory. Miotics are of but little avail and no form of surgical intervention has been devised which can cure or even check the process. Iridectomy is not followed by good results, nor have its substitutes proven of service in this destructive form of glaucoma. The best results seem to be attained by repeated posterior sclerotomies. See Congenital anomalies.

Buphthalmos. (L.) A person affected with buphthalmia (q. v.).

Burchhardt, Max. Born at Naugard, in Pomerania, Jan. 15, 1831, he received his medical degree at the University of Berlin. In 1864 he was Privat-docent in Berlin; in 1867, however, he accepted a similar position in Königsberg. In 1874 he returned to Berlin, where he
remained until his death, holding simultaneously the position of Chief Physician of the Staff at the "Militärturnanstalt," Chief Physician of the First Berlinese Garrison-Hospital and of the Ophthalmic Division of the Charité.


He died at Berlin, Sept. 26, 1897.—(T. H. S.)

Burchardt’s stereoscope. This instrument is an adaptation of the stereoscope to the detection of simulated blindness. See his monograph on the subject: Praktische Diagnostik der Simulation von Gehühlslähmung, von Schwerhörigkeit und von Schwachsichtigkeit, Berlin, 1891.

Burchardt’s international test-types. In an attempt to provide international test-types, as well as tests for illiterate persons, and so to avoid a variety of figures and other conventional characters Burchardt has employed a number of differently arranged dots corresponding visually with the Snellen types. The diameters of these are, of course, equal to the reciprocals of the distance at which they should be accurately counted.

Burch’s experiment. This procedure is described by Burch (Practical Exercises in Physiological Optics, p. 87) as follows: "According to Hering the colours are associated in pairs, red with green and yellow with blue, so that after stimulation by one the other is naturally excited. Thus after excitation by red light, which uses up the red-green substance, there is a period of enhanced activity in the secretion of it, giving rise to the sensation of green. The validity of this hypothesis may be investigated by applying spectrum analysis to the colours produced by contrast. Thorp’s transparent replicas of Rowland’s diffraction gratings afford an excellent means of doing this. They are practically transparent, and having 15,000 lines to the inch, give a spectrum of light coming from a slit out of the direct line of vision, with about as much dispersion as an ordinary good pocket spectroscope. Over each eyepiece of an ordinary stereoscope is fixed a Thorp’s replica of a diffraction grating. Two adjustable slits are held in a frame in front of the aperture by which light is admitted when viewing opaque photographs. The spectra of the first order of these two slits appear each near the middle of the corresponding glass,
one a little to the left and the other to the right of it. To prevent the colours of these spectra from being overpowered by the background, two black patches of exactly the right size are pasted on each of the coloured glasses. These patches are combined stereoscopically, and on one of them appears the spectrum seen by the right eye and on the other that seen by the left. The field of view appears to some persons purple, but to others the colour seems to oscillate between red and blue through purplish grey. But the two spectra look quite unlike each other. That seen against the red background shows little or no red but a splendid green and an equally splendid violet, while the other, seen against blue glass, has the red well developed, the green pale and dingy, and the blue almost absent. It is important to have the slits of the right width, so that the colours of the spectra may be neither too bright nor too dull. The intensity of the effect increases as the observation continues. A great deal depends on the kind of blue used. With cobalt glass the red is not very bright, owing to the transmission of a good deal of red by the cobalt. A gelatine film stained with prussian blue, in addition to the cobalt, greatly improves the red. A pale yellow film, which cuts off the violet, causes the violet of the spectrum to stand out strongly. A magenta film brings out spectral green as the complementary colour. The physical stimulus is in this case complex, consisting of red and violet. On adding a yellow film, and thus cutting off the violet, the violet is added to the green of the contrast spectrum, but, if a blue glass is added instead of the yellow, the violet vanishes and the red stands out strongly with the green. Thus it is shown that the complementary to any one simple colour is not one colour, but all the rest of the colours of the spectrum—a fact strongly opposed to Hering's theory, and in favour of that of Thomas Young.'

Burnett, Swan Moses. One of the most distinguished of American ophthalmologists. He was born at New Market, Jefferson County, Tenn., March 16, 1847. His professional education was received at the Miami Medical College, Cincinnati, 1866-67 and at the Bellevue Medical College 1869-70. At the latter institution in the last named year he received his medical degree. From 1870-75 he was engaged in general practice in Knoxville, Tennessee. While a student at Bellevue, he had paid especial attention to ophthalmology and otology, and, in 1875-76, he proceeded to Paris and London for the purpose of further study in these, his favorite, branches. Returning to America in 1876, he settled in Washington, D. C., devoting himself entirely to diseases of the eye and ear.

In 1878 he was appointed to the lectureship on ophthalmology and
otology in the school of medicine of Georgetown University—a position which he held until, in 1883, he was offered the clinical professorship of the same branches in the same school. In 1889 he was given the professorship of the same subjects, and this position he held until his death.

He was one of the attending staff of the Dispensary and Emergency Hospital, of which he was also president. In this institution he "founded and equipped" the "Lionel Laboratory," in memory of one of his sons, "Little Lord Fauntleroy." He was also ophthalmologist and otologist to the Children's and Providence Hospital, and a member of the consulting staff of the Episcopal Eye, Ear, and Throat Hospital.

He was a member of numerous societies, and, in 1889, was elected president of the Medical Society of the District of Columbia.
In 1890 he received the honorary degree of doctor of philosophy from the Georgetown University.

Dr. Burnett was a skilful operator, a clear and forceful writer, a teacher of unsurpassed ability, a true gentleman and an ever loyal friend. As a teacher, he was especially remarkable for the influence which he exercised upon his students. Thus (for one example out of many) Dr. H. V. Würdemann has said: "I look back to the year of 1888, spent as his assistant, with particular pleasure, and know that his teaching was one of the principal factors in getting me interested in scientific ophthalmology, and to his example and advice I owe my literary inclinations. He aided me in scientific work more than any teacher I have ever had. In him I particularly feel the loss not only of a teacher, but of a steadfast friend, and believe that I feebly express the feeling of the medical profession. His life and example will remain one of the guiding stars of ophthalmic progress."

Dr. Burnett was about the medium height, a trifle lame (as the present writer has been informed), had an extremely pleasant voice, and was always very well dressed.

He was a connoisseur in art, and made a large collection of valuable paintings, as well as of war implements, especially helmets and swords. Many of the items in his art collection had been presented to him. A very large number, however, of Japanese objects of vertu he had purchased of Japanese noblemen. He was also a collector of books, and, among his treasures, were thousands of first editions, books containing their authors' autographs, specially and sumptuously illustrated volumes, etc.

He was twice married, first to Frances E., daughter of Edwin Hodgson, Esq., of Manchester, England. This lady was the gifted authoress of "Little Lord Fauntleroy," the central character of which was, as above suggested, the "Lionel" of the Lionel Laboratory. Still another son was born of this marriage—Vivian Burnett, now connected with McClure's Magazine. By the second marriage Dr. Burnett had no children.

He died of oedema of the lungs, the result of chronic myocarditis, Jan. 18, 1906, at his home, No. 916 Farragut Square, Washington. His second wife and his son Vivian survived him.

Dr. Burnett's most important books and articles are the following:

Books:
Translation of Edmond Landolt's "Manual of Examination of the Eyes."
"A Theoretical and Practical Treatise on Astigmatism" (St. Louis, 1882).
"The Principles of Refraction in the Human Eye Based on the Laws of Conjugate Foci" (Philadelphia, 1904).
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Articles:
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"A Case of Choroiditis Exudativa" (Archives of Ophthalmology and Otology, New York, 1877).
"Double Optic Neuritis (Choked Disc) and Sloughing of the Right Cornea Accompanying a Sarcomatous Tumor on the Right Side of the Brain" (Archives of Ophthalmology and Otology, New York, 1877).
"Results of an Examination of the Color Sense of 3,040 Children in the Colored Schools of the District of Columbia" (Archives of Ophthalmology, New York, 1879).
"Are There Separate Centres for Light, Form and Color Perception?" (Archives of Medicine, New York, 1884).
"The Comparative Frequency of Eye Diseases in the White and Colored Races in the United States" (Archives of Ophthalmology and Otology, New York, 1884).
"Theories of Color Perception" (American Journal of Medical Sciences, Philadelphia, 1884).
"A Case of Obstructed Retinal Circulation with a Series of Pictures Showing the Changes in the Vascular System During Its Establishment of New Vessels in the Retina" (Ophthalmic Record, Nashville, 1899).—(T. H. S.)

Burnett's rule. The findings of the ophthalmometer, as was long ago pointed out by Javal, Donders and others, are not absolutely correct since there is generally a decided difference between the amount of corneal astigmatism, so indicated, and the total astigmatism of the
eye. That one may estimate the actual amount of astigmatic error, Burnett formulated this rule:—"For the total subjective astigmatism, subtract 0.50 D from the corneal astigmatism when it is according to the rule, and add 0.50 D if the corneal astigmatism is against the rule."

**Burning, Ocular indications of.** See *Legal Relations of ophthalmology*, in middle third of the section.

**Burn's amaurosis.** Blindness resulting from sexual excess.

**Burns of the eye.** Burns of various parts of the anterior ocular apparatus, whether by chemical caustics, hot fluids, hot metals, burning match heads, explosions of gas, etc., destroy or injure the epithelium and the sub-epithelium tissues. Following these are often sloughing and scarring of the cornea; occlusion and distortion of the puncta lacrimalia and symblepharon, as well as destruction and displacement of the palpebral tissues. Perforation of the eyeball may also take place, resulting in panophthalmitis, or if a certain recovery occur, in staphyloma, hernia of the iris, etc. The sclera may also suffer in much the same way. In burns from lime the calcic oxide coming in contact with the water of the tissues is "slaked" and converted into calcium hydrate.

According to Parsons (*Pathology of the Eye*, p. 1130-31) this chemical combination is accompanied by great evolution of heat (150° C). The worst results occur if the process takes place in the eye, but slaked lime or its mixture with sand, etc., (mortar) is also extremely caustic. Lime burns have been experimentally investigated by Gosselin, v. Gouvea, Gühmann, Stroschein, and others. V. Gouvea found that the epithelium was destroyed, the particles of lime penetrating the tissues and causing necrosis by the abstraction of water. The lime-containing scar tissue is intensely white and porcelain-like, giving rise to an extremely dense cicatrix. According to Gühmann the lime exists in the tissues as calcium chloride, carbonat and phosphate, not as hydrate. According to Stroschein it combines with the proteid material to form an albuminate. Probably both conclusions are correct. According to Rosenthal and zur Nedden the lime acts upon the "mucoid" substances of the cornea. The treatment with sugar solution (Gosselin) is deleterious. For further information on this important matter see *Injuries of the eye.*

**Burnt alum.** See *Alum, Dried.*

**Burow's blepharoplasty.** See *Blepharoplasty.*

**Burow's operation for entropion.** In this operation the upper lid is everted, and with a round, pointed scalpel an incision, about 3 mm. from the free border and parallel to it, is made from one end of the
BUROW'S SOLUTION

Bursa, Hygromatous degeneration of the orbital. This is a rather obsolete name for exudation cyst of the orbit. It is probably a genuine cyst and not a mere dropsy of the capsule of Tenon. As is well known, the tendon of the superior oblique is surrounded at the pulley by a bursa and there are other bursae between the tendons of the levator palpebræ and superior rectus muscles. Exudation cysts arise within these bursal cavities and contain the usual synovial or serous fluid.

Their treatment is surgical, and consists in the total extirpation of the tumor. As Stedman Bull pointed out, this procedure is preferable to puncture or incision, with subsequent cauteronization of the sac, the introduction of a seton or partial excision. He says that "the disadvantages of all these methods, except the total extirpation, lie in the subsequent adhesions between the orbital tissue and the eyeball and the consequent limitation of motility. Hence, under all circumstances, the only operation that promises a satisfactory result is that of total extirpation of the cyst, under the most complete antiseptic precautions."

Bursal capsulo-lenticular cataract. An obsolete term for a capsulo-lenticular cataract supposed to be associated with a small cyst within the capsule, filled with purulent matter.

Businelli, Francesco. Born at Maniago (Venice) in 1828, he studied medicine first in Padua, then at Vienna, where the powerful influence of Jaeger and von Arlt directed his attention to ophthalmology. In 1854 he became Assistant to the Eye-Clinic at Vienna. Returning to his native country, he became, in 1861, Professor of Ophthalmology at Sassari, and in 1872 at Modena.

He was a diligent translator from the English, the German and the French. Among the most important of his own compositions are: "Intorno al astenopia" (Giorn. della R. acad. med. di Torino, 1860);
"Osservazioni critiche sul opera del Dott. Grittì" (Giorn. d' oftalm., 1862); "Ressoconto dei casi oculistici, etc.," (loc. cit., 1865); "Sulla lussazione sottocongiuntivale del cristallino, etc.," (Gaz. med.-ital. delle Prov. Vente, 1869); "Sul estrazione di corpi estranei penetrati nell' occhio" (Letter to the Academy at Modena, 1869); "Sull' ottal-mia dei neonati" (Modena, 1872).

Businelli died Nov. 27, 1907, aged 70.—(T. H. S.)

**Busse, Chr. Fr. Heinr.** A 19th century ophthalmologie privat-docent in Berlin. Very little information is now procurable about this man. He is, however, known to have contributed the ophthalmological articles to the fifth edition of Bernstein's "Surgical Lexicon" (1818).—(T. H. S.)

**Bussole.** (G.) Compass.

**Buttermilk.** This article of diet, whether of the natural variety or made by the so-called Bulgarian method, is useful for eye patients, especially for those confined to their rooms or to the house with such acute diseases of the eye as iritis, choroiditis, etc.

Cases of poisoning from spoiled buttermilk, in which the eye was involved, are on record. As a matter of fact such poisoning comes under the category of ptomaines, and the picture so produced is identical with the botulism (q. v.) set up by rotten fish, spoiled meat, decayed sausages, oysters, etc. Although this subject will be further considered under the caption **Toxic amblyopia** it may be said here that of 34 cases of so-called ptomaine poisoning 33 exhibited paresis of the lid muscles, 27 had lowered visual acuity, while 2 suffered from complete though transient blindness.

**Button-holing the iris.** During the extraction of cataract even a careful operator, in his anxiety to remove as small a portion of the iris as possible, may find after the use of the scissors that he has made a "button-hole" opening in that membrane. This generally follows the seizure of the iris too near its base.

The iridectomy can still be carried out by passing in a Tyrrell's hook, drawing out the little band of uncut tissue and snipping it with the scissors. Herbert advises that after this mishap "the narrow strip of tissue may be readily hooked upwards by the cystotome (held in the right hand) after the capsulotomy has been done. If very narrow it tears readily; otherwise the loop is released, and the forceps and scissors are again taken up. The forceps are used so that one blade passes down in front, and the other, generally more or less embedded in soft lens matter, behind the band. This will still be found lying near the wound, retraction being interfered with by the sticky lens substance. The points of the forceps being closed
beyond the band, the latter may then be readily hooked up and cut away. Or if the eye be very unsteady the forceps may be dispensed with. The left hand may be usefully employed with the curette or expressing hook. Pressure is applied at the lower edge of the cornea, as for expulsion of the lens. The wound is thus forced open, and the little band of iris stretched and carried forward on the presenting lens, either into the wound or near it, so that it may be easily cut with scissors. Usually the strip of iris may be made to present sufficiently well for the scissor blades to be applied transversely, snipping off lens substance together with the iris. Should by chance a long tag be left attached to one angle of the coloboma, this shrinks afterwards, but forms a posterior synechia." See Cataract, Senile.

**Buttalmo.** (It.) Buphthalmos.

**Butter.** A popular article of the ancient Greek, Roman and Egyptian ophthalmic materia medica. It was often used as a poultice, oftener, however, as a menstrum for other, and more active, substances. (Butter, in fact, was not regarded by the ancients as a fit article of diet. Even the savage Celts and Germans did not eat it, but used it as a salve, medicinal or cosmetic.)—(T. H. S.)

**Button, Aleppo.** A nodular, parasitic, boil-like, exotic skin disease that occasionally attacks the lids. It has many synonyms, among them Oriental button. See Aleppo button.

**Buzzi’s blepharometrum.** A set of instruments for cutting out a portion of the eyelid for trichiasis, consisting of a Beer’s forceps and a pair of curved scissors.
C

C. The chemical symbol of carbon.
Ca. The chemical symbol of calcium.

Cabani's pallet. A shovel-shaped instrument made of two plates of perforated silver, jointed and movable on each other. It is used to seize the extremity of the nasal probe in Méjean's operation for lachrymal fistula.

Cabinet noir. (F.) Dark room.
Cabinets for ophthalmic operations. See Black's Cabinet and Unlearnable test types.

Cabrol, Barthélemy. A celebrated French surgeon and anatomist. Born at Jaillac, in the diocese of d'Albi, he studied and practised at Montpellier. Quitting Montpellier in 1555, he settled in his native town, and soon became very distinguished. In 1570 he was appointed public demonstrator of anatomy at Montpellier, and soon thereafter was body-physician to the Duc de Montmorency. In his treatise on anatomy, he entitles himself Surgeon to the King in the following fashion: "Chirurgus Regius Dominique Monmorancii Franciae Connestabuli.'

Of his writings, two have come down to our day in print and one in MS. Those in print are: "Alphitebeton Anatomicum, id est Anatomes Elenchus Accuratissimus, Omnes Humani Corporis Partes eâ quà Secari Solent Methodo Delineans, Acessere Osteologia Observationesque Medicis ac Chirurgicis Perutilis" (Geneva, 1604) and "Collegium Anatomicum Clarissimorum Trium Virorum Jasolini, Severini, Cabrolii" (Hanover, 1654). The book in MS. is entitled: "L'Ordre et Manière que Fault Tenir pour bien Démonstrer la Dissection du Cerveau" (in "Bibliothèque National, Paris, Fonds Français, no 2062, p. f. 67 and 68.)

In the course of his writings he mentions a number of ophthalmologic matters, but is memorable almost solely because he established for all time the fact that the optic nerves do not arise from the anterior, but from the posterior, portion of the brain.—(T. H. S.)

Cacao. Oleum theobromatis. Oleum theobromae. A fixed oil (incorrectly called "cocoa" butter) expressed from the roasted seeds of 1350
Theobroma cacao. J. C. Roberts uses heavy ointments and medicated bougies in the treatment of stenosis of the lachrymal duct. He prescribes a salve with cacao butter base. Following the passage of the probe a lachrymal syringe is loaded with this ointment medicated with protargol 1/2 per cent., argyrol 10 per cent. or, occasionally, zinc sulphocarbonate (q. v.). The syringe is introduced well into the duct and slowly withdrawn as the contents are expressed so that duct and sac are kept dilated and medicated while the ointment is slowly melting.

**Cachectic irido-cyclitis.** This is a discarded term for a uveitis met with in those patients who are debilitated by recent illnesses, such as influenza, pneumonia, typhoid fever, etc.

**Cachet.** (F.) Wafer.

**Cachets oculistiques.** (F.) Old Roman stones engraved with the name of a medicinal preparation, that of the oculist ordering it, and of the eye disease which it was intended to cure.

**Cachexia exophthalmica.** Exophthalmic goiter.

**Cachexia pellagrosa.** A term for pellagra, a disease frequently associated with eye symptoms. It is due to chronic poisoning from diseased or fermented corn (maize), and affects chiefly the skin, the digestive apparatus, and the cerebro-spinal system. E. M. Whaley (Ophthalmic Record, November, 1909) has reported the eye signs of this curious disease from the examination of thirty-five pellagrains, fifty per cent. of whom were insane. Examination as to fields and color-sense it was impossible to make. He found but one ocular symptom that seems to be characteristic of this disease, and on account of the small number of cases would not like to be too sanguine as to its being pathognomonic of pellagra. Still, Lombroso seemed to find it, though he did not state to what extent. This symptom is an apparent thickening of the retina, which gives the fundus reflex a peculiar indistinct yellowish color, not so pronounced as the senile reflex.

The dilation of the pupil was not so prevalent as was expected from the Italian reports. This may be accounted for by the fact that observations in different localities give some variation in the symptoms, and the season of the year has also been seen to affect the kind and virulence of the attack.

The ages of the patients varied from eight to seventy-six years, only two of whom showed normal eyes.

They did not carry their upper lids as high as they should, thereby giving the appearance of general lassitude. This dysskinesis of the upper lids in these subjects is not due to paralysis; it is voluntary and due to the fear of light. If unilateral, (and care must be taken
in the examination to exclude paresis from other cause) ptosis due to ptomain poisoning, fungi, lead, and so forth, must be eliminated. If you can make the pellagrin look up he will not correct the lid-drop by throwing the head back, unless there be other cause present, and an involuntary ptosis exist. Frequently, on raising the patient's head, the lid or lids, as the case may be, will descend lower.

Dilated pupil occurred bilaterally in three cases only; unilaterally in two cases, and one of the bilateral cases was myopic. Two cases resisted the action of homatropin for two hours, four resisted it less strenuously, while the others reacted in the usual twenty minutes. Hypersensitiveness to light, as shown by contracted pupils, was the rule.

Shallow anterior chambers were found in thirty-three per cent. of the cases. While the gastro-intestinal symptoms were very pronounced and the inflammation extended to the mouth and postnasal space, an obstruction of the lacrymal duct was found. This was noted in five cases, all of which had the mucous membranes very much affected by the disease. Photophobia of slight degree, without the inflammatory changes which usually accompany this condition, was present in six cases.

The findings are tabulated as follows:

Lids: Paretic, one; lachrymation, two; dacryocystitis, two; conjunctivitis, two; muddy conjunctiva, two; jaundiced conjunctivæ, three; obstruction of lacrymal duct, five.

Cornea: Ulcer, four; superficial inflammation, two; increased sensibility, two; subnormal sensibility, seven.

Muscles: Paresis (rt. rectus), one; nystagmus, one.

Anterior chamber: Shallow, twelve; deep, one.

Iris: Iritis, serous, one; sluggish reaction, to light, six; hypersensitive, four; photophobia, six; reaction to homatropin, slow, four; prompt, one; spastic reaction to light, two.

Pupils: Unilaterally dilated, two; bilaterally contracted, three; bilaterally dilated, three; Argyll Robertson, one.

Tension: Plus, bilateral, one; plus, unilateral, two.

Fundus: Retinitis, two; detached retina, one; optic atrophy, three; optic neuritis, three.

Lens: Cataract, bilateral, three; unilateral, two; cloudy lens, one. Arteriosclerosis was found in 15 cases. See Pellagra.

CACODYLATE DE SOUDE

CACODYLATE DE SOUDE. (F.) Cacodylate of sodium.

CACODYLATE OF SODIUM. SODIUM DIMETHYLARSENATE. (CH₃)₂ AsO, NaO. This arsenical compound occurs as a white, amorphous powder, soluble in water. It is employed as an alterative in place of other arsen-
lates and arsenical remedies on account of its comparatively slight toxicity. The ophthalmologist is interested in it because of its distinct value in general conditions closely related to many ocular affections in which it is prescribed, especially in syphilis, anemia, chlorosis, Basedow's disease, chorea, diabetes, etc.

The adult dose is $\frac{1}{2}$ to 2 grains (0.03-0.12 grm.); children, 1/6 to $\frac{1}{2}$ grain, according to age. Hypodermically, $\frac{3}{4}$ to 11/2 grains. This remedy is especially useful in phlyctenular disease and in parenchymatous keratitis (whatever their origin) and patients improve most markedly when the remedy is administered in part or wholly beneath the skin.

In a letter from the makers (Parke, Davis & Co.) of *ampullae* containing convenient doses of this drug—especially for hypodermic use—they say:—"We enclose a list of our various glaseptic ampoules, from which you will observe that we market five different dosages of sodium cacodylate in this form. The dose of this particular arsenical compound has increased of recent years, since freer use has been made of the drug in the treatment of syphilis, and it has been found that many patients bear large doses well. It has even been stated that 100 grains can be given in three weeks, though the drug accumulates in the system to some extent. Obviously, the smaller doses should be given first, and gradually increased if necessary.''

**Cacophthalmia.** (L.) Malignant ophthalmia.

**Cacostie.** (F.) A disgust or repulsion for food.

**Cade.** (F.) Juniper.

**Cade, Oil of.** OLEUM CADINI. OIL OF JUNIPER. This agent is a clear, brown, thick liquid obtained by the destructive distillation of juniper wood. It is practically insoluble in water; slightly in alcohol; entirely soluble in ether and chloroform.

Preparations of tar-like oils have long enjoyed a reputation in ciliary blepharitis. Schmidt-Rimpler advises for this purpose a 50 per cent. mixture of oil of cade in petrolatum, to be applied to the lid edges at night time, or the following formula will be found useful: olei cadini 1.5 (gr. xxiii); zinci oxidi 4.0 (5j); vaselini 10.0 (5iiss).

**Cadmium iodide.** CdI$_2$. This salt occurs as colorless, flaky crystals soluble in water and alcohol. It is a resolvent and antiseptic and although commonly used as an application to scrofulous glands, chronic inflammations, chilblains, and skin diseases is sometimes, in the form of ointment, used in ophthalmology. Its principal application (one part to eight parts of lard) is to indurated lachrymal glands, to which it is applied in conjunction with massage.

**Cadmium salicylate.** (C$_6$H$_4$) (OH)CO$_2$) Cd. This salt forms tabular
crystals, colorless, slightly acid, soluble in 68 parts of cold water, made by the action of salicylic acid on cadmium carbonate.

A 1 per cent. aqueous solution of this drug has been recommended by Cesario as an eyewash in infective keratitis and conjunctivitis associated with much secretion of pus or mucus.

**Cadmium sulphate.** CdSO₄. This salt presents colorless crystals, soluble in water and alcohol. It is a decided astrigent and antiseptic and has been recommended as a substitute for zinc sulphate (q. v.) in collyria in 10 per cent. solution.

A proprietary collyrium called Osmosine, said to be effective in "any affection of the eye from inflamed, or common tired, or sore eyes, to the most serious disease of that organ," has been advertised as containing cadmium sulphate, hydrastin, boric acid, glycerine and water.

**Cadran astigmatique.** (F.) Astigmatic clock-face.

**Caduc.** (F.) Decayed; perishable.

**Caducity.** Senility; the feebleness of advanced age.

**Cæcitas.** (L.) Blindness.

**Cæcitas crepuscularis.** (L.) Night-blindness. Hemeralopia.

**Cæcitas diurna.** (L.) Day-blindness. Nyetalopia.

**Cæcitas minor.** (L.) Partial blindness or amblyopia.

**Cæcitas nocturna.** (L.) Night-blindness. Hemeralopia.

**Cæcitas verbalis.** Word-blindness (q. v.).

**Cælometer.** Cælometer. An instrument for illustrating the elements of astrography.

**Cæsarian.** A collyrium much employed in Greco-Roman times "against every kind of disorder in the eyes, except those that are treated by mild medicines." It consisted of copperas, misy, white pepper, poppy tears, gum, cadmia, and antimony. For the exact proportions in which these ingredients were combined, see Cæls.—(T. H. S.)

**Café.** (F.) Coffee.

**Caillement.** (F.) Coagulation.

**Caisson disease.** Although the symptoms of this interesting affection are well known, yet it is doubtful whether the one ophthalmic affection ascribed to it, viz., keratitis, is really the result of the conditions that produce the malady.

**Calabar, Fève de.** (F.) Calabar bean.

**Calabar bean.** See Physostigma.

**Calabarbohne.** (G.) Calabar bean.

**Calamitazione.** (It.) The use of a magnet for experimental, diagnostic or therapeutic purposes.

**Calaza.** (It.) Chalazion.
Calcaire. (F.) Calcareous.

Calcareous cataract. A cataract characterized by the deposit in the lens of carbonate and a little phosphate of calcium. See Calcareous lens.

Calcareous conjunctiva. This term is generally applied to ordinary lithiasis of the conjunctiva, that is, to small, whitish bodies buried in the conjunctiva of the inside of the lids, generally near the edge. They are hard, almost round, and usually project above the general level of the conjunctival surface. They are calcareous formations, and are lodged in the Meibomian glands, of whose secretion they seem to be the degeneration.

The same term has also been used to indicate the *conjunctivitis petroidea* of Leber. Here the conjunctiva is the seat of an inflammatory swelling in which white opaque spots are to be seen that increase in size and finally coalesce, forming a mass as hard as stone. An examination of these concretions shows them to be a calcareous infiltration of the conjunctival tissue.

Calcareous keratitis. This is one of the synonyms for "ribbon-shaped" corneal opacity or *keratitis trophica*. The affection may be either acquired or congenital. The latter condition is very rare. The acquired type is found in two different clinical forms: In the one instance the interpalpebral part of the cornea, in eyes which were previously normal, becomes opaque, owing to the development of a smooth subepithelial opacity. In the other type an oval, transverse band of opacity develops in eyes which have long been blind from iridocyclitis, sympathetic ophthalmitis, or glaucoma. This form of opacity produces a roughening of the cornea, which occurs chiefly in the lower third of that tunic. Since this is the part of the eye which is exposed when the globe is rolled upward, as in sleep, the condition has been thought to be due to imperfect closure of the lids during sleep or in the course of exhausting disease. In the first type the local change consists in a deposit of lime salts beneath the epithelium, which is unaffected. The opacity is sharply defined while the remaining cornea is clear. The opacity forms a gray area, three to five millimetres in width, passing across the cornea below the centre of the pupil. Often there is an oval opacity at the outer, and another at the inner, part of the cornea, separated from the limbus by clear corneal tissue. The two oval masses are connected by a bridge through which the pupil can be seen. Usually the process requires years for its development, but Poulett Wells has described a case of marked zonular opacity of the cornea which developed in a few months. Some authors have attributed these opacities to an
excess of uric acid in the blood, while others think them due to external injurious influences. Fuchs saw transverse films in both eyes of a physician who for many years had blown calomel into them, and Topolanski met with the disease in hat-makers whose eyes were daily irritated by flying pieces of hair. A corneal disease, which is similar to ribbon-shaped opacity, is found among persons engaged in the manufacture of anilin dyes and of naphthalin. The long-continued irritation of the fumes produces a brown or gray superficial opacity of the cornea. The affected zone corresponds to the interpalpebral cleft. The opacity, which is located in the epithelial and superficial corneal layers, slowly disappears after the patient changes his occupation. The presence of transverse films is not incompatible with the possession of useful vision. Where vision is much reduced the films should be removed by scraping (abrasion) of the cornea. If the capacity is extensive, iridectomy may be required.—(J. M. B.)

Calcaceous lens. Cataracta calcarea. Cataracta gypsea. Almost any form of hypermature cataract may undergo further degeneration. This is especially the case in complicated cataract, when the lens mass may shrink, after conversion into a chalky or calcified concretion containing lime salts, cholesterin crystals and other debris. Calcaceous lens generally takes on a peculiar, uniform color which varies from whitish-yellow to chalk-white—a coloration that generally helps the diagnosis.

Calcarine. Pertaining to the hippocampus minor or, as, for instance, the calcarine fissure, so closely related to the visual centre.

Calcarine fissure. This is the portion of the cerebral cortex in which is chiefly placed the cortical centre for vision. It is in the occipital lobe in the mesial aspect of the cerebrum and joins the occipital fissure. See Intracranial organs of vision.

Calce. (It.) Lime or chalk.

Calcification of the lens. See Calcaceous lens.

Calcii permanganas. See Lime permanganate.

Calcite, otherwise known as Iceland spar, is a transparent crystalline form of calcium carbonate, and was at one time found in great quantities in Iceland. It crystallizes in many forms, each of which may be reduced, through cleavage, to a rhombohedron, bounded by six similar parallelograms with angles equal to 101° 55' and 78° 5'. Two opposite solid angles are encompassed by three obtuse angles, whereas each of the remaining solid angles is encompassed by one obtuse angle and two acute angles. The diagonal line, through the crystal, which connects the corners containing the three obtuse angles, or any line
CALCIUM HYPOCHLORITE

drawn parallel to it, is termed the axis of the crystal, in which no double refraction occurs. See Axis; also Double refraction.—(C. F. P.)

Calcium hypochlorite.—See Lime, Chlorinated.
Calcium permanganate. See Lime permanganate.
Calculs lacrymaux. (F.) Lachrymal calculi.
Calculus, Lachrymal. Dacryolith. Chalky concretions of the lachrymal gland are extremely rare. These lachrymal calculi, as they are sometimes called, may cause considerable irritation and should be removed through an incision made at the upper cul-de-sac through the conjunctiva.
Calculus, Meibomian. A name for calcareous conjunctiva (q. v.).
Caldwell's lachrymal probes. Caldwell devised a probe for treating lachrymal stricture, which consists of a staff 11 cm. long, with a bullet-shaped end about 1 cm. in length. These probes are made in pairs and the tips are so graded in size that each unit represents 0.25 mm. of diameter.
Caleidophone. Kaleidophone. An instrument in which a number of mirrors are so arranged that objects viewed through it appear repeated in symmetrical patterns.
Calhoun, Abner W. A celebrated American ophthalmologist. He was born at Newnan, Georgia, April 16, 1846. His father, Dr. Andrew B. Calhoun, was a well known Southern practitioner, and his mother was one of the Wellborns of Wilkes county, one of the old families of Georgia. When he was only fifteen years of age, his primary education was interrupted by the outbreak of the Civil War. Though the youngest member of his company, he served throughout the entire war, and was one of those who surrendered with Lee at Appomattox.

After the war he completed his primary training, then for two years studied medicine with his father, finally proceeding to the Jefferson Medical College at Philadelphia, where he received his degree in 1869, standing at the head of his class. Then he went abroad, where he studied for four years.

At first he intended to become a teacher of anatomy, and to the end of his days he was fond of talking of the time when he was prosector to the great anatomist, Hertel. While abroad, however, he realized the necessity and the opportunity in the South for a man well grounded in ophthalmology and otology. Hence he turned his attention to these specialties. His student associates abroad and life-long friends afterwards were Peter A. Callan, Lucien Howe and the late Dr. Lefferts, of New York. Most of his work was done in the clinics of von Graefe, in Berlin, and Politzer, in Vienna.
Returning to America in 1873 he settled as ophthalmologist and otologist in Atlanta, Georgia. He soon became Professor of Ophthalmology in the Atlanta Medical College, in which capacity he served for nearly forty years. He was a great favorite with all the students, chiefly because he understood his subject thoroughly and possessed an inborn faculty for simplification.

In his practice, too, he was very much liked. Rich and poor alike were welcome in his office. In the days before City or Charity Hospitals he not only treated many patients free, but he even boarded them "without money and without price."

His practice, however, was very large and he managed to save money. This he invested profitably and so became rich. In fact, he was widely known in the South as a man of affairs, as a conservative
and nearly always successful financier. The largest and most powerful corporations and other financial institutions of the South felt honored by the presence of Dr. Calhoun's name on their boards of directors.

He wrote but little, being "too much engaged," as he used to say, "in making history to have any time for writing it."

In medical society work, however, he was very active and held many offices. Among these were the Presidency of the Georgia State Medical Association, the Vice- Presidency of the American Medical Association, and the Chairmanship of the Section on Ophthalmology in the same national organization.

Dr. Calhoun was a man of magnificent physique, tall, straight, distinguished looking and decidedly military in his bearing. He was an absolutely indefatigable worker. In fact, no quantity of work ever seemed too much for him. He broke down one assistant after another. He would work "at a gruelling pace" in his office and in the hospital all day, and leave fresh, strong and alert. He often declared that his military training in the war was chiefly responsible for his health and strength. However, even when he enlisted in the army, though he was then only fifteen years of age and indeed was the youngest member of the company, he was plainly the tallest, and, from all accounts, the strongest and most active.

Love of home was one of Dr. Calhoun's strongest traits. Once, when receiving an invitation to join several clubs, he politely replied, "What time I have to spare from my practice I spend at home with my dear wife and children."

He died in Atlanta, Aug. 21, 1910, after a long and painful illness, which he had borne without one word of complaint. Many of the poor had been accustomed to calling him "The Great Physician," and this is the only inscription on his tomb. However, he was more than merely a great physician. He was a good, true-hearted man; a good son, a good father, a good brother, a good husband, a good friend—a useful and never-to-be-forgotten citizen.—(T. H. S.)

Cali. Pseudo-calabar bean. Horse-eye beans. Bread-nut berry. The nut of Mucuna urens contains pseudo-physostigmine, a miotic resembling eserine. Its exact (comparative) value as a sialagogue and pupil contractor has not, so far as I can learn, been worked out.

Calibrator. An instrument for measuring the caliber of a duct or other passage.

Caligineux, -euse. (F.) Said of the eyes when they lose their brilliancy.
Caligo. Dimness of vision; also an opacity of the cornea, lens, or vitreous body.

Caligo cornea. (L.) Opacity of the cornea.

Caligo humorum. (L.) (Obs.) Blindness from opacity of the ocular media.

Caligo lentis. (L.) Cataract.

Caligo oculorum. An ophthalmic term in common use among the ancients, and employed especially by Pliny. It meant merely "dimness" or "mistsiness" of the eyes. If the affection were caused by ocular inflammation, then the proper remedy was the so-called "Collyrium of Asclepius." If, however, the trouble resulted from old age, then there were indicated inunctions of honey, of old olive oil, and of oil of cypress.—(T. H. S.)

Caligo pupilla. (L.) (Obs.) Defective vision due to a closed pupil.

Caligo synizesis. (L.) Defective vision from closure of the pupil.

Caligo tenebrarum. (L.) Hemeralopia, or night-blindness.

Caligus. This is a crustacean of the order Copepoda, genus Caligus, probably Caligus curatus which, according to Rayner Batten (The Lancet, Apr. 7, 1900) found lodging in the left eye of a fishmonger. A cyst, 2 mm. in diameter, formed on the upper sclerocorneal junction, from which the parasite was removed, leaving only a superficial scar.

Calipers, Ophthalmic. With the increasing necessity for the correct centering of spectacles there comes the demand for a rapid and accurate measurement of the ocular base line. It is no longer found sufficient, as in former days, to take a rough measurement of the interpupillary distance. The instrument (see the figure) was devised by Bishop Harman (Trans. Ophthal. Soc. United Kingdom, 1910, p. 54.) for the purpose of measuring the base line in working with the registering form of diaphragm test, and the new calipers have proven, after a year's work with that instrument, to give this measurement with the greatest expedition and with an accuracy that meets the stringent conditions of that test for binocular vision. In experimental forms the calipers were exhibited at meetings of the Ophthalmological Society of the United Kingdom in 1909 and 1910. The material used is steel, and the workmanship is excellent.

The method of usage is as follows: The patient faces a distant light, either a window or lamp, and looks at it with both eyes; the images of the light are seen upon the cornea and mark the visual axes. The surgeon faces the patient at arm's length, places the rule upon the patient's brows, and sights the fixed wire over the image on the patient's right eye. Then the other wire is slid over the image on the left
CALLEUX, CORPS

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cornea and carefully sighted. The surgeon sights the patient’s right with his own left eye, and vice versa. In measuring the base line for near vision the procedure is the same, but the light is put over the surgeon’s head at the requisite distance and the patient looks at it. The vertical scales on the jaws are for the purpose of measuring the vertical displacement of lenses for the correction of hyperphoria. The trial lenses are tilted until the defect as measured with the scale test-card in the diaphragm test is corrected, the rule is held horizontally across the patient’s brows, and the depression of the lens of one side as compared with the other read off.

Harman’s Ophthalmic Calipers.

Calleux, Corps. (F.) Corpus callosum.
Callionymus. Cobitis anableps. A fish, the gall of which is said by Pliny (Nat. Hist, xxxii, 24, 17) to be of use in lid-diseases, leucoma, and general weakness of the eyes.—(T. H. S.)
Callositas palpebrarum. (L.) An obsolete term for a hardened or brawny condition of the eyelids.
Calmette’s ophthamo-tuberculin reaction. Shortly after the publication of the observation of Wolff-Eisner, that the instillation of tuberculin into the eyes of patients with tuberculosis produces a decided conjunctival hyperemia and exudation, Calmette reported a series of observations on tuberculosis and non-tuberculosis patients and showed that the reaction is typical and specific. The test is performed with old tuberculin which has been precipitated by alcohol, dried and redissolved in water. One drop of a 1 per cent. solution is instilled into the conjunctival sac. In 3 to 8 hours a varying degree of hyperemia appears, accompanied by some lachrymation and subjective irritation. The hyperemia reaches its maximum in about 24 hours and then gradually subsides. Frequently there is pronounced exudation and occasionally edema of the lids and surrounding tissues. Baldwin has suggested the following schema for recording the reactions:
Negative—No difference in color when both eyelids are pulled down and compared.
Doubtful—Slight difference with redness of the caruncle.  
+-Distinct palpebral redness with secretion.  
++—Ocular and palpebral redness with secretion well marked.  
+++—Deep injection of entire conjunctiva with edema of lids, photophobia and secretion.

As in the case of the cutaneous reaction of v. Pirquet, positive reactions have been obtained in many cases not suspected on clinical grounds of being tuberculous. The frequency with which the reaction is found in supposedly non-tuberculous individuals calls to mind post-mortem statistics in which it has been found that in over 90 per cent. of individuals dying from all causes, some trace of tuberculosis such as apical scars, etc., is found. In drawing conclusions from the ophthalmic as well as from the cutaneous and other tuberculin tests we must be guided not only by the specific reaction, but also by the other clinical findings.

The following table compiled by Hay summarizes the comparative results reported by some twenty observers, using the methods of Koch, v. Pirquet, and Calmette.

<table>
<thead>
<tr>
<th></th>
<th>Total No. of cases</th>
<th>Positive reaction</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuberculous cases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Koch*</td>
<td>291</td>
<td>237</td>
<td>81.5</td>
</tr>
<tr>
<td>Pirquet</td>
<td>1419</td>
<td>1191</td>
<td>88.8</td>
</tr>
<tr>
<td>Calmette*</td>
<td></td>
<td></td>
<td>88.6</td>
</tr>
<tr>
<td>Suspected cases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pirquet</td>
<td>281</td>
<td>208</td>
<td>79.0</td>
</tr>
<tr>
<td>Calmette*</td>
<td>516</td>
<td>268</td>
<td>51.9</td>
</tr>
<tr>
<td>Koch*</td>
<td></td>
<td></td>
<td>55.5</td>
</tr>
<tr>
<td>Non-tuberculous cases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pirquet</td>
<td>418</td>
<td>250</td>
<td>59.8</td>
</tr>
<tr>
<td>Calmette*</td>
<td>1320</td>
<td>204</td>
<td>15.4</td>
</tr>
</tbody>
</table>

The easy technique of the ophthalmic tuberculin test renders it particularly attractive as a means of diagnosis. It should be remembered, however, that it is not entirely without danger, and tuberculin even in dilute solution should not be indiscriminately instilled into the eyes of patients. Care must be taken that the test is carried out only in normal eyes.

The instillation of tuberculin often gives rise to a local hyper-susceptibility to tuberculin, and hence a second instillation should not be made into the same eye. In comparison with the thousands of ophthalmic tests, the accidents with Calmette's reaction have been relatively few. There are, however, a considerable number of cases on

*Frankel and Beck's statistics.
record in which the reaction has been attended by corneal ulceration, keratitis, etc., with permanent injury to vision, even in healthy eyes. (Knapp, Wiens and Günther, Pollard.)

Citron outlines certain restrictions to the use of the test: the reaction should not be tried unnecessarily in scrofulous children; in persons exposed to conditions which may easily cause inflammation; in districts where trachoma is prevalent; in patients who have been tested before; in patients under treatment with tuberculin; in cases where one eye is or has been diseased; and in cases where the diagnosis is clinically certain.—(E. E. I.)

Although the status of the Calmette reaction is now fairly well established it has been the subject of much favorable and some unfavorable comment. For example, three of T. H. Butler’s (British Med. Journal, Aug. 8, 1908) cases have done so badly that he believes that the dangers of the Calmette reaction are very real, and that, since the reaction is by no means conclusive, it is hardly a justifiable method of diagnosis.

In the first case a typically tuberculous process was set up in a perfectly healthy eye as a result of the instillation of tuberculin; a central corneal nebula will permanently reduce considerably the acuteness of vision.

In the second example, although there was no complication of the cornea, a violent reaction was followed by chronic conjunctivitis with much thickening and a very chronic phlyctenule.

In the third patient a very violent muco-purulent conjunctivitis occurred and resisted all treatment for two months. In none of these three cases was there preexisting eye disease.

Ernest Thomson (The Ophthalmoscope, July, 1908) notes that constitutional reaction has been reported by several observers. Tuberculin causes movements of the tuberculo-opsonic index similar to those which follow a subcutaneous injection. Napier reports 2 cases where tuberculin was administered subcutaneously after use of the Calmette’s test, and in each case a severe conjunctivitis came on some weeks later in the eyes to which only the test had been applied. The inference is that the ocular test causes a local change of some kind which responds sharply to the introduction of tuberculin into the circulation. The local reaction on diseased eyes is generally considered to be dangerous. Many cases have been reported where the eyes had been permanently damaged. Very severe conjunctivitis, lasting many weeks, has been reported by a number of observers. Phlyctenular keratitis has followed in a few cases. Where one eye is healthy and the other diseased, especially with a keratitis of doubtful tuber-
cular character, the application of the test to the apparently healthy eye is fraught with danger. Knapp reports such a case.

Bearing on this question, Lapersonne has published in the Presse Médicale an article in the course of which he considers the injurious effects imputed to the Calmette procedure and has stated that the dangers are insignificant and that the positive oculo-reactions which have been obtained are considerable in number. Brunetière (La Clinique Ophthal., Jan. 25, 1908) in this connection remarks that for two months past there have been many oculists who object to the new method. Kalt reported a case in which he attributed aggravation of tubercular intraocular lesions to the ophthalmo-reaction. Morax believed in that case the aggravation was a coincidence. Brunetière is of the opinion that the cases in which complications arise are few. He reports a case of phlyctenular conjunctivitis in which the ophthalmo-reaction apparently gave threatening symptoms, which, however subsided later.

The active introduction and general use of the ophthalmo-reaction have caused Trousseau (Clinique Ophthal., Jan. 25, 1908) to point out the dangers of this tubercular test. Facts accumulate which show that the measure is not free from risk. Ordinarily the reaction appears in from 5 to 8 hours, and between 12 and 20 hours its maximum is reached; after that time a recession should take place. If the reaction is very violent it may last several days. Trousseau relates a case of a child of 7 years that prior to an attack of measles had had excellent health. Following the measles the child had phlyctenular conjunctivitis, for which yellow ointment was applied. A slight bronchitis appeared and the parents wished the test of the ophthalmo-reactions made, the application of which was followed by a severe swelling of the lids with abundant secretion. Twenty-one days afterward the child was brought to Trousseau, and the removal of the conjunctival condition required active treatment for some time. The author believes the trouble to have been caused by the tuberculin.

An instance of serious impairment of vision following the use of ophthalmo-reaction for the purpose of diagnosing tubercle is also reported by Maitland Ramsay. (The Lancet, March 7, 1908.) The patient, a girl of 12, was suffering from superficial vascular ulceration of the right cornea. There was a history of a similar attack in the left eye 2 years before and, though careful examination revealed no sign of tubercle in the lungs or abdomen, both cervical and submaxillary glands were much enlarged. One drop of 1 per cent. solution of tuberculin was instilled into the left eye, which was at that time perfectly free from inflammation, though there was a faint
nebula on the cornea, the result of a previous attack of ulceration. Within 24 hours there was violent muco-purulent reaction, the discharge being very abundant and accompanied by marked swelling of the lids and thickening of the palpebral conjunctiva. The inflammation could not be influenced by treatment and progressed until the cornea quickly became vascular and abraded over the central area. Ten days after the instillation, 0.25 cubic cm. of 1 to 1000 solution of Koch's old tuberculin was injected subcutaneously. This was followed by a rise of temperature and resulted in great improvement in the right eye, though the left remained unchanged. Subsequently the old tuberculin was injected twice, the first time to the amount of 0.25 cubic cm., and the second time to the amount of 0.5 cubic cm.; 7 weeks after admission the right eye was almost recovered, while in the left the discharge had begun to lessen. Subsequently the improvement in the latter was steady, but there remained, as a result of the Calmette instillation, a considerable opacity of the center of the cornea, and in consequence the vision was seriously impaired.

The reaction of tuberculin on the conjunctiva, as it is employed at the present time, has, according to Collin, the following disadvantages and dangers: Children and very sensitive adults compress forcibly the eyelids after a drop of tuberculin is instilled, expressing thereby a good deal of the fluid, thus preventing its absorption. The amount absorbed cannot be properly estimated. The author advises an instillation of a 3 per cent. cocain solution for from 5 to 10 minutes before the instillation of the tuberculin.

Tuberculin is contraindicated in cases of trachomatous, follicular, phlyctenular and catarrhal conjunctivitis, not only because the specific reaction is obscured in these affections, but also because the procedure may endanger the eye which had already been affected.

Instillation of tuberculin into the conjunctiva is not without danger to the eye, because the inflammation which follows the procedure does not disappear very rapidly, and frequently produces marginal ulcers of the cornea, which may lead to perforation. In one case a vaccine tuberculosis of the conjunctiva was produced.

Frank Brawley concludes, from a study of the reported cases, it would seem that much work is yet to be done before the ophthalmom tuberculosis reaction and its relation to general tuberculosis are fully determined. Exhaustive eye tests with suspensions of various percentage strengths of tuberculin, controlled by skin tests, tuberculin injections and the opsonic index for tubercle bacilli, must be made before we can decide upon the exact value of the procedure and its possibilities of harm to such a delicate organ as the eye, especially in
the presence of the various ocular diseases. Second eye tests should be made in the opposite eye where possible, or in the same eye at long intervals, as the experience of the majority of observers seems to show that the test has a cumulative effect, rendering the eye more sensitive or possibly causes mechanical irritation if used too often in increasing dosage.

**Calomel.** Mercurous chloride. Subchloride of mercury. HgCl. This well-known remedy is a fine, odorless, tasteless, smooth, heavy, white, impalpable powder, which the microscope reveals as minute, needle-like crystals. It is insoluble in water but exposed to boiling water it decomposes into metallic mercury and the bichloride. Perhaps its effects upon the eye are due to this gradual decomposition and the formation of minute quantities of mercuric chloride.

Calomel in crystals is of considerable interest to the chemist, as it has always been looked upon as occurring as an amorphous powder. The new crystalline form is manufactured by the interaction of mercuric chloride and lithium sulphite. Some ophthalmic surgeons consider it a great improvement on the ordinary variety for ophthalmic use, as it is more adherent and is decidedly less irritating than ordinary calomel as a dusting powder for eye treatment. It is interesting to note that the specific gravity of this new calomel is only 4.5 to 5, as against ordinary calomel, 6.5 to 7. This probably explains the reason of the superior adhering quality. The salt, either in the form of powder alone, or mixed with a little sterile boric acid powder or starch or an ointment (5 to 10 per cent. strength), should certainly be worth a thorough trial by the ophthalmic surgeon. It is manufactured by W. Martindale, 10 New Cavendish St., London, England.

It is well to remember that neither calomel nor any other salt of mercury should be applied to the conjunctival sac if iodides are being taken internally lest that irritant, mercuric iodide, be formed.

Calomel has enjoyed a considerable vogue in Europe as a powder for dusting ("flicking" it from the end of a camel-hair pencil or blowing it through an insufflator) over the eyeball and into the sac in phlyctenular and other diseases of the conjunctiva and cornea. It is less frequently employed than formerly. Under the name aqua opthalmica nigra it was used by von Graefe in purulent conjunctivitis. He advised the following formula:

\[
\begin{align*}
\text{R} & \\
\text{Ext. hyoseyami} & 1.0 \\
\text{Calomelanos} & 0.6 \\
\text{Aquaæ rose} & 30.0 \\
\text{Aquaæ calcis} & 100.0
\end{align*}
\]
A reaction follows with the formation of the black mercurous oxide.

Klein reports the successful employment in the after-treatment of trachoma granulations of one part of calomel thoroughly incorporated with five parts of powdered cane sugar (q. v.). The mixture is dusted on the everted lids as usual.

A. Duane believes that when dusted into the eye it is of service not only in phlyctenular conjunctivitis, but also in all forms of superficial infiltrating keratitis. Of course, in applying it, he makes sure that the patient is neither taking iodides nor has been taking them recently.

**Calomelano.** (It.) Mercurous oxide. Calomel.

**Calomelol.** This is a trade name for the soluble, colloidal forms of calomel containing albuminoids. It is marketed as a white-gray, odorless, tasteless powder containing 80 per cent. of mercurous chloride and 20 per cent. of proteids. It is soluble in water, making an opalescent liquid, but insoluble in alcohol and ether.

The action of calomelol is the same as that of calomel (q. v.) but is said to be its superior because of its solubility in water, less irritant qualities and because it is distinctly non-toxic. Used as a dusting powder it can be mixed with starch, zinc oxide or it can be applied as calomelol ointment. This latter is prepared by combining 45 parts of calomelol with 55 of lard.

**Calops.** Having large, brilliant eyes.

**Calorescence.** A name given by Tyndall to the process of transformation of rays of low refrangibility (non-luminous rays) into those of higher refrangibility (luminous rays) by the interposition of a body to be heated, such as a piece of carbon or platinum.

**Calorimeter.** An instrument for transforming the potential energy of food into heat, and for measuring the number of heat-units thus produced. Two forms are used, the water-calorimeter and the ice-calorimeter. (Gould.)

**Calorimetry.** Estimation of heat-units by means of the calorimeter. By *direct calorimetry* is meant the estimation of the amount of heat produced and given off by an animal incased in a ventilated cabinet, (the whole inclosed in another cabinet filled with air or water) by gauging the amount of heat imparted to the air or water in the second cabinet. In *indirect calorimetry* an estimate is made of the calorific value of a known quantity of food ingested by an animal during a given period.

**Calorimetry, Ophthalmic.** In the Graefe-Saemisch Handbuch, II, ii, 45, Leber gives a thorough treatment of the subject, and another expo-
sition by a different author occurs in *Encycl. française* (II, p. 56, 1905).

**Calory.** A heat-unit; the amount of heat required to raise the temperature of one kilogram of water one degree centigrade.

**Calotropis procera.** (L.) This is a plant belonging to a genus of East India trees and shrubs of which the *madar* is a member. It is widely used in Asia for a number of diseases. It exudes a milky juice which, when introduced into the human eye, produces an anesthesia of the cornea. Guillery has made experiments on animals in which after ten minutes a complete corneal anesthesia was produced, followed in seventy-five minutes, by conjunctival anesthesia. This condition continued for twenty-four hours. Experiments upon himself showed a similar result, including a slight clouding of the cornea; but eventually entire recovery, with the visual acuity as before the experiment.

**Calotte.** (F.) (1) An adhesive plaster formerly applied to the head of persons affected with ringworm; (2) the upper and internal part of each peduncle of the brain, and the posterior occipital portion of the cerebral hemispheres which is in contact with the parietal lobes.

**Calotype.** *Talbotype.* The negative photo process on paper, invented by Fox Talbot.

**Calx uesta.** Quicklime.

**Calycularis.** (L.) An old name for hyoscyamus (q. v.).

**Camelina sativa.** (L.) A plant formerly used in various forms of external eye diseases.

**Camel's-hair brush.** A small, fine brush used for making various applications to the surface of the body, especially flicking powders onto the external eye, for cleansing the ear, etc.

**Camerae oculi.** (L.) Anterior and posterior chambers of the eye.

**Camera lucida.** An invention of the chemist Wollaston, designed to facilitate the delineation of distant objects. It consists of a solid four-faced prismatic piece of glass mounted upon a brass frame, or arranged to fit over the eyepiece of a microscope. The prism has its angles so arranged that the rays from the object are reflected into the eye so as to appear to come from the surface of the paper. The prism is covered at the top by a metallic eyepiece, the hole in which lies half over the edge of the prism, so as to afford a person looking through the hole a view of the picture reflected through the glass, and a view upon the paper of his pencil or tracing-point.—(C. F. P.)

**Camera obscura.** A dark chamber in which the images of external objects, received through a convex lens, are exhibited distinctly in their natural colors on a white surface placed at the focus of the
lens. The simplest form of this instrument, the so-called pinhole camera, consists of a darkened chamber into which no light is permitted to enter except by a very small hole as a substitute for the lens. The camera obscura is often made in the form of a circular building capable of holding a number of people, who stand about a white-surftaced table which is placed in the center of the structure, and on which the luminous image is projected through the roof by a prismatic lens. Portable cameras of various sizes and forms, are made for the purpose of drawing or tracing the images projected on paper. The human eye and the photographic camera are modifications of the camera obscura.—(C. F. P.)

Camera oculi. (L.) A chamber of the eye.

Camera oculi tertia. (L.) Canal of Petit.

Camera tertia aquosa. (L.) This is a term occasionally applied to the vitreous or hyaloid canal.

Campani's eyepiece. A negative eyepiece used with a microscope.

Campani's ocular. Huygenian ocular. A system composed of two plano-convex lenses whose convexities are directed towards the objective. The lower and larger lens is the field-lens, the upper and smaller one the eye-lens.

Campanula of Haller. Since fishes have no ciliary muscles, in many of them accommodation occurs by means of a process of the choroid called the processus falciformis, which extends through the embryonic choroid fissure into the vitreous humour towards the lens, around which it expands to form the so-called campanula Halleri. See, also, Comparative ophthalmology.

Campbell, T. Beattie. For more than 20 years the capable and efficient secretary of the Royal Westminster Ophthalmic Hospital, London. He died in London, Nov. 28, 1906, after an illness of two years. He was a nephew of the poet, Thomas Campbell, author of "The Pleasures of Hope."—(T. H. S.)

Camper, Peter. Born at Leyden, Holland, in May, 1722, he studied at the University in that city, and received therefrom his philosophical, as well as his medical, doctorate in 1746. His dissertation, presented on this occasion, was entitled, "Diss. Optica (de) Visu." After a year or two of practice in Leyden, he travelled about a good deal, received a number of professorships of no particular consequence, finally, however, being appointed in Leyden to the chair of anatomy and surgery. He wrote and published a number of works of no ophthalmologic interest, and wrote, but did not publish, in Latin, an ophthalmologic text-book, called "Petri Camper de Oculorum Fabrica et Morbis Commentaria, 1766." According to Joseph Hirsch-
berg, who succeeded in finding a copy of the MS. "To be sure, this 'ophthalmology' was for Peter Camper only an incidental affair, as compared with his greater productions; but the lightning of his soul shines forth plainly in various passages of this volume."—(T. H. S.)

Campher. (G.) Camphor.

Camphoid. This compound is a substitute for collodion (q. v.). It is made from a solution (1 in 40) of pyroxylin with equal parts, by weight, of camphor and absolute alcohol. It may be used as a vehicle for application to the skin of such drugs as iodoform, phenol, salicylic acid, resorcin, iodine, chrysarobin, and ichthyol. Iodoform dissolves in it to the extent of 1 in 10. The preparation dries in a few minutes, leaving a film, which is not easily washed off. It is very useful as a protective after operations on the lids and in wounds about the eye.

Camphor. An important application for the eyes is this substance, C_{10}H_{18}CO, obtained from all parts of the cinnamomum camphora. It is a white, translucent, tough substance with a peculiar odor, slightly soluble in water, very soluble in alcohol, ether and various oils.

Camphor and its compounds are incompatible with carbolic acid, resorcin, menthol, salol, salicylic acid, potassium permanganate and most concentrated solutions of salts.

Gum camphor has been used in ointments or dissolved in spirituous fluids to form eye liniments but its employment in this way is, for obvious reasons, restricted. The following formula is intended for acne palpebrarum: Sulphuris, 1.0 gm. (gr. xv) camphoræ; olei olivæ, ââ 0.6 gm. (gr. ix) unguentī rosatī (P. G.) 15.0 gm. (§§s).

Camphor water has always been a favorite menstruum in collyria although the gum is very slightly soluble in water, even with the aid, as in the officinal aqua camphoræ (q. v.) of magnesia levis and other adjuvants.

The best ophthalmic form of this remedy is camphor water made after the German method. A piece of camphor or, better, a number of small pieces of camphor in a muslin bag are suspended in a gallon bottle three-fourths full of sterile, distilled water. The bottle is shaken three or four times daily. At the end of a week the camphor bag is withdrawn and the water decanted as needed.

It is mildly astringent and stimulating and as such is often prescribed in the slighter forms of conjunctivitis. As Spirits of camphor it may be rubbed over the forehead, or the fumes allowed to rise
from a few drops in the palm of the hand into the open eye, for the temporary relief of ocular headache.

**Camphoroxyol.** A trade name of a substitute for hydrogen peroxide (q. v.). It is a clear, limpid liquid, readily miscible with water and said to be more stable than peroxide of hydrogen. It is 3 per cent. (by weight) aqueous solution of H₂O₂ produced by adding to an alcoholic solution of camphor enough of a concentrated H₂O₂ solution to make a preparation of 3 per cent. strength. It contains 1 per cent. of camphor, held in solution by the addition of about 33 per cent. of alcohol. In cold weather the camphor may precipitate, but it will readily re-dissolve on warming. The advertising literature claims that while H₂O₂ decomposes almost immediately on coming in contact with blood, pus, etc., leaving nothing to prevent reinfection, camphoroxyol continues to exert its antiseptic action after the peroxide has spent its force. The preparation is as non-toxic and harmless as H₂O₂, but, according to experiments made by Beck, possesses a bactericidal power 4 to 5 times greater than peroxide of hydrogen. According to the same authority a 10 per cent. solution of camphoroxyol equals in disinfectant strength a 1:1000 solution of the bichloride of mercury and is superior to a 5 per cent. carbolic acid solution. It also has power to stimulate the growth of healthy granulations. The product has been found very useful in the treatment of infected wounds and ulcers. F. C. Hotz and other observers report good results from its use in purulent otitis media. As a rule, the product is employed in 5 or 10 per cent dilutions; however, it has often been used in 25 or 50 per cent dilutions, and sometimes even in full strength with little or no discomfort to the patient.

**Camphor water.** See *Aqua camphorae.*

**Camphre.** (F.) Camphor.

**Camphrique.** (F.) Pertaining to camphor.

**Campimeter.** An apparatus for measuring the field of vision; similar to the perimeter, but in the form of a blackboard graduated on one side like the projection of a part of a hemisphere. See, also *Haitz campimeter.*

**Campo di accomodazione.** (It.) Field of accommodation.

**Campo di sguardo.** (It.) Field of fixation.

**Campo latente d'accomodazione.** (It.) Latent range of accommodation.

**Campylotes.** (L.), f. n. Crookedness or distortion, particularly of the eyelids.
Camus's mask for general anesthesia. This is a mask for giving chloride of ethyl which permits its inhalation in fractional doses.

Canada balsam. A transparent liquid resin obtained from the bark of the balsam-fir. It is used for mounting microscopic objects and cementing lenses.

Canal, Central. A name given to the hyaloid canal, or canal of Cloquet.

Canal ciliare. (F.) Canal of Fontana.

Canal des Glaskörper. (G.) Hyaloid canal.

Canale jaloideo. (It.) Canal of Cloquet.

Canal godronné. (F.) Canal of Petit.

Canal, Hyaloid. Canal of Cloquet (q. v.).

Canal hyaloïdien. (F.) Hyaloid canal.

Canalicule, -ée. (F.) Grooved.

Canaliculi, Atresia of the. See Lachrymal apparatus, Diseases of the.

Canaliculi, Dilatation of the. See Lachrymal apparatus, Operations on the.

Canaliculi, Division of the. See Lachrymal apparatus, Operations on the.

Canaliculi, Double. This congenital abnormality is usually associated with double puncta, but this is not necessarily the case. A complete account of the matter will be found under Congenital anomalies of the eye.

Canaliculi, Foreign bodies in the. See Lachrymal apparatus, Diseases of the.

Canaliculi, Lachrymal. Two small excretory channels for the tears, one in the inner third of each lid, running from the puncta laerimalia to the lachrymal sac, which they enter by a double or a single opening. See Anatomy of the eye.

Canaliculi, lachrymal, Obliteration of the. See Lachrymal apparatus, Diseases of the.

Canaliculi, Leptotheix of the. This condition is due to one or more fungi which, however, are rarely found in the canaliculi. It is more frequent in the lower than in the upper canaliculus. The inner part of the lid, corresponding to the canaliculus, is red and swollen, with a tendency to ectropion, the appearance resembling that of a stye. The disease is unilateral. According to Kipp, it occurs in the proportion of 1 to 53,600 eye cases. The caruncle and plica semilunaris show a persistent conjunctivitis; and a tenacious, yellowish, creamy fluid exudes from the punctum. Noyes mentions a pumping or sucking movement in the dilated punctum. The fungous mass may be rounded and firm, feeling hard like a chalazion. The condition may be mistaken for hordeolum or for chronic dacry-
OCYSTIS. From the latter it can easily be distinguished by the absence of distension of the lacrimal sac, and from the former by its chronic nature. Higgins met with a case of leptothrix which was mistaken for an epithelioma. Microscopic examination of the mass showed it to be composed of isolated, unbranched, straight, and very thin filamentous cells, similar to leptothrix buccalis, found in the tartar of teeth. Leptothrix has the characteristic of secreting lime salts. When calcified, it forms a hard mass known as tear-stone. Up to 1874 the fungus found in these secretions was reported to have been leptothrix. Since that date streptothrix was found in all instances. Since 1894 actinomyces has been reported as present in such concretions. Evidently the subject demands further investigation. In the treatment of this disease pressure will cause the soft part to exude, but will not cure the condition. It will be necessary to slit the canaliculus and apply antiseptics to the portion distended by the mass. A mild solution of nitrate of silver will be found useful.—(J. M. B.)

Canaliculi, Mucoccele of the. This is a very rare disease, although several instances of it have been reported. The dilated canal, with its covering and contents, has been known to measure 11x6 mm. The mucoccele generally contains a liquid, infected mucus. Effective treatment consists in evacuating the cystic cavity, after which the lining epithelium should be destroyed by means of the cautery.

Canaliculi, Obstruction of. See Lachrymal apparatus, Diseases of the.

Canaliculi, Operations on the. See Lachrymal apparatus, Operations on the.

Canaliculi, Slitting of the. See Lachrymal apparatus, Operations on the.

Canaliculi, Syringing of the. Dilation of one or both puncta followed by the introduction of the point of a Meyer or Anel (q. v.) syringe will enable the operator to inject various fluids into the nose, if the lacrimal nasal duct be not too much obstructed. In the latter event the fluid may regurgitate through the corresponding canaliculus or escape through the other punctum. If, in addition to this mode of escape, it distends the sac the obstruction to the passage of the liquid into the nose is probably within the nasal duct.

Besides its use as a diagnostic or prognostic means, syringing of the canaliculi may be used for therapeutic purposes, in which case it should be avoided in acute infections and be confined to the treatment of more chronic cases of dacryocystitis. It is a valuable remedy and often succeeds in relieving or curing partial occlusions of the nasal
passages, without resort to operative measures. See Lachrymal apparatus, Diseases of the.

Canaliculus, Actinomycosis of a. This is an extremely rare infection of the lacrimal, apparatus and was probably first (1894) described by Schroeder who, in a concretion removed from a canaliculus, found microscopic appearances typical of the ray-fungus. He believes that all previous cases of obstruction of a canaliculus by a fungus were due to the development of actinomyces. Elschnig and Evetsky agree in this opinion, which the author knows to be incorrect. Actinomy- cosis has been found a few times producing obstruction of the canali- culi. The treatment for actinomycosis includes slitting of the canal- iculus, removal of the mass, curettement of the walls of the dis- tended canal, and the application of a bichlorid solution (1 to 1000).

—(J. M. B.)

Canaliculus and lachrymal duct probes and dilators. The value of these instruments lies chiefly in the fact that they can be introduced through the undivided canaliculus, or through the enlarged punc- tum, into the nose in such cases as are capable of cure by reasonable dilation of the naso-lachrymal duct. Where it is necessary to dilate the passage still further slitting of the canaliculus (q. v.) may be necessary as an adjunct procedure. As is well known, when grad- ual dilation is desired the Bowman probes, in series, are the stand- ard. Other favorite models are those of Theobald, Caldwell, Wil- liams, Ziegler, Galezowski and Wilder, some of them being devised for the purpose of rapidly dilating the naso-lachrymal canals.

A modification of the Bowman probes are those invented by Henry W. Williams (Trans. Amer. Oph. Soc., 1867, p. 30). They are flex- ible that they may adapt themselves to the sinuosities of the lachrymal canal. These modified probes have bulbous extremities, of the sizes of Bowman’s series, but are slender for one-third of the distance from the bulb to the flat disk at their middle. They are of alloyed silver to give an elastic flexibility; pure silver is too liable to bend.

Samuel Theobald devised probes that differ from the Weber conical probe in that they increase in size more rapidly from the point backwards. He later substituted aluminum for silver in the sizes above No. 7. Below No. 7 coin silver answers better. The aluminum was found to be smoother and more slippery and could be intro- duced with greater ease. (See the Am. Jour. of Oph., March, 1887, p. 63; and Trans. Am. Oph. Soc., 1901, p. 398.)

J. Oscroft Tansley’s lachrymal probe (Trans. Am. Oph. Soc., 1888, p. 63) is a modification of Weber’s and consists simply in sup-

J. J. Kyle (Am. Jour. of Oph., Vol. 13, p. 362) suggests that the
ordinary probe be made in halves with a screw joint so that one-half may be removed, while the other half, in situ, acts as a style.

Maynard G. Dorell's nasal duct dilator (Trans. Oph. Soc., United Kingdom, 1900, p. 275) when closed is only a little larger than a No. 2 Bowman probe; the maximum dilation of the terminal portion is equal to a No. 7. By turning the thumb-screw at the end of the instrument an inner rod is pulled through a steel tube and the probe point separated from the split extremity. A series of fine lines on the rod indicates the amount of dilation.

C. H. Beard (Amer Jour. of Ophthal., Oct., 1901, p. 290) has devised a series of gold sounds, made in different sizes of gold wire, with bulb or fusiform terminals, and with broad flat handles. See Lachrymal apparatus, Operations on the.

Canaliculus, Foreign bodies in a. All sorts of foreign bodies find their way into the lacrimal canaliculi. Among these have been birdshot, hairs, eyelashes, pieces of silk thread, and dacryoliths, that have been formed in this part of the drainage apparatus. The author has met with one case in which the lower canaliculus was occupied by a growth of leptothrix, which formed a round, hard mass, producing epiphora and considerable inflammatory disturbance. The canaliculus, however, was not completely obstructed, since a stream of water from a syringe passed down the nasal duct.

Any foreign body, such as a cilium or a piece of the beard of barley or wheat, if projecting, can be seized with forceps and removed. If not projecting, the canal should be opened to a small extent and the offending substance should be picked out with forceps. Dacryoliths are to receive the same treatment.—(J. M. B.)

Canaliculus knives. The earliest knives used in slitting the canaliculi

Various Naso-Lachrymal and Canaliculus Knives.

   Knife. 6. Schweigger's Canaliculus Knife.
   Knife.
are those of Weber and Bowman. During the last forty years a great number of instruments have been devised to the same end, the principle types of which are figured herewith.

**Canaliculus, Polyp of a.** As a result of long continued inflammation of the lining mucus membrane of a canaliculus, hypertrophy of the mucous follicles and other constituents of the mucosa may ensue and minute polypi may form. As in similar canals elsewhere these growths produce secretion and in the canaliculi may be the cause, indirectly, of a chronic conjunctivitis. The *treatment* is incision of the canal and removal of the offending growths.

**Canaliculus, Wound of a.** In wounds of the eyelid one or both canaliculi may be involved. It is extremely difficult to approximate the incised or lacerated edges of this small canal when its integrity has been interfered with. When either canaliculi is cut or torn the remaining portion should be carefully examined and opened into the lachrymal sac. This may prevent obliteration of the remaining lumen and furnish satisfactory drainage after the remainder of the wound has healed. Sometimes it is possible to pass a small probe through the interrupted canal, leaving it there until the entire wound has cicatrized.

**Canal, Infra-orbital.** See *Orbit.*

**Canalino lagrimale.** (It.) Lachrymal canal.

**Canalis Cloqueti.** (L.) Canal of Cloquet; the hyaloide canal.

**Canalis hyaloideus.** (L.) Canal of Cloquet.

**Canalis lacrimalis.** (L.) Lachrymal canal.

**Canalis opticus.** (L.) Optic foramen.

**Canalis Petiti.** (L.) Canal of Petit.

**Canalis petitianus.** (L.) Canal of Petit.

**Canalis Schlemmii.** Schlemm’s canal.

**Canal, Lachrymal.** See *Lachrymal apparatus.*

**Canal, Medullary.** See *Embryology of the eye.*

**Canal of Cloquet.** *Hyaloide canal.* *Canal of Stilling.* The vitreous body is perforated posteriorly by a lymph space, the so-called hyaloide canal, canal of Stilling, or canal of Cloquet. It extends from the optic disc, where it forms a funnel-like space called the *area Martegiana,* to the lens and marks the course of the hyaloide artery of pre-natal life. Its width is from 1 to 2 mm., the free end narrowing sometimes to a point where it touches the lens on the nasal side of the posterior pole of the latter. In many of the lower animals this canal is plainly marked during life and gives passage to well-developed blood-vessels and other organs. A demonstration of its presence in the adult mammal can only be made by dropping some colored solution onto the
posterior surface of the exenterated and entire vitreous: See Anatomy of the eye.

Canal of Ferrein. A triangular channel once supposed by Ferrein to exist, between the free edges of the eyelids when they are closed, and to serve for conducting the tears toward the puncta lacrimalia during sleep.

Canal of Fontana. A series of passages or spaces (very small in man, but of larger size in some of the lower animals) formed by the interlacing of the connective-tissue fibres forming the framework of the peripheral processes, or roots, of the iris; situated in the angle of the anterior chamber and serving as the medium of transudation of the aqueous humor from the interior to the exterior of the eye.—(Foster) See Histology of the eye.

Canal of Lauth. This is a name for the circular sinus or canal of Schlemm.

Canal of Petit. Camera tertia aquosa. Circulus Petitii. Post-zonular lymphatic space. A supposed canal (properly a space intersected by numerous fine interlacing fibres) existing between the anterior and posterior laminae of the suspensory ligament of the crystalline lens, or zonule of Zinn; extending from the periphery of the lens nearly to the apices of the ciliary processes.

Canal of Schlemm. An irregular space or plexiform series of spaces occupying the sclero-corneal region of the eye; regarded by some as a venous sinus, by others as a lymph-channel. On section it is sometimes circular, sometimes irregularly ovoid, and in places consists of several channels. In the opinion of Salzmann and Brown (Anatomy of the Human Eyeball, p. 41) the term canal should not be used for this structure "because it rarely is a single elongated lumen, and then for a stretch of only 0.2 to 0.5 mm. in a horizontal direction; usually there are two or more lumina; they lie side by side or over one another in the scleral furrow. Seen from the surface, Schlemm's canal is like the bed of a great stream which flows along undivided for a stretch, then is divided into several branches for a stretch. For this reason the form of the lumen changes in various sections of the same eye. The endothelial lining of Schlemm's canal has the same appearance as in other vessels and forms an extremely thin membrane with nuclei projecting inward. Aside from the endothelium, Schlemm's canal has no real wall, at least none such as one finds in other vessels of the same size; it seems to be simply entrenched in the adjoining tissue. On the other hand, it is not correct to say that the endothelium lies immediately upon the sclera, for a loose tissue, poor in fibres but rich in cells, is inter-
posed between the two, as a rule; sometimes this is only a thin layer, sometimes it is quite well developed. One sees this layer best in sections stained with Van Gieson; the tissue is then sharply set off from the deep red of the sclera by its yellow color. One encounters a similar tissue on the chamber side of the canal, usually, only there it is less developed or is not present as a continuous layer and is poorly differentiated from the neighboring trabecular meshwork. On the other side it extends along the veins going off from Schlemm's canal into the sclera. Schlemm's canal is in any case closed off from the spaces in the meshwork lying inward to it, i.e., no visible breaks in its wall are present. For this reason only solutions or the finest suspensions, such as ink, pass into the canal; cells remain in the meshwork of the iris angle and lie outside the wall of Schlemm's canal. On the other side, however, the canal communicates freely with the venous system by means of vessels given off here and there along the seleral side of the canal; these go obliquely outward and backward into the sclera and unite with the anterior ciliary veins while still within the sclera. An actual capillary net for the supply of the canal does not exist, and it must be that some of the deeper limbus capillaries give off blood to it; in any case it seems to connect laterally with the ciliary venous system as a whole, if one may judge from the direction of its blood stream. In prepared specimens the lumen of the canal is usually empty or contains only a few red-blood cells. Complete filling of the whole canal with blood only comes about in a stasis of the venous system, e.g., in persons who are hanged. In the question as to whether or not the canal contains blood or aqueous during life, I am disposed to the view that it contains aqueous. It is certainly demonstrated that its main rôle is to carry away the aqueous, and its position to one side of the actual course of the blood-stream warrants the supposition that it carries aqueous. On the other hand, a slight circulation disturbance during life or hypostasis in the cadaver is probably quite sufficient to fill it partially or entirely with blood owing to its open communication with the veins.'" See Anatomy of the eye, and Histology of the eye.

**Canal of Stilling.** Another name for the canal of Cloquet (q.v.), or hyaloid canal.

**Canal of the vitreous.** A synonymic term for the hyaloid canal, or canal of Cloquet (q.v.)

**Canal, Optic.** This is the interval in the sclera which marks the entrance of the optic nerve. According to Dwight (System of Diseases of the Eye, Vol. 1) the optic foramen or canal of the sclera is
situated about three millimetres from the posterior pole on the nasal side and about one millimetre below the horizontal meridian. By macerating a specimen it is easy to show that it is not a simple single canal, but a series of minute orifices through which pass the single fibres of the optic nerve. On reaching the sclera the external or dural sheath of the nerve becomes continuous with it, and the connective tissue that surrounds and interpenetrates the different bundles of fibres (perineurim, endoneurium) becomes condensed to a perforated sheet that stretches across the canal and is continuous with the sclera on either side.

**Canals, Corneal.** When properly treated with silver solution the corneal spaces appear as irregular star-like areas, due to the presence of minute ramifications known as corneal canals. These spaces extend in all directions and are the means of communication with neighboring spaces in the cornea. Altogether, these spaces and the canals form a system of channels throughout the *substantia propria*, which are really the lymph-spaces of the cornea.

**Canamusali de Baldach** (also called AlKanamusali). The author of a celebrated Arabic work on ophthalmology, of which merely the part devoted to ophthalmic medicines has come down to our day. This fragment exists only in a Latin translation appended to the "*Surgery*" of Guido, which, in its turn, is a part of the *Collect. Chirurg. Venet.* (Eds. of 1497, 1499, and 1500). Canamusali is said to have been an Armenian, who flourished at Bagdad about the middle of the 13th century. Steinschneider, however, in 1867, and Leclere in 1876, attempted to establish his identity with Ammar (or Omar), whose name in full was Abul Qasim Ammar b. Ali al-Mausili. Hirschberg, lately, has shown that the identity does not exist.—(T. H. S.)

**Canard.** (F.) Duck.

**Cancer, Cohnheim's theory of.** According to this observer, in fetal life portions of the epithelium become nipped off and included in the connective tissue. These inclusions, if stimulated to activity, in later life give rise to a cancerous growth.

**Cancer of the ocular structures.** As the term cancer is generally employed to include not only epithelioma and carcinoma but other malignant neoplasms, as well as combinations of them, the reader is referred to *Tumors of the ocular apparatus*.

**Cancer primitif.** Primary cancer.

**Cancro.** (It.) A general term for malignant tumors, infiltrations, and ulcers.
Cancroide des paupières. (F.) Epithelioma or rodent ulcer of the eyelids.

Cancroid ulcer. Rodent ulcer. Jacob's ulcer. This disease, a slowly progressive ulcer of the face, not uncommonly involves the eyelids. Although it is histologically a carcinoma it is often described as a form of epithelioma. Clinically it represents features which serve to distinguish it from epithelioma. The essential facts of rodent ulcer were described by A. Jacob, in 1827, in these words: "The characteristic features of this disease are the extraordinary slowness of its progress; the peculiar condition of the edges and surface of the ulcer; the comparatively inconsiderable suffering produced by it; its incurable nature, unless by extirpation; and its not contaminating the neighboring lymphatic glands." Jacob's ulcer begins as a small nodule with depressed centre, of firm consistence and brownish-red color. After a variable period the skin breaks, leaving an ulcer with undermined edges and infiltrated border. This becomes broader and deeper, destroying all tissues, including the bones. It extends in the direction of the orbit, and often the eyeball falls out. Its etiology is obscure and the prognosis must be guarded. The treatment is excision. Recently the treatment by the Roentgen ray and Finsen's light has given encouraging results.—(J. M. B.)

Cancroin. A substance (said to be identical with neurin), introduced by Adamkiewicz as a material for hypodermatic injection in cases of malignant disease, it being regarded by him as an alexin destructive of cancer-tissue. (Gould.)

Candescence. Incandescence. The emission of light by a body heated to a high temperature.

Candle-balance. An instrument used in photometry to determine the weight lost by a candle burning a given length of time.

Candle-power. The illuminating power of a sperm candle burning at the rate of 120 grains per hour.

Candle tree. See Catalpa.

Canepin. (F.) n. A very thin variety of sheep-skin, used to test the sharpness of instruments.

Canescence. A whitish or hoary colour.

Cane sugar. Common sugar. Sucrose. Saccharose. This well-known agent occurs in commerce as pure-white, dry, hard crystals soluble in about half of their weight of water.

Mention has already been made of a mixture of this agent with calomel (q. v.) and other substances, to be used as a dusting powder for the after-treatment of trachoma granulations. I have also used
fine powdered sugar alone for the same purpose and am aware that it has been recommended by others but, I fear, with no particular results. Its application is sometimes followed by pain, lachrymation and irritative injection of the bulbar vessels. Fuchs advises the use of simple syrup in the treatment of lime burns.

As an astringent excipient L. D. Brose finds the following finely powdered mixture, dusted into the eyes morning and afternoon, followed by massage, to be useful in chronic trachoma. The sugar has a distinct therapeutic value in the formula: R Pulv. sacchar, alb. 10.00; pulv. cupri citratis, 1.00.

Gosselin also advises the application of syrup (sugar solution) for the relief of lime burns, but this practice is condemned by Parsons and others.

Canite des cils. (F.) Bleaching or whitening of the eyelashes.

Canities. Poliosis. Grayness or deficient pigmentation of the hair without other apparent lesion. The disease may affect all the lashes of both eyelids or it may be confined to a small number of cilia of one lid only. Sometimes the eyebrows are affected either alone or in conjunction with the eyelids. Sometimes the affection is congenital; more frequently it is of nervous origin. Cases have been observed where the disease seemed to result from sympathetic ophthalmia, exophthalmic goitre, injuries to the head, certain brain diseases, etc. Probably the occurrence of poliosis in some of these diseases is merely a coincidence.

Cannabinon. This agent is a balsamic resin extracted from the flowering tops of Cannabis sativa. It is a dark-brown, sticky mass, very disagreeable to the taste, soluble in benzine, alcohol, and oils, insoluble in water. It is a hypnotic, the doses being 1/2 to 1 1/2 grains (0.03—0.1 gm.)

When taken in toxic doses it is likely to produce hallucinations of vision, "rolling" of the eyes, and weakness of the eyesight—symptoms that persist for several hours.

Cannabis indica. The amblyopia from the various preparations of this powerful drug may be said to resemble in a general way that from alcohol-tobacco. In acute intoxication the patient may have dim, violet-colored vision, visual hallucinations, and decrease in the range of accommodation. In the chronic form of poisoning—as in the hashisch habit—there is a central amblyopia, with fields intact at the periphery. The eye symptoms of poisoning from the balsam appeared in one recorded case after taking one decigram. In half an hour both pupils were semi-dilated, and reacted very slowly to light. In a few hours, as the general symptoms became more pro-
nounced, the pupils were dilated \textit{ad maximum} and were not affected by light. The patient claimed that he could no longer see, and this loss of vision continued for some time. See \textit{Toxic amblyopia}.

\textbf{Cannelé.} (F.) Striated; grooved.

\textbf{Cannelure.} (F.) Groove (on a director).

\textbf{Canopite.} A collyrium much in favor among the ancients. It consisted of cinnamon, saffron, acacia-juice, flowers of arsenic, resin of myrrh, frankincense, pepper, copper, and other substances. It was employed especially for trachoma.—(T. H. S.)

\textbf{Canthal.} Pertaining to the angle of the eyelids.

\textbf{Cantharellus aurantiacus.} This poisonous mushroom has been known to produce a nystagmus-like movement of the eyeballs, with restriction of the visual fields for red and white. The patient also had paresis of the eye muscles, accompanied by diplopia. The pupils were unequally dilated, but reacted to light. The patient was unable to read fine print. On the third day the paralysis began to disappear and in six days the patient was as well as ever.

\textbf{Cantharides.} \textit{Spanish flies.} The juice of cantharides was employed throughout antiquity as a remedy for staphyloma. See \textit{History of ophthalmology}.—(T. H. S.)

Preparations of the dried beetle—cantharis vesicatoria—owes its powers to cantharidin present in the animals to the extent of 0.17 to 1 per cent.

When it is necessary to apply a blister to the ocular neighborhood this remedy is best employed in the form of cantharidal collodion, although the “paper” cerate or plaster may be used. Any of these takes about 5 hours to produce vesication. After the application has remained in situ sufficiently long to blister, the vesication may be much increased by following it with a poultice. The serum should be removed from the pendant bleb by pricking it, after which a soothing cerate should be applied.

I much prefer the cantharidal collodion; it is more certain, more cleanly, more easily controlled and localized and probably less painful than the other forms of the “fly” blister.

Blisters are useful as counterirritants and local depletants and as such have a place in ocular therapeutics.

\textbf{Canthi, The.} The angles formed by the junction, both towards the nose and at the temples of the upper and lower lids. See \textit{Canthus}.

\textbf{Canthitis.} (L.) Inflammation of the angle of the eyelids.

\textbf{Cantholysis.} (L.) The operation of canthotomy combined with division of the external canthal ligament. See \textit{Blepharoplasty}.
Cantholysis of Agnew and von Ammon. See v. Ammon-Agnew cantholysis, also Blepharoplasty.

Canthoplasty. A plastic operation in the vicinity of the canthus of the eye (almost always the outer canthus); strictly, the reconstruction or re-establishment of the canthus by a plastic operation that lengthens the palpebral fissure. As examples of the numerous operations devised to accomplish this end von Ammon simply divided the canthus, leaving a rhomboid wound to heal by granulation. Pagenstecher’s method consists of a combination of canthotomy and the use of Gaillard’s ligature; the tissues are lifted with a forceps so as to form a fold parallel with the margin of the lid, through the base of which the ligatures are passed.—(Foster.) See Blepharoplasty.

Canthoplasty, Prince’s operation for. This procedure was proposed by David Prince (Am. Jour. Med. Sciences, Oct., 1866, p. 381) for cases of decided contraction of the commissure accompanying entropion. It was intended as a part of the operation for trichiasis. Knapp (Norris and Oliver’s System, Vol. 3) found it useful also ‘in other cases where there is great shrinking of the conjunctiva, or where a previous operation has left the tissues at the canthus in a cicatricial condition. From a point just outside the canthus carry an incision downward and inward from one-third to one-half the length of the lower lid and parallel to its free margin; and from a point on the same horizontal line with the first, and five or six millimetres farther out, make another incision also downward and outward, to meet the first incision at its extremity. Dissect up the triangular flap of skin thus marked out to its base, and cut through the other tissues at the canthus by a horizontal incision beneath the flap. Undermine the upper edge of the wound, so as to free the outer angle of the lid. Pass a suture armed with a needle at each end through the point of the flap, introduce the needles under the upper edge of the wound, bring them out through the skin beneath the brow, and tie the two ends of the thread over a roll of buckskin or plaster. The flap is thus doubled upon itself and presents a surface of sound skin to the lower edge of the wound. The suture is left four or five days, until the flap becomes united in its new position. The wound beneath the lid is closed by undermining its edges and uniting them with sutures. If there is no entropion, the flap may be made shorter and may be taken from a position more directly downward.’

Canthorrhaphy. Suture of the canthus to restore the normal condition of the interpalpebral aperture. It was first resorted to for the exophthalmos that followed the too free tenotomies practised in the early operations for strabismus. The operation was given definite technic
and systematized by von Arlt, who called it median tarsorrhaphy, to distinguish it from the external or lateral variety. Its principal indications, perhaps, are in slight degrees of atonic ectropion with eversion of the lachrymal punctum, and in the sagging of the lower lid from the wearing of an artificial eye. By some, however, it is considered preferable to the median form for lagophthalmos. Its results are certainly less disfiguring than are those of external tarsorrhaphy.—(C. H. B.) See Blepharoplasty.

**Canthotomy.** The operation of simply dividing the canthus (usually the external) without division of the tarsal ligament or any plastic operation. See Blepharoplasty.

**Canthrope.** (F.) Canthus.

**Canthus.** The palpebral commissure, or the angle formed by the junction of the upper and lower lids. The *inner* or *internal canthus* presents an outline somewhat similar to a horseshoe, at the free ends of which are situated the puncta lachrymalia. These are directed a little backward, and are closely applied to the eyeball. Here, also, is found a small, pink body—the lachrymal caruncle—which is set down in the concavity of the "horseshoe" against the eyeball; it is composed of skin and conjunctiva.

There is nothing especially noticeable at the *outer* or *external canthus* except that the upper lid at its junction with the lower at the external commissure seems to overlap the lower exactly at the angle. This is because the small fold usually seen in that situation and the eyelashes suggest such a condition.—(A. N. M.) See Anatomy of the human eye.

**Canthus, External.** See Canthus.

**Canthus externus.** (L.) Outer canthus.

**Canthus, Fissure of the.** This is a disagreeable and frequently painful condition, generally found at the outer commissure, which often gives a good deal of trouble. As Harlan has stated (Norris and Oliver's *System* Vol. 3, p. 84) it is a condition until quite recently not mentioned in text-books, and forms a complication of some form of ophthalmia. "In cases of conjunctivitis and keratitis accompanied with considerable photophobia and orbicular spasm, a little groove is sometimes formed by the continued folding of the skin at the outer canthus, which is excoriated by the discharges from the inflamed conjunctiva, and a superficial ulceration is produced. The reflex irritation of this fissure increases the orbicular spasm and becomes an important factor in maintaining the irritable condition of the eye. Slight cases can generally be relieved by touching the part with the point of a mitigated nitrate of silver pencil; while the blepharospasm is decided and obstinate, a canthotomy will be useful; while in chronic
cases with a tendency to blepharophimosis the more permanent effect of a canthoplasty may be required.''

**Canthus, Internal.** See Canthus.

**Canthus internus.** (L.) Inner canthus. Internal canthus.

**Canthus major.** Inner canthus.

**Canthus minor.** Outer canthus.

**Canthus nasalis.** (L.) Inner canthus.

**Canthus temporalis.** (L.) Outer canthus.

**Cantoplastica.** (It.) Canthoplasty.

**Capacity of the orbit.** In the adult the actual capacity of the orbit (of which space the eyeball occupies about one-fifth) is according to Gayat (*Essais de mensuration de l'orbite*, *Ann. d'ocul.*, 1873, lxx. 5-20) from 25 to 33 ccm. In children of ten years of age it is about 22 ccm.

**Capillaire.** (F.) Capillary.

**Capillarimètre.** (F.) Instrument for measuring the diameter of capillaries.

**Capillary angioma.** This is a nævus or blood-tumor (usually of congenital origin) and appears as a bright red spot upon the eyelid or its border.

Operative interference should be undertaken as early as possible; excision or cauterization, with nitric acid, is usually effective. The use of a 1 per cent. mixture with collodion or mercuric chloride (q. v.) acts very well in minor cases. The eschar formed by the application of this remedy falls off in a week or two without leaving a permanent cicatrix. It may be repeated if necessary.

**Capillary drainage.** Although this procedure has many evident drawbacks, yet it has been advised for the treatment of hypopyon ulcer by Rollet and Moreau (*Traitement de l'hypopyon par le drainage capillaire de la chambre antérieure*. *Rev. Gen. d'Oph.*, November, 1906, p. 481.)

They report 17 cases cured by this method, and describe the operation as follows: With a Graefe knife, a puncture and counter-puncture are made in the lower part of the limbus. A single horse hair is then, after thorough sterilization, passed through both openings. When difficulty arises in passing the hair, a hypodermic needle is first introduced, the hair passed through the needle and the needle withdrawn. The hair is left projecting 2 or 3 cm. on each side of the cornea for drainage. The eye is then dressed and closed.—(H. B. C.)

**Capillary embolism of the retina.** Obstruction of the minute arteries (capillaries of the retina) by a minute embolus. See *Embolism of the retinal arteries.*
CAPILLARY FISTULA OF THE LACHRYMAL SAC 1387

Capillary fistula of the lachrymal sac. A fistulous opening into the lachrymal sac may be caused by the rupture of an abscess of that cavity. This opening may appear a considerable distance below the punctum, as well as in a number of places along the orbital border. It does not always communicate with the sac, but has been known to open into the lower canaliculus. Tears, mucopolus and pus exude from these openings. The term capillary fistula is applied to the minute orifices from which the fluid escapes as long as this condition exists, until the proper drainage into the nose has been re-established, or until the diseased sac and its infected surroundings have been extirpated.

Capillary loops of the cornea. Although the normal cornea is throughout most of its extent non-vascular, yet at the sclero-corneal junction there are terminal vascular loops which encircle the cornea and supply it with blood. As Piersol has shown (System of Diseases of the Eye, Vol. 1, p. 233) this "vascular area, although very narrow, is not quite uniformly developed, being broadest above and below where it measures 1-1.5 millimetres (at most 2.0 millimetres) and narrowest on each side, where it attains a width of 0.5-1.0 millimetre. The capillary loops composing this peripheral net-work are derived from delicate arterial stems continued from the anterior ciliary arteries through the episcleral branches. After passing the limbus the arterioles rapidly break up by dichotomous division into twigs of great delicacy,.005-.006 millimetre in width, which communicate with one another by numerous anastomoses and terminate in capillary loops forming a series encircling the cornea. The capillaries give origin to the wider venous radicles, the diameter of which, as determined by Leber (Die Circulations- und Ernährungsverhältnisse des Auges, Grefe und Saemisch's Handbuch, Bd. II., p. 334), is about double that of the arteries. The veins join the episcleral net-work and become tributaries to the anterior ciliary trunks. During fetal life the peripheral parts of the cornea are invaded by the precorneal vascular net-work. This normally diminishes before birth to the limits already described, and probably at no time extends completely over the cornea, the central portion remaining uninvaded. The more deeply situated vascular loops occasionally observed in the human cornea are probably to be referred to pathological processes, although in some animals, as the ox and the sheep, according to Richiardi (Sui vasi sanguiferi della cornea, Zoologisch. Anzeiger, No. 76, 1881), such vessels normally exist." See, also, Histology of the eye.

Capillary retinal pulse. This sign is readily seen with the aid of the ophthalmoscope. It follows high blood pressure in the aorta and a difference between the systolic and diastolic blood movement when the
pulse waves are abnormally developed in the capillaries. In short, it occurs especially in cases of aortic insufficiency and cardiac atrophy. The capillary pulse is rhythmic; synchronous with the carotid pulse there occurs reddening and pallor of the optic papilla.

**Capillary zone of the choroid.** Chorio-capillaris. This important layer of the choroid occupies the inner aspect of the vascular coat and is separated from the nerve layer only by the delicate vitreous membrane. The short posterior ciliary arteries give off numerous twigs which form a capillary net-work, which is embedded within a homogeneous matrix (free of pigment) that fills the intercapillary meshes of the net. This ground-substance is probably a modified connective tissue, like the perivascular lymph-sheaths that surround the larger blood-vessels.

**Capillitium distichia.** (L.) Distichiasis (q. v.).

**Capiteux.** (F.) Heady; alcoholic.

**Capovolta, Immagine.** (It.) Inverted image.

**Capranica's doctrine.** This observer believed that the three pigments in the oil globules associated with the inner and outer layer of the retinal cones, are identical, while Kuehne and Ayres have isolated three pigments—chlorophane, xanthophane and rhodophane—with, possibly, a fourth—kyanophane.

**Caprenalin.** This is the trade name (Wyeth) of a preparation combining the analgesic, hemostatic and blood-pressure raising properties of suprarenal extract, intended for use especially in ophthalmic operations. The blanching of the conjunctiva occurs after the instillation in a minute or two and its effects last about a quarter of an hour. It is also recommended as an adjunct (for intensifying their medicinal effects) to cocaine, pilocarpine, eserine, atropine, eucaine, etc. Caprenalin is sold in vials containing one grain each or in glass-stoppered bottles containing one ounce of an aseptic 1-1000 solution.

**Caprisant, Pouls.** (F.) Goat-leap pulse.

**Capsitis.** (L.) (Obsolete.) Inflammation of the capsule of the crystalline lens.

**Capsocataracta.** (L.) Capsular cataract.

**Capsotomy.** A form of the word capsulotomy.

**Capsula adiposa bulbi.** The pad of fat upon which the eyeball rotates within the orbital cavity. Also called the adipose body of the orbit. See Anatomy of the eye.

**Capsula aquæa cartilaginosa.** One of the numerous synonyms for Descemet's membrane.

**Capsula bulbi oculi.** (L.) Bonnet's capsule.

**Capsula fibrosa.** (L.) The sclerotic coat of the eye.
**Capsula lenticularis.** The capsule of the crystalline lens.

**Capsula preaquosa.** A name given to the membrane of Descemet.

**Capsular advancement.** For the relief of squint a modified form of the ordinary operation, in which the incision and the sutures involve the capsule of Tenon as well as the tendon of the muscle to be advanced. See *Muscles, Ocular, Operations on the*.

**Capsular advancement of de Wecker.** This is one of the oldest forms of the so-called capsular advancement. De Wecker (De l'Advancement Musculaire au Moyen du Double Fil., *Annales d'Oculistique*, Tome 70, p. 225) made an incision over the insertion of the capsule, isolated the tendon and raised it with de Wecker’s double advancement hook. A suture threaded to three needles is then taken, the central needle is passed through the center of the tendon from the scleral surface outward; and each of the other needles is passed beneath the conjunctiva to a point in the vertical meridian of the eyeball 3 or 4 mm. back from the corneal margin as shown in the figure. The thread is then cut in the middle, making two sutures.

![Advancement by the Method of de Wecker Showing Introduction of Sutures.](image)

These two sutures can be tied separately in the ordinary way, the two ends of the lower suture together. But de Wecker chose to tie the corneal end of the upper suture to the muscle end of the lower suture; and the muscle end of the upper suture to the corneal end of the lower suture. In this way he made in effect a single crossed suture, making it impossible to draw the lower part any more or any less tense than the upper. He hoped thus to avoid drawing the tendon of a lateral muscle either upward or downward and thus changing its plane of action. Subsequently de Wecker practised his capsular advancement with division of the tendon in some cases, and also employed a stitch resembling that suggested by Savage.—(E. J.)
Capsular artery. During the development of the eye and while the vitreous space is small the latter is traversed by two series of vessels, that of the retina and a net-work that almost covers the posterior surface of the lens. A vascular trunk is projected from the central artery of the retina along the optic nerve-stalk until it reaches the posterior face of the lens. Here it divides and subdivides into a fine capillary net-work, called the capsular artery, or anterior hyaloid artery.

Capsular cataract. An opacity confined to either the anterior or posterior lens capsule. See Cataract, Anterior Capsular and Cataract, Posterior Capsular.

Capsular cataract, Posterior. See Cataract, Posterior polar.

Capsular cataract, Anterior. See Cataract, Anterior polar.

Capsulation. (F.) Putting remedies into capsules.

Capsule bacillus of Loeb. This micro-organism resembles the capsulated bacillus of Pfeiffer, although it is somewhat larger and thicker than the latter. It was originally obtained from a case of keratomalacia in a child. It is an aerobic, non-motile and non-liquefying bacillus, and is capable of growth in the usual culture media at ordinary temperatures.

Capsule, Bonnet's. The posterior portion of the sheath of the eyeball up to the passage of the tendons of its muscles; practically the capsule of Tenon (q. v.). See Capsule of Bonnet.

Capsulectomy. The removal, generally by special capsule forceps, of a portion of the anterior lenticular capsule as a preliminary to the extraction of the lens itself, a very old procedure, having been in vogue since the days of Daviel, especially when the capsule was found to be opaque.

It was not until 1874 that Förster began to employ this method as a part of the routine extraction. It is now adopted by many experienced surgeons and is a procedure that has many advantages to recommend it. Although practised both in the simple and combined operations it seems better adapted to the latter method because the iridic coloboma offers a larger opportunity for the use of capsular forceps.


Capsule forceps. The removal of a portion of the anterior capsule, as a preliminary to the extraction of cataract, depends for its success upon certain manipulations.
In performing the operation the patient is asked to look down and the eyeball is fixed below in the vertical meridian. The surgeon should have a clear view of the anterior capsule. The forceps are then introduced (closed) and the blades directed straight downwards. They are passed to the lower border of the pupil, and slowly opened to their fullest extent. The terminals are then pressed very carefully and slightly backward against the anterior surface of the lens and closed. The forceps are then—always gently—pushed downwards. By this latter manoeuvre the capsule generally ruptures above. With a careful side-to-side movement the instrument, with the torn piece of capsule, is removed from the anterior chamber. If this manoeuvre has been properly performed the lens will come forward and the subsequent extraction is easy. Failure to seize the capsule in the first instance may be followed by a second trial. In soft, semi-fluid or swollen cataracts, especially if the capsule be tough, it is not easy to grasp the membrane. In attempting to tear out a piece of capsule in this way care should be exercised not to use force of any kind or in any direction lest the suspensory ligament be torn, the lens dislocated or some other injury be done to the ciliary body. If a reasonable attempt to use the capsule forceps fails a cystotome should be substituted, as repeated attempts to perform any step of a cataract operation is likely to demoralize the patient, while the efforts themselves may cause loss of vitreous or produce some other undesirable trauma. See Cataract, Senile.

Capsule of Bonnet. The oculo-orbital fascia insheathes all the organs which pass through it, forms an acetabulum in which the eyeball rests, is continuous with the sheath of the optic nerve, forms a secondary attachment for the ocular muscles, and prevents morbid collections in the orbit from reaching the surface. It covers the posterior four-fifths of the eyeball (except a space one centimetre in diameter in the middle of which the optic nerve passes) and here consists of two layers, between which is Tenon's space. This is continuous with the subdural and subarachnoidal spaces of the optic nerve. The capsule of Tenon divides and subdivides, forming a covering for every tissue in the orbit. Some anatomists limit Tenon's capsule to that part of the fibrous envelope of the eyeball in front of the point where it is pierced by the ocular muscles, and they give the name of Bonnet's capsule to the part behind. Tenon's space, according to Schwale, is a lymph-space; but this is denied by Langer. That part of the dura which surrounds the optic nerve from its entrance through the optic foramen to the posterior surface of the eyeball is known as Bonnet's sheath, or the dural covering of the nerve.—(J. M. B.)
Capsule of Tenon. The tarso-orbital fascia, according to most writers, forms the capsule of Tenon, a thin, translucent, fibrous membrane, which covers the posterior two-thirds of the globe from the tendinous insertion of the straight muscles which pass through it, to the optic nerve, with the external sheath of which it is identical. A second layer separates the eyeball from the bed of fat upon which it rests. The two layers form a closed sac (Tenon’s space), lined, in part, by flat, endothelial cells. This sac is thought by some to constitute a true lymph space, and to communicate with the arachnoid and dural spaces of the optic sheath. Tenon’s capsule also forms, with the tendons and part of the bellies of the orbital muscles, a sort of cup-like receptacle, which not only cuts off important organs of the orbital cavity from the outside world, limiting the danger from external agents, but, at the same time, enables the globe to be rotated by the extra-ocular muscles, without friction.—(A. N. M.)

One of the best descriptions of this rather complicated and most important of the ocular envelopes is given by Dwight (Norris and Oliver’s System, Vol. 1, p. 99). He says that near the cornea, the conjunctiva and the capsule of Tenon fuse into a single membrane. The latter encloses the “lymph-space between itself and the globe and separating the latter from the fat of the orbit. Bands of connective tissue run through this space. They are particularly numerous in the posterior part. Authorities differ as to the place at which the capsule ends behind. It goes to the optic nerve. Nevertheless, Schwalbe has shown that a lymph-space around the optic nerve can be injected from it. It would seem that this could take place through small openings, especially at the points of entrance of the ciliary vessels and nerves, and that the capsule may be said to reach the optic nerve, as gross appearances indicate. It is taught as by common consent that the capsule of Tenon is a socket in which the eyeball rotates without change of position, except, perhaps, that under certain circumstances it may move a minute distance forward or backward. Anatomy shows that this is impossible. It is easy to see that as Tenon’s capsule is closely attached to the globe near the cornea, it is out of the question that the former should stand still while the latter moves in it. Undoubtedly the two move together on the cushion of fat behind them, and perhaps some slight motion may occur between them. The muscles pierce or, more properly, invaginate this membrane.”

Capsule of Tenon, Advancement of. See Capsular advancement.
Capsule of Tenon, Inflammation of the. See Tenonitis.
Capsule of the aqueous humor. Membrane of Descemet.
Capsule of the lens. The transparent elastic envelope of the crystal-
line lens. This is a delicate, structureless, elastic envelope, lined in front by endothelial cells, which are wanting on the posterior surface. Owing to this and other differences, and, for the purpose of reference, this covering of the crystalline lens has been called the anterior and posterior capsule, although there is no distinct line of separation between them. The capsule is quite strong and elastic, though brittle. When cut through it tears irregularly, and the incised edges curl up in a roll with the inner surface outward. The minimum thickness of the capsule is at the posterior pole. Each surface shows a zone of maximum thickness occupying a position concentric with the equator toward the periphery of the lens.—(A. N. M.) See Histology of the eye.

Capsulite oculaire. (F.) Tenonitis.

Capsulitis. Inflammation of the capsule of the lens, or of the fibrous capsule of the eyeball.

Capsulitis, Aqueous. This is one of the several names of serous iritis, or deep punctate keratitis (q. v.).

Capsulitis ocularis. (L.) Inflammation of the fibrous capsule of the eyeball, or tenonitis (q. v.).

Capsulo-ciliary. Relating to the capsule of the lens and to the ciliary organ.

Capsulo-lenticular. Relating to the crystalline lens and its capsule.

Capsulo-lenticular cataract. A cataract in which the opacity involves both the capsule and the substance of the lens.

Capsulo-lenticular extraction. A form of cataract operation in which both the lens body and its capsule are removed at the same time. See Cataract, Intracapsular extraction of.

Capsulo-pupillary. Pertaining to the capsule of the crystalline lens, the iris and the pupil.

Capsulo-pupillary membrane. This is one of the names given persistent pupillary membrane, one of the congenital anomalies of the eye, which will be found fully described and illustrated under that heading.

Capsulotome. An instrument for rupturing the capsule of the crystalline lens in cataract operations. Also an instrument used by Buller in capsulotomy to steady the capsule; it consists of two fine needles fixed parallel to each other in a handle. See Cataract, Senile, also Capsulotomy.

Capsulotomy. An operation performed as a part of cataract removal, consisting of an incision of the capsule of the crystalline, either preparatory to or at the time of removing the lens by extraction or absorption. As an example of the many capsulotomy methods, that of Valk (Ophthalmic Record, August, 1908) may be described here.
CAPSULOTOMY, IMMEDIATE

The instrument used by him resembles the usual cystotome (q. v.), except that instead of a knife tip set at right angles to the shank it has a needle point. It can be moved about in the pupillary space without wounding the margins of the iris. The capsulotome is introduced underneath the iris in making the lower capsular tear, and is carried on around to one side and then above, where the iris is pushed upward and then downward to the starting point. A round piece of capsule is thus detached which probably comes away with the lens. He finds that since adopting this method he does not have to do subsequent needlings for opaque capsules. See Cataract, Senile also Discission.

Capsulotomy, Immediate. This is an operation performed upon the posterior capsule of the lens. As an outcome of the observation that it frequently becomes thickened after a successful cataract extraction some operators have attempted to make an opening in the posterior capsule immediately after the delivery of the lens. In the hands of a skillful operator it may be the ideal procedure. After extracting the lens in the ordinary way and removing all cortex, the operator introduces the point of a curved gold enameled hook, made of malleable steel, which is passed on the flat into the anterior chamber behind the lower pupillary margin. The instrument is then turned backward, hooked into the capsule, drawn gently to the mouth of the inci-
sion, rotated on the flat again, and withdrawn. This procedure tears
the capsule and permits the vitreous humor to come forward. Fox
states that in patients on whom he performed this operation 15 per
cent. required needling or capsulotomy with scissors, while of cases
in which it was not performed 75 per cent. required later operations.
However, the author has tried this operation and is not favorably
impressed with it. Recovery is slow and iridocyclitis is likely to be
a complication.—(J M. B.)

Capsulotomy, Preparatory. Primary capsulotomy. Preliminary or
preparatory cystotomy. Primary capsule rupture. Under these
and some other designations is indicated the practice of rupturing or
incising the anterior capsule of the lens, some time before the ex-
traction of the cataract. The object is not so much the actual "ripen-
ing" of an immature cataract as to bring about a loosening or entire
separation of the capsule from the contained lens, so that when the
expression of the latter is subsequently undertaken it may, as in
clinical maturity, be removed in its entirety and leave behind no
irritating cortical matter to prolong convalescence and form a sec-
ondary cataract. This subject, referred to under Cataract, Secondary;
Discussion; Cataract, Senile, and other captions, is so fully and ably
discussed by Percy Fridenberg (Jour. Am. Med. Assoc'n, Sept. 21,
1912) that it is freely quoted here:

"The ripening operations which were in vogue some years ago do
not seem to have remained in favor. Massage of the lens is carried
out, it is true, by some operators where preliminary iridectomy is
performed, but the results do not indicate any very decided, uniform
or reliable effect. The only mechanically effectual procedure, that of
MacKeown, consisted in injecting fluid directly under the lens capsule
and was, obviously, too dangerous to gain popularity. None of the
other methods was reliable and all were slow, if effectual at all.

Von Graefe and Mannhardt advised puncture of the anterior
capsule three to ten days before extraction in immature cataracts,
for the purpose of causing complete opacification of the still trans-
parent clear cortical masses in unripe cataract. This operation was
reintroduced by Correnti, in 1872, in a paper which speaks of the
procedure as "opening of the anterior capsule preparatory to the
extraction of cataract."

'Primary capsule rupture' is the name by which Drake-Brockman
designated this method of operation in a series of case reports.

The initial step of the operation is a division of the lens capsule
by a stop-needle, the pupil having been previously fully dilated by
atropin. This plan he adopted at first in the case of Morgagnian
cataracts in order to gain a more exact knowledge of the size of the nucleus, and accordingly to limit the section through the cornea. The risks attending the removal of cataract are hereby greatly lessened and the escape of the cataract is facilitated. Drake-Brockman subsequently applied this method of operative procedure to all kinds of cataract and found that the results justified a continuance in the operation. He says: 'In no other kind of operation can either so large a surface of the lens capsule be exposed for division by the cystotome, or the iris be kept away from the lens and be rendered less liable to an injury in the division of the capsule.' As soon as the nucleus in a Morgagnian cataract has escaped into the anterior chamber, it can be more readily examined as to its size, and the corneal incision can more accurately be made to permit of the escape of that body. The advantages of this plan are: 1. It allows a more extensive laceration of the capsule at the same time that the anterior chamber remains replete with its fluid. 2. It permits of a more complete exposure, and a more thorough knowledge is gained of the size and character of the cataract. 3. It diminishes the tendency on the part of the iris to contract, even after the corneal section has been completed, and by this means facilitates the escape of the lens. 4. By it, the possibility is gained of more accurately judging of the extent to which the cornea must be divided to permit of the escape of the lens. 5. The less necessity there is for the introduction of a traction instrument to effect the removal of the lens, the less interference there is with the natural position of the structures of the eyeball.

Of 674 operations, 79, or 11.72 per cent., were unsuccessful. Of this number, 101 were for Morgagnian cataracts. The iris was excised in only 75 total cases. Chloroform was administered in 654 cases, and the iris prolapsed in 64, or 9.46 per cent., the latter accident being due, in several cases, to vomiting caused by the anesthetic. Glaucomatous change occurred on six occasions, but this could not be attributed directly to the operation. In further endeavoring to render the operation still more simple, Drake-Brockman laid aside the needle and in 34 cases effected the capsule division by means of the cataract knife 'before completing the transfixion of the corneal tissue,' i.e., while making the section. Of this number, six proved unsuccessful. In the endeavor to divide the capsule of the lens fully, the iris is more liable to be injured and the lens structure cut into and broken up, so that iritis occurred in greater frequency. As no corresponding advantages were to be gained by this treatment of the
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lens capsule, it was abandoned in favor of the original procedure of division by the needle, prior to making the corneal section.

In a second communication, four years later, the same author reports 1,433 additional cases operated on during the previous three or four years. Of these, but 5.58 per cent. were failures, a very great improvement over the first series. These results (7.54 per cent. failures), Drake-Brockman claims, contrast favorably with any other method of operation. The procedure was applied to all forms of senile cataract, and in some cases of cortical cataracts, with entirely satisfactory results. The original crucial incision of the capsule was abandoned in the second series, Drake-Brockman having adopted, instead, a linear division along the upper pupillary margin. This more simple procedure was found equally effectual. Rohmer practised extensive discission of the anterior capsule and paracentesis of the anterior chamber, followed by massage, through the upper lid, for several seconds. The opacity was almost complete in from twenty-four to thirty-six hours, and entirely so within three or four days. Extraction was then performed 'in a day or two.'

Elschnig gave up the discission needle, as it made an easily infected wound and was not well adapted to incising the lens masses, and used a Graefe knife, which was carried in laterally in the horizontal meridian from 1 mm. outside the limbus. Elschnig disapproves of discission for ripening senile cataracts, as all cataracts in individuals above 50, whether mature or not, can be extracted easily, no matter what the condition and proportions of nucleus and cortex. In old patients, Elschnig extracts as soon as the vision has diminished so that the day's work cannot be done.

Mooren used a narrow Graefe knife to split the capsule in immature cataracts, especially in zonular forms.

Jackson, in discussing the technic of discission for maturation, lays stress on the importance of making a small central opening and allowing the aqueous to drain off, allowing the lens to be ploughed up with a comparatively small incision, as the consequent reaction is proportional to the amount of soft lens-matter which exudes through the cut capsule into the anterior chamber.

Alessandro advises multiple punctures of the anterior capsule. The discission needle is carried in at the outer quadrant of the cornea and five to ten punctures made. Maturation takes place in a week or two.

Fage makes a small incision into the anterior capsule in the pupillary area, allows the aqueous to drain off, and then massages through the cornea. Maturation is complete, on an average, in three weeks.
Iridectomy is not necessary. Tynen, of Austin, Tex., in 1900, reported under the title of ‘preliminary capsulotomy,’ a procedure of primary opening of the capsule at the time of operation, using Bowman’s stop-needle prior to the corneal section. Tynen believed this to be original with himself, it having been suggested by a case in which there had been prolapse of fluid vitreous and the lens had sunk into the posterior chamber (sic), requiring extraction with iris forceps. When it came to operating on the other eye, Tynen, fearing a similar complication, performed ‘preliminary’ capsulotomy just before making the corneal section and was gratified by rapid and easy, almost spontaneous delivery of the lens, although here, too, a small amount of fluid vitreous escaped. The procedure was then applied methodically, and Tynen refers to thirteen cases. In all but two the healing was uncomplicated, and the final results excellent. The two exceptions were cases in which marked iritis developed, due, as Tynen thinks, to the use of too strong solution of atropin, ‘crowding the iris up into the neighborhood of the corneal wound.’ The leading point in the operation, according to this writer, is in making the capsulotomy the primary step, thereby enabling the operator to deliver the lens the very moment the corneal section is completed. When this section is finished, pressure with the flat of the blade causes the corneal opening to gape, when at the same moment counter-pressure with the fixing forceps below aids the expulsion, and the lens slides out through the still open pupil with surprising ease. ‘The lens, having no other avenue of escape, almost always indicates a tendency to follow the knife as the corneal incision is progressing, and when it is finished the lens is partly in the anterior chamber.’ Tynen adds that in cases in which the lens is to be dislocated this can be done most easily in performing his ‘preliminary’ capsulotomy, and that the operation then resembles Delgado’s. The incision is made in the upper quadrant of the dilated pupil following the curved pupillary margin of the iris. Both the point of the instrument and the field of operation are in full view.

Homer E. Smith, of Norwich, N. Y., has reported a method which had as its object ‘to know in advance the size of the section required, and to make certain an efficient capsulotomy with a maximum of precision and a minimum of risk.’ The method, he says, is applicable only to such cases as one would select for the simple extraction, and is not the operation of choice when the iris lacks the lustrous appearance of health, when the lens is amber-colored or dark-gray, and when the iris is rigid, with little dilating ability to the pupil. The chief objections to the simple operation, which, according to Smith, is indicated in
95 per cent. of the cases, namely, the difficulties of an efficient capsulotomy, of effective removal of fragments of cortex, and of easy delivery of the lens through the pupil, are met by the method proposed. As to the better visual and cosmetic results, he adds, there can be little question. He then describes a primary capsulotomy with a small Knapp's knife-needle making a crucial incision, 'not only through the lens capsule, but partly into the lens-substance itself. If the cut in the capsule is practically invisible, a large nucleus is present, and the usual section of the upper two-fifths of the cornea will be required for the easy exit of the lens. If semi-gelatinous lens matter escapes, a section of one-third will suffice, while if a milky liquid issues, the cataract is hypermature and the section may be made with the angular keratome. A period of waiting between the capsulotomy and extraction is required for the anterior chamber to reform completely, as there is usually sufficient loss of aqueous to render the eye soft and unsuitable for good section. This loss of time is really a gain in results, for even in four hours there is sufficient imbition of aqueous to facilitate the separation between cortex and capsule and to make easier the delivery of the lens.'

It will be noted that this is the first reference to an artificial maturation of the cataract by means of preliminary or rather primary capsulotomy.

In a recent publication Smith reviews this procedure, and now for the first time calls attention to its value as a rapid and safe method of causing operative maturity of senile cataract, by causing separation of the cortex from the posterior as well as anterior capsule, by entrance of aqueous under the capsule through the knife-needle incisions, this process being completed over night.

The original idea of a more effective, complete, and safe capsulotomy, avoiding the dangers of the usual cystotome opening, was now replaced by the hope of causing a rapid maturation of cataract allowing extraction with a minimum of remnant cortex, with the incidental advantage of a more easily delivered lens, little or no necessity for prolonged anterior-chamber irrigation or mechanical expression for removal of retained cortical débris, and a posterior capsule left free from adherent lens-matter. Smith's first experience showed him that the knife-needle could be improved on. The blade was too long and not cutting sharp up to the point. He had constructed a 'miniature scalpel' with a cutting-blade 2 mm. long and a slender shank just thick enough to stop the corneal puncture. Smith has not departed from his original crucial incision which is not allowed to penetrate deeply into the lens-substance. For this reason the shank is
gradually withdrawn, as the knife is carried along in making the incisions. 'Were it not for this maneuver the blade would sink dangerously deep into the lens or possibly dislocate it.' The only disadvantage of this preliminary capsulotomy, according to Smith, is that it requires more time and trouble as the technic of asepsis must twice be gone over.

We cannot, however, dismiss all objections in a single sentence unless we close our eyes to the fact that it is the danger of infection, even more than the time and trouble of disinfection in a second operation, to which we hesitate to expose our patient and which we would not risk unless there is something definite to be gained. The disadvantages of the ordinary capsulotomy are many, but the main point to be considered in weighing the pros and cons of the new procedure is the question whether we can expect decidedly better visual results and comparatively early operation in immature cataracts with little or no additional risk. The disadvantages of capsulotomy with mature lenses have become negligible quantities since the perfection of the capsulectomy method. The crucial incision rather complicates this and may have to be superseded by the peripheral curved or straight incisions in the capsule which still allow a central portion to be torn out with the forceps. The main advantage of preliminary capsulotomy is the rapid maturation, operatively speaking, of an immature but partly opaque lens by changing of sticky cortex into a homogeneous substance which no longer adheres to the capsule and either comes away with the nucleus or can easily be flushed out of the anterior chamber. As Smith well says: 'It makes an immature cataract operable at once and saves the patient much weary waiting and loss of usefulness.' The procedure is safe, efficient, and easy of execution. It is adapted to all types of cortical cataracts, but it is particularly of value in the immature variety. It makes the capsulotomy the easiest step in the extraction operation and greatly facilitates the delivery of the lens. Finally, delivery is accomplished with little or no pressure, so that there is less danger of complicating prolapse or loss of vitreous, and a secondary operation is rarely necessary. This last point alone, if borne out by observations and experience of other surgeons, would be sufficient, in my opinion, to constitute this procedure a valuable and important innovation. For the danger of the preliminary capsulotomy would be balanced and wiped out by the fact that the extraction is the last operation. Comparing the two, one would infer, theoretically, that there was less risk in needling the capsule of an immature cataract than in performing discission of a
secondary membrane, and this appears to be borne out by statistics and the consensus of opinion among eye surgeons.

Does the adoption of this procedure mean the passing of the immature cataract? If so, it is indeed a boon for patient and surgeon. The operations heretofore performed for maturing a partially opaque lens have been dangerous, ineffectual or unreliable, and all have required, at the shortest, three or four weeks to produce the required effect. Iridectomy, either simple or combined with massage of the lens, through the cornea or directly with the spatula introduced at the time of the iridectomy into the anterior chamber, have been tried and found of doubtful advantage. The dangers have been emphasized, particularly by Major Smith.

The objections raised by Major Smith apply to the needling as formerly practiced, and involve the instrument and the lapse of time between the discission and the intended extraction. In the preliminary capsulotomy of Homer Smith, of Norwich, a suitable cutting instrument is used and so little time elapses between its introduction into the eye and the extraction of the cataract that no danger need be feared. High tension might, it is true, develop over night, but the extraction would nip this process in the bud. Iritis could hardly develop if the pupil had been kept dilated, or at least would be in the stage of incipiency and hence easily controlled. The escape of lens-matter into the anterior chamber could hardly cause much trouble in the short time elapsing before the lens is completely removed.''

Capuchon. (F.) Hood; covering.
Capys. A blind seer of early Rome. He prophesied to Romulus the victories of the Roman arms from the beginning until the time when Rome's great rival, Carthage, should be destroyed.

"In the hall-gate sat Capys,
Capys the sightless seer;
From head to foot he trembled,
As Romulus drew near.
And up stood stiff his thin white hair,
And his blind eyes flashed fire."

Macauley, ""The Prophesy of Capys."" XI.
—(T. H. S.)

Caqué, Jean-Baptiste, of Rheims. Born Oct. 9, 1720, at Machaule, a country town in Champagne, he studied surgery at Rheims and Paris, was military surgeon from 1744-48, and, in 1749, settled in Rilly-la-Montagne, a village in the neighborhood of Rheims. In Vol. II—43
1751, he moved to Rheims, having been made surgeon to the Hôtel-Dieu of that city. In 1752 he became Correspondent, in 1759 Fellow, of the Academy of Surgery at Paris. He was known all over Europe as a cutter for stone, but was hardly less celebrated as a cataract extractor.

Among his general works are: "On Crural Hernia," "On the Section of the Epiploon in the Operation for Hernia," "On the Uselessness of the Suture after Cæsarean Operation," "On Cutting by the Aid of the Hidden Lithotome."

According to Hirschberg, there now exist, in the City Library at Rheims, four ophthalmologic MSS. by Caqué, as follows:

1. On Cataract.
2. On the Cataracts of 1768.

—(T. H S.)

Caractère. (F.) Character.

Carbazotic acid. See Acid, Picric.

Carbol. (G.) Phenol, or carbolic acid.

Carbol-fuchsin. A well known laboratory staining fluid consisting of 90 parts of a 5 per cent. watery solution of carbolic acid and 1 part of fuchsin dissolved in 10 parts of alcohol.

Carbolic acid. See Phenol.

Carbolic acid amblyopia. After washing out an empyema with a carbolic acid mixture Niedeii observed amaurosis with dilated pupil.

Burns of the external ocular apparatus from this agent are very serious matters, even when the injury (especially of the cornea) seems to be superficial. Later on there may develop considerable necrosis of the corneal tissues, with iritis, exudates into the anterior chamber and loss of vision. As in all other burns of the kind the eye should be immediately washed out with water and the sac filled with castor oil or a similar bland substance. See Injuries of the eye, also Phenol.

Carbolized solution of iodine. When a mixture of equal parts of tincture of iodine and pure phenol with a little glycerin is properly applied it makes an excellent cautery for non-spreading ulcers of the cornea. After staining (see Fluorescein), irrigating and anesthetizing the globe the diseased area should be thoroughly probed with the point of a wooden tooth-pick soaked (not merely dipped) in the solution, excessive fluid being removed from the tooth-pick with blotting paper. This procedure may be repeated several times if necessary. Inasmuch as the phenol whitens the ulcer-area it is easy to
regulate the application. Success depends upon using as little as possible of the cauterant and tattooing it well into the infected spot. There is little or no destruction of true corneal substance by the carbolic acid and, consequently, a minimum amount of scarring.

**Carbolsäure.** (G.) Carbolic acid (phenol) purified for medicinal use. **Carbon bisulphide.** CARBON DISULPHIDE. Although this substance produces an amblyopia that closely resembles that of alcohol-tobacco, yet no anatomical examination in man has been made and described. Animal experiments with disulphide of carbon show changes in the cells of the central nervous system but no alterations in the retina or optic nerve. To the year 1894 I (The Toxic Amblyopias, p. 7 and 48) collected less than fifty cases of toxic amblyopia from this cause since Delpech’s article (the first on record) appeared in 1856.

Bisulphide of carbon is a colorless liquid of a peculiarly pungent and disagreeable odor. It is almost as volatile as “sulphuric” ether and its fumes soon diffuse themselves through an apartment and vitiate the resired air. It exerts a powerful solvent effect upon fats and is used in large quantities for extracting oily matters from fabrics and other materials. It is also used in electro-plating. But its chief value in the arts depends upon its power of vulcanizing or “sulphurizing” rubber. Alixed with a small percentage of mono-chloride of sulphur (SCl.) it is extensively employed in the manufacture of rubber articles.

It has not been yet established what part, if any, is played by the sulphur chloride in producing the intoxication. This latter agent is a deep orange-colored, non-volatile liquid and is now much used in the production of “artificial rubber,” but so far no cases of amblyopia have been reported from its separate employment. Where carbon disulphide is employed in conjunction with the chloride of sulphur in vulcanizing, it is the former that occasions the retrobulbar and simple optic neuritis, which are the characteristic ocular lesions of the intoxication. Decided changes are found at the papillary region. In the earlier stages these are haziness of the disc and other signs of a chronic papillitis, but later on pallor and atrophy appear. Central defects in the visual field are almost always found when sought for at the onset of the ocular symptoms. Indeed we may regard the early changes as almost invariably those of a retrobulbar neuritis gradually deepening into a true simple atrophy, unless the patient is removed from the malign influence of the poison and properly treated. Becker remarks that the oval scotomata in his case lay more above than below the fixation point, as in alcohol-tobacco amblyopia, and believes the whole process to be probably a
retro-bulbar neuritis affecting the macular fibers, the color sense being more disturbed than the form sense.

Improvement begins as soon as the patient is removed from the influence of the poison. Many of the cases included in the report of the committee appointed by the Ophthalmological Society of the United Kingdom were treated by phosphorus. Recovery from most of the symptoms—the anaphrodisia and weakness of the legs being very intractable—occurred after several months. Hirschberg treated his two patients with potassic iodid combined with a course of sweating. Becker gave the iodid with iron, and, later, ext. nucis vom. internally, followed by strychnia injections. Lavigerie claimed good results from the use of potassic iodid and strychnia. Gallemairets' case—a well marked example of retro-bulbar neuritis—was treated with quinin and strychnia and improved greatly.

**Carbon dioxide snow.** This agent (solid CO₂) has already been described in Volume 1, p. 447 of this Encyclopedia, but it may be further said here that as a remedy in the treatment of rodent ulcer, trachoma, ocular papilloma and several other diseases of the eye it holds a place among the useful remedies of the ophthalmic pharmacopoeia. For example, N. B. Harmon and E. R. Morton (Brit. Med. Jour., Oct. 23, 1910) give experience in conditions named. In trachoma the action is of a delicate order and is used to promote a well-defined shock to the tissues with a subsequent brisk reaction, no actual destruction of the tissues being permitted. The treatment was tried in four examples of this affection; applications for fifteen seconds, and later thirty seconds, were used at weekly intervals. These were painless and the results apparently very satisfactory. But the writers add that one cannot be enthusiastic after this short experience in a disease of such a chronic nature as trachoma. If further trial should prove that the effects are only half as good as those now obtained by bluestone, the remedy has a future before it because it is painless, simple and cheap.

Regarding the treatment of papilloma and rodent ulcer with carbon dioxide snow, the results were phenomenal, one or two treatments effecting a cure without scarring. Leonard Mitchell has used the snow in the treatment of: 1. Rodent ulcers with great satisfaction; he emphasizes the necessity of making the maximum application to the growing edge of the ulcer. 2. Trachoma, for which its use had been widely tested at the Royal London Ophthalmic Hospital. The application brings on a smart vascular reaction in the whole conjunctiva, and the beneficial results are attributable to this inflammatory reaction. It is desirable to carry the freezing to a point just short of
destroying conjunctival tissue. 3. In spring catarrh an absolute cure was obtained in a long-standing case by three applications of 15 seconds. 4. In lymphatic nevi of the conjunctiva excellent results are obtained.

Fifty cases of trachoma in Hong Kong were treated by Harston (Brit. Med. Jour., July 15, 1911) who describes the method he employed in the use of the remedy. The snow is hammered into a mould and cut into the form of a sharpened pencil, the sloping point being made as long as possible, but thick enough to avoid fracture when applied to the everted conjunctiva, this being an important point since considerable pressure has to be applied to secure maximum efficiency. The lids are everted and the snow is applied to the conjunctiva, care being taken to avoid contact with the cornea. The patient is told to look down as much as possible so that the snow may be applied to the transition fold. After treating this part, the remedy is applied to the tarsal conjunctiva, an interval being allowed to elapse so that the effect may pass off from the fornices before applying any pressure on the tarsal conjunctiva. The reason for this will be easily appreciated by the surgeon should the patient inadvertently raise the eyeball; the cornea is then apt to come into contact with the excess of snow deposited. Pain immediately ensues, and blepharospasm naturally follows, markedly exaggerating the discomfort of the patient. In the same way, after applying the snow to the tarsal conjunctiva, an interval is allowed to elapse before replacing the everted lid.

At the first application the snow is applied to each part for fifteen seconds; later, when the patient is accustomed to the treatment, for as long as twenty, twenty-five, and thirty seconds. The pain caused passes off at the end of two minutes, and is infinitesimal compared with the pain caused by bluestone, silver nitrate, and such caustics. The disease is considerably shortened in its course, and the resulting scarring is considerably less than when other caustics have been used. In this series of cases the applications were made once weekly. Provided Bowman’s membrane is intact, pannus and corneal ulceration clear up rapidly. The worst cases to treat are those of acute trachoma, with much edema of the lids and conjunctivæ and much purulent secretion. The cases which respond most rapidly are those which have already become chronic, with slight discharge, and with slight scarring—that is to say, those cases in which Nature has already attempted a cure. Of the papillary and granular types of the disease, the latter is, in the writer’s experience, the more readily amenable to the treatment with carbonic dioxide snow.
Carbone. (F.) Carbon.

Carbonic acid, Amblyopia from. A number of ocular diseases have been ascribed to carbonic oxide and monoxide poisoning. Among them are nuclear palsy (affecting the eye muscles), interstitial optic neuritis (observed by Raffegean) contraction of the visual field, venous hyperemia of the retina, but with contracted arteries, partial color-blindness, etc. See Toxic amblyopia.

Carbosulfure. (F.) Bisulphide of carbon.

Carbuncle of the eyelids. This acute, inflammatory swelling of the lid skin and other palpebral tissues occurs as a dusky, firm phlegmon which terminates in sloughing of the parts and especially in death of the skin. Small vesicles first form on the lid surface and burst, discharging a bloody pus. In other words, one sees the picture of a carbuncle in the soft and loose palpebral skin and areolar tissue. As soon as the slough separates it leaves a more or less deep cavity which on healing slowly fills with granulations and forms a cicatrix.

The treatment consists in a single crucial or of multiple incisions. According to the requirements of the case, one may add curettement of the dead material and the packing of the pus cavity with iodoform gauze. During these manipulations care should be taken not to injure the eyeball. If the swelling be very great a canthotomy is indicated. Cases of carbuncle of the lids, like carbuncle elsewhere, call for tonic and other general treatment.

Carburé. (F.) Containing carbon; combined with carbon.

Carburine. (F.) Carbon dioxide.

Carcinoma of the caruncle. Although carcinoma is an extremely rare new-growth in the caruncle, yet it does occasionally occur. When found, it springs from some of the caruncular glands. The neoplasm and its surroundings should, of course, be carefully extirpated, after which the part ought to be exposed, with great care and due protection, to the Roentgen ray.

Carcinoma of the choroid. In the majority of instances this disease occurs as a metastasis from the mammary gland. Sometimes the original neoplasm has been situated in the pleura, lungs, stomach, liver, thyroid, kidney, etc. The rarity of metastatic growths in the eye is accounted for by anatomic conditions—the small size of the ophthalmic artery and the fact that it is given off from the internal carotid at an angle of ninety degrees. While metastasis should be more common in the left eye than in the right, owing to the difference in the carotids, statistics do not show this to be true. The left carotid should receive emboli more easily than the right, inasmuch as it rises from the aorta directly. Metastatic growths occur most often at the
posterior pole of the eye, owing to the great calibre of the short ciliary arteries. In one-third of the cases the disease was bilateral. The ages of the patients ranged from thirty to fifty-eight years. The disease is twice as frequent in females as in males. Vision is destroyed within a few weeks after the appearance of ocular symptoms. The average duration of life is about six months. The disease appears ophthalmoscopically as a "flat, oval deposit or tumor, on the temporal side of the nerve, involving the macula with a central elevation of +3 D., its edges gradually fading off into the surrounding fundus. Its color is a dirty-yellow, with scattered pigment spots" (Mitvalski). No vessels are apparent in the growth. The retina becomes detached at an early period. The tension of the affected eye may be normal, increased, or reduced. Enucleation may be necessary to relieve pain.—(J. M. B.)

The histology of the neoplasm depends, as Parsons (Pathology of the Eye, p. 535) points out "upon the nature of the primary carcinoma, and also varies much independently of this. It is always a glandular carcinoma, with definite alveoli containing epithelial cells, and the differences are those of detail. In none of the cases has there been any difficulty in diagnosis, with the exception of Bock's case, in which an adenoma was diagnosed. The vast majority of cases are secondary to typical scirrhous of the breast, and the choroidal growth shows evident traces of its origin. It is generally more cellular than the primary tumour, a feature which is not uncommon in secondary carcinomata. Different parts of the growth often vary in this respect. The more cellular tumours or parts consist of alveoli of various sizes containing large round, or polygonal cells with single large nuclei. There is no intra-cellular stroma, and the stroma between the alveoli is sparse, consisting merely of the compressed choroidal tissue. The chromatophores are usually degenerated, having lost their processes; the pigment has often escaped, and is aggregated into small clumps. The vessels are flattened out and scarcely visible, though hemorrhages are frequent both within and outside the affected parts. The tumour rarely consists entirely of this soft medullary type, as was found in Schultze's first case; usually only the more rapidly growing parts have this structure. This is seen when the lamina vitrea is burst through, which only occurs seldom and late. The tumour then grows more quickly and more equally in all directions, so that a round mass is formed. This has never been seen large, owing to the lateness of its occurrence. The true scirrhous type is equally rare, having only been observed by Uhthoff. Here there are great masses of dense fibrous tissue, containing chromatophores and free pigment, rarely in
large quantity, with small alveoli, containing comparatively few cells. Generally the tumour is intermediate in structure between these two types, having parts which are more cellular. The adenomatous type is seen when the primary tumour springs from tubular glands, as in the stomach, intestines, liver, etc. Such cases have been described by Kamocki, Gayet, Reis, Bock, etc. In Gayet's case there were numerous tubules, lined with cylindrical epithelium. In Kamocki's case the tumour consisted of glandular tissue, in some places resembling the lacrymal gland, in others the thyroid. The epithelial cells were mostly cylindrical, arranged in a single stratum. The peripheral parts had the structure of an acino-tubular gland. The stroma consisted of fibrous tissue containing numerous choroidal pigment-cells. Preparations from the central portions of the tumour closely resembled a cystoma of the ovary. The cavities were lined with flattened epithelium, and filled with colloid masses containing swollen cancer cells and red and white corpuscles. Papillary processes projected into the lumen. Bock's case presented several peculiarities. There was a definite tumour, deep green in colour, consisting of large polygonal and cylindrical cells arranged in tubules like liver-cells. The lumina of the tubules contained bile, giving the tests of biliverdin. The liver, skin, lungs, muscles, orbit and arachnoid were all affected. Bock regarded the tumour as an adenoma, but there can be little doubt that Wintersteiner is correct in classifying it with the metastatic carcinomata of the choroid, in this case following a primary liver growth. Reis's case somewhat resembles Kamocki's. The growth was adenomatous in type, with cylindrical cells. These contained vacuoles, and the cyst-like spaces were filled with mucinous material. There were also papillary projections from the walls into the lumen. There was widespread degeneration, so that many of the spaces were filled with amorphous masses.'" 

Suker and Grosvenor (Ophthalmology, October, 1909) have carefully recorded a case and have given us a complete clinical and anatomical report of it. They have also studied 64 cases described in the literature of the subject and from these studies draw our attention to the following data: It does not occur before the age of puberty, nor directly thereafter, but usually between 30 and 60; the invariable presence of a primary carcinoma in some other organ; the great tendency for bilaterality; exceedingly rapid loss of vision; the uniformity in the lodgment of the embolus in the ciliary arteries; the uniformity in its character of growth; the short duration of life after its appearance in the eye; the rapidity of its growth along paths of least resistance; the scarcity of its perforating the globe; the rarity of epibulbar
Carcinoma of the ciliary body. Primary carcinoma of the ciliary body is one of the rarest of tumors, as is also the secondary form of the neoplasm. Badal and Lagrange reported a case in a boy, aged eight. The neoplasm showed itself in the ciliary region as two nodules that were composed partly of regular tubules lined by a single layer of cylindrical epithelium, and a part of the same tubular tissue filled with epithelial cells. In addition there were irregular epithelial cells grouped within the carcinomatous tissue, but separated by thin layers of areolar tissue. Collins and von Michel have reported other growths in the ciliary body that were probably carcinomatous. Secondary carcinoma of the ciliary body is practically always a metastasis from the choroid. Several cases are on record in which the disease followed a primary growth in the breast. An example of this is seen in a woman, aged 33, described by Cutler (Trans. Amer. Ophthal. Soc., 1905). Only two other cases of metastatic carcinoma involving the ciliary body and iris alone have been reported, one by Uhthoff, the other by von Briehn.

Carcinoma of the conjunctiva. Epithelioma of the conjunctiva. This neoplasm invades the conjunctiva in the situation which an epithelioma commonly prefers, namely, where one epithelium joins another, in the conjunctiva near the corneo-scleral junction. Here there is not so much difference in the epithelial covering as in the character of the underlying tissues. An additional factor in the development of this type of tumor in this region is the peculiar arrangement of epithelium, for in normal sections the epithelium is often found growing into the corneal tissue in the form of conic processes. The tumor begins as a small, rounded, or nodular, hard mass, slowly increasing in size and not painful. Eventually it spreads to all the ocular structures. Microscopically it is found that round-cell infiltration precedes the advancing growth of epithelial cylinders. The cylinders grow along the corneal canals. The corneal lamellae become broken up and destroyed, Bowman’s layer disappears, and the membrane of Desce-
met resists the longest. When it ruptures, the iris becomes fastened in the wound and the new growth spreads to the deeper structures. On the other hand, the epithelioma may spread along the lymph-sheaths of the anterior ciliary arteries. Often these tumors are lobulated and overlap the cornea, from which they can be lifted with a probe. The cornea may appear not to be infiltrated, but only flattened by the mass, but microscopic section will show it to be involved. The surgeon, under these circumstances, shaves the growth off level with the cornea, touches the base with the electrocautery, and expects a cure. Almost invariably, however, there is a recurrence, but not necessarily at the old site. These tumors are rarely pigmented. They are found in middle-aged and elderly persons. Although springing usually from the limbus, epitheliomas sometimes grow from other parts of the conjunctiva. Diagnosis may be difficult or impossible until after microscopic examination. Epithelioma of the conjunctiva is always a serious disease. If removed early and thoroughly it may not return.

When small, the cornea not being involved, the growth is to be excised. If large, or with considerable involvement of the cornea, the eye must be enucleated. Exceptionally, cases occur in which removal of a tumor which involves the superficial layers of the cornea will not be followed by a recurrence. If the growth is large and has extended into the eyeball, it will be advisable to remove all of the orbital contents.—(J. M. B.)

Carcinoma of the eyelid. This neoplasm occurring in the lid tissues is generally of slow growth, and closely resembles epithelioma (See Cancroid ulcer). In the skin it begins as a simple papule over which a crust appears. This is followed by a spreading ulcer with elevated edges which, if not extirpated, will eventually destroy lid, surrounding tissues and eyeball, even though many years elapse between its first appearance and the death of the patient. Its extremely slow growth sometimes makes it difficult of diagnosis; it may be mistaken for a tertiary syphilitic sore or a tuberculosis (lupus) of the skin.

The only treatment of any value is removal of the growth by the knife or curette and the subsequent application of the X-rays. Chloride of zinc paste, or arsenical plaster may, however, take the place of the cutting operation. C. Hirsch reports a case of ulcerated epithelioma of the lower lid of a woman, aged 58, which, if subjected to an operation, would have necessitated the removal of the whole lid. It was treated with Röntgen rays (from 10 to 5 minutes) at intervals of eight days, under proper precautions. After three sittings, four weeks after the commencement of the cure, the skin of the lid was normal, excepting two thickened places, which, however, disappeared
CARCINOMA OF THE IRIS

after four radiations with 0.015 radium bromid (in aluminum capsule) surrounded by a covering of lead. After ten weeks the patient came again with a grayish, mushy infiltration of the conjunctiva, for which the treatment with Röntgen rays proved to be inadequate. However, it healed completely after twelve radiations with radium (given for over an hour twice a week), with a perfect cosmetic result, which has endured to date, almost five months after the healing. Any skin defect due to operation or caustic application may be made good by a blepharoplasty (q. v.).

Parsons, speaking of carcinoma of the Meibomian glands, says that “some of the acini were normal, whilst others were filled with cells of epitheliomatous type, some forming concentric nests with mucoid degeneration in the centre. Other cells contained inclusions resembling coccidia. Fuchs has described a carcinoma of the Meibomian or of Krause’s glands which invaded the tarsus, the latter showing hyaline degeneration. Cases are also reported by Snell, and Scott and Griffith. The latter was a typical alveolar carcinoma, the cells showing great diversity of character. Some were exactly like sebaceous epithelium, and in some sections of the Meibomian glands the cells had perforated the basement membrane and were invading the tarsus.”

Carcinoma of the iris. It is a question whether primary carcinoma of the iris exists. There are very few recorded cases in literature, some of these being of doubtful import. Parsons, in commenting on reported cases (Pathology of the Eye, p. 329), believes the nature of the neoplasm in this situation to be doubtful. “Emmanuel regards it as inflammatory; Lagrange, again, supports the author’s diagnosis. Ginsberg points out that it differs from carcinoma in growing only from the surface without invading other tissues and in possessing no stroma; and from a typical epithelial proliferation of inflammatory origin in bursting the fibres of the zonule and in forming isolated nodules on the surface of the iris; moreover, the ciliary body showed no trace of inflammation. In spite of these criticisms, the inflammatory theory seems the more probable. There was a history of inflammatory attacks, and the tension is said to have been +2, neither of which statements are consistent with absence of signs of inflammation in the ciliary body. There is also a note of red corpuscles, mononuclear and, in smaller numbers, polynuclear leucocytes in the fibrous tissues about the growth. Further, the statement is not inconsistent with inflammatory hyperplasia such as is seen more frequently in the ciliary body, especially when combined with oedema. There are several cases on record of secondary carcinoma of the iris by continuity from metastatic growth in the choroid; at the same time the iris is seldom implicated in these
cases. In Ewing’s case the iris was largely transformed into fibrous tissue, amongst which lay plugs of cancer-cells; there were also nodules on the anterior surface, below which the vessels were blocked with cancerous thrombi. These were found in the posterior ciliary arteries by Abelsdorff, but not in the iris vessels. This author and v. Michel consider that the iris is involved by dissemination, not by continuity or embolism. There does not seem to be much in favour of this view, though in Lagrange’s case, as also in Abelsdorff’s, the iridic tumour was not in direct continuity with the main growth.”

Carcinoma of the lachrymal gland. The rarity of this tumor may be understood from an analysis of 132 cases of lachrymal growths collected by Warthin. Of these only 6 could be called carcinoma. The same observer points out that more than two-thirds of the neoplasms whose history he has collected are of neoplastic origin. No doubt the great majority are of mixed character, corresponding with the varieties of tissues that constitute the gland. All malignant tumors of this gland grow rapidly. Practically, treatment consists of the early use of large doses of potassium iodide (in the hope that the growth may be syphilitic in character), failing which the tumor should be extirpated.

Carcinoma of the orbit. True cancer of the orbit rarely or never occurs as a primary growth except as an extension from the lachrymal gland. Secondary tumors may, however, involve it in connection with disease of the conjunctiva or other lid tissues; these extend inward and may fill the whole orbital cavity. The prognosis is always grave. The treatment is entirely surgical—exenteration (q. v.) of the orbital contents and subsequent use of the X-rays. See Orbit, Operations on the.

Carcinoma of the sclera. There is probably no such neoplasm as a primary carcinoma of the sclerotic; it invariably arises as a metastasis from the choroid.

Carcinoma of the sphenoidal sinus. This is an extremely rare tumor which may involve the orbit by extension into that cavity.

Cardamon. AMOMUM. Recommended by Dioscorides, the greatest materia medicist of antiquity, as a remedy for phlegmon of the eyes. —(T. H. S.)

Cardinal. A 13th century professor of medicine at Montpellier, who is known to have died before 1294 and to have written a treatise called Glosule super Librum Aphorismorum Ypocratis. In this work, which is still extant, there is some ophthalmologic matter, but none of much importance.—(T. H. S.)

Cardinalis. The Latin form of cardinal (q. v.)
Cardinal points of a lens or optical system. Two distinguished pairs of conjugate axial points, introduced by Gauss, the most important of which are the principal points, and to which Listing has added another pair, the so-called nodal points. The six cardinal points are the two principal foci, the two principal points and the two nodal points. The first principal focus \((F_1)\) is the point on the principal axis where the incident rays intersect, or would intersect if produced, which emerge from the system parallel to the axis (see diagram). The second principal focus \((F_2)\) is the point of axis-intersection of the emergent rays, whose incident direction has been parallel to the principal axis. The principal points on the axis are such that, when an incident ray (produced if necessary) passes through the first principal point \((H_1)\), the corresponding emergent ray (produced if necessary) passes through the second principal point \((H_2)\), but the incident and emergent rays are not necessarily parallel to each other. Each principal point is the image of the other. The nodal points are two points on the principal axis so disposed that every ray which before refraction is directed towards the first nodal point \((K_1)\) appears, after refraction, to come from the second nodal point \((K_2)\), and follows a direction parallel to its incidence to the system. The two nodal points are mutually the image of each other. The distance between the two nodal points is equal to the distance between the two principal points. The two planes drawn through \(F_1\) and \(F_2\), and \(H_1\) and \(H_2\) at right angles to the principal axis, in the case of axial pencils, are called the two focal planes and the two principal planes, respectively. The rays that originate, or appear to originate, from a point in the first focal plane, are, after refraction, parallel to each other and to the lines of direction \(K_1D_1\) and \(K_2D_2\). The incident rays which are parallel to
each other, intersect, after refraction, in some point on the second focal plane. This point is where the corresponding line of direction cuts the second focal plane. The two principal planes are so disposed that the directions of an incident ray and its corresponding emergent ray cut the two principal planes in two points \( J_1 \) and \( J_2 \) on the same side and at the same distance from the principal axis. The second principal plane is the optical image of the first principal plane and vice versa. The principal planes are called planes of unit magnification, since an area of definite shape and size in the first principal plane produces a virtual image of precisely the same shape and size in the second principal plane. They are the only two conjugate images which have the same size and are situated on the same side of the principal axis. The first principal focal distance \( (F_1 \; H_1) \) is the distance between the first principal focus \( (F_1) \) and the first principal point \( (H_1) \); the second principal focal distance \( (F_2 \; H_2) \) being the distance between the second principal focus \( (F_2) \) and the second principal point \( (H_2) \). See Refraction of the eye.

Cardinalpunkte. (G.) Cardinal points of an eye or of a lens system.

Cardinal rotations of the eyeball. The best means for the study of the four cardinal rotations is Stevens' tropometer. A fair degree of accuracy may be obtained by the use of the perimeter and a lighted candle, or a small electric light, in a dark room. This method, though not the better of the two, will be described first. The patient should be placed in front of the perimeter as for the taking of the field of vision. The eye to be tested must be in the center of the perimeter curve. The extent of the outward rotation is determined by asking the patient to fix the blaze of a small candle, or a small electric light, as it is moved behind the arm of the perimeter, toward the temporal side of the eye under test. When the patient can turn the eye no further out, the operator putting his open eye (one eye should be closed) in line with the candle and the center of the rotated cornea, observes the image of the candle reflected from the center of the cornea, and then reads the number of degrees marked at the point of location of the candle. In like manner the extent of rotation of the same eye in the opposite direction is determined and noted. The arms of the perimeter are now to be placed in the vertical position, when the extent of the upward and downward rotations can be measured in the same way. There is no necessity for other than these measurements in the four cardinal directions. Muscles found capable of making these rotations reach the standard, will be fully capable of doing the work of effecting any other rotation, which, after all, must be a combination of the forces affecting the cardinal rotations. Both eyes
should be thus tested. The Stevens tropometer, shown in the accompanying cut, is an instrument of greater precision and is more convenient for use. The arrangement for fixing the head needs no description, since it is easily understood. At the base of the instrument is a thumb-screw by means of which the tropometer proper can be placed at varying distances from the patient’s eye. The object of this arrangement is to so adjust the instrument that the reflected image of the cornea will extend from one of the darker lines in the scale, to the other one, and this adjustment should be made at the beginning of every examination. Near the center of the upright piece there is a thumb-screw for elevating or depressing the mirror so that its center may be on a level with the patient’s eye. At the top of this upright there is a flat base by means of which the mirror-box of the tropometer may be placed directly in front of the eye to be examined. This is effected by simply sliding the tropometer in either the one direction or the other. The horizontal part of the tropometer is a little more difficult to understand, and yet it is simplicity itself. It consists of a square box, closed completely by metal on all sides except the one facing the patient, and in the center of this side is an opening which is filled with a disc of perfectly plain transparent glass, in the center
of which is a white dot at which the patient is directed to look, at the beginning of the examination. Inside of this box is the mirror, placed at an angle of 45° on a vertical axis. From this mirror the patient's eye is reflected, an aerial image of which is formed on the graduated disc, so that the operator at the other end of the instrument may see it. The sharpness of the image is regulated by the thumb-screw in the center of the telescope part, by means of which the lenses contained in the tube are so adjusted as to enable the operator to get perfect sharpness of outline of the aerial image. The disc containing the graduated scale has been constructed with mathematical correctness. In the center of this disc there is a heavy line extending entirely across. At right-angles to this base-line there extends from each side a heavy line, the distance between the two being nearly 60°. On either side of the base-line there are lighter lines placed at points 10° apart. When the handle of this disc is vertical, the position is for measuring superversion and subversion. With this instrument adjusted so the patient's cornea extends from one heavy line to the other, the base-line passing down through the center of the cornea, and the image itself being sharply focussed, we take the superversion by asking the patient to look up as far as possible. In the reflected image the eye appears to move downward, for the image is inverted. The position of the lower margin of the cornea (upper of image) is now noted and the extent of the rotation is read off on the scale. In a normal condition the superversion should be 33°. This having been noted, the patient is asked to look straight forward again, when the image of the cornea will extend from one heavy line to the other as before, while the base-line will pass directly down through the center of the pupil. Now the patient is asked to look down as far as possible. Unless the upper lid is held up by external force, it will so cover the cornea that the measurement cannot possibly be taken. An assistant is necessary then to elevate the upper lid in order that subversion may be taken. While the patient is looking down as far as possible, the position of the upper margin of the cornea (lower as it appears in the image) is noted, and the extent of the rotation is read off on the scale. This should be about 50°. The superversion and subversion having been taken, the handle connected with the scale-disc is turned from the vertical to the horizontal. Now the instrument must be so adjusted that the base-line will coincide with the horizontal meridian of the cornea, while the cornea itself extends from one heavy line to the other. If the left eye be under test, abversion is taken by asking the patient to look as far towards the left as possible. The location of the nasal margin of the cornea, when the eye is in extreme abversion, is noted on
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the scale and the extent of the rotation is read off. This should be about 50°. This done, the patient is asked to look straight forward, when the instrument is adjusted as before. Now he is asked to look as far towards the right as possible, when the extent of the adversion can easily be determined. This should be about 50°. The power of rotation in the four cardinal directions having been found normal, it would be correct to conclude that rotation in any one of the oblique directions would also be normal. Any marked variations in the different versions from the standard, as noted above, should be considered a very important guide as to any surgical procedure to be resorted to, but this will be more clearly set forth in the study of heterophoria. Both eyes should be thus tested. The candle method of simply watching the eye as it rotates in each of the four cardinal directions, does not commend itself as being at all accurate; and yet it is better than no examination to determine the extent of these rotations. Unless the temporal rotation carries the outer margin of the cornea to the external canthus, and the inner rotation carries the inner corneal margin to the internal canthus, it would appear that these rotations are too limited. In the upward and downward rotations there are only the lid margins, themselves movable, to give us an approximate judgment as to their extent. This method is of use in a case of paresis or paralysis, but it ought never to be relied on for other purposes. The extent of these rotations, as given by different authors, varies but little. Landolt makes the standard of these rotations as follows: Out, 46°; in, 44°; down, 50°; up, 33°. Stevens places the standard as follows: Out, 48° to 53°; in, 48° to 53°; down, 50°; up, 33°. The standard set by Stevens is probably more nearly correct. A knowledge of an excess of, or deficiency in, these measurements can but be helpful when the question of a muscle operation presents itself. The rotating power of a muscle should never be reduced by operation below the standard measurement for that muscle.—(G. C. S.)

Cardinose. (F.) Heart disease in general.

Cardiogmos strumosus. A name proposed by Hirsch for Basedow's disease. The term has never come into general acceptance, but is still met with at rare intervals. The disease in question has perhaps been more frequently re-christened than any other two affections in the entire ophthalmologic nosology. See Basedow.—(T. H. S.)

Cardiophthalmos. (L.) An old term for exophthalmic goitre.

Cardiosténome. (F.) Narrowing of the cardiac cavities and orifices.

Cardiotrophie. (F.) The nutrition of the heart.

Cardiovascular diseases, Eye symptoms of. See Bright's disease, Ocular symptoms of.

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Carebarie. (F.) The sensation of heaviness of the head.

Care of the artificial eye. So important do I regard this matter that I invariably furnish patients printed instructions concerning the care and use of the artificial eye, as follows: Each night before retiring remove the artificial eye and cleanse the socket with a clean boric acid solution. This solution should be made by dissolving a tablespoonful of boric acid crystals in a pint of boiling water, which should be kept in a perfectly clean, corked bottle. In cleansing the socket it is a good plan to lie on the back and, filling the eye cavity by means of a medicine-dropper, with the boric solution, open and close the lids a number of times; then turn over on the side and allow the fluid to escape from the socket. Wash the artificial eye in the boric acid solution before retiring, dry and polish it with a soft, clean towel, then put it into a clean, covered box for the night. It is essential that the socket should be kept free of discharge, especially pus or matter, otherwise the lids and socket may become irritable and inflamed. A new eye should be procured (or the old one polished) as soon as the old one becomes rough or does not fit well. An artificial eye generally lasts a year. Should anything go wrong with the artificial eye, the eye-lids or the socket the oculist should be consulted at once. It is a good plan to have on hand an extra artificial eye, so that the second one may be worn should anything happen to the other.

I am convinced that for the first week or two, or until the patient and his orbit have become accustomed to the presence of what is to some extent an irritating foreign body, the eye should be worn only for a few hours daily. At first it may be kept in place for an hour at a time, say, three times daily, after which it may be worn for longer periods until it is eventually retained all day.

I have a number of patients who, for various reasons—generally cosmetic—wear their prosthesis day and night, and I cannot see that any harm has arisen from following this plan, but, as a rule, the wearer should be told that it is conducive to the health of the parts to give the orbit a rest during the night.

Care of the eyes. Although this subject will be more thoroughly discussed under the heading Hygiene of the eye, just as certain aspects of it may be studied in the pages devoted to School Children, Eyes of, and Blindness, Prevention of, yet it may not be out of place to say something about the ordinary care of juvenile and adult eyes. It seems hardly necessary in this day and generation to point out that it is quite as important to conserve the eyesight as to restore it. The application of those hygienic rules that have been formulated as the
result of a study of ophthalmology is as necessary in the practice of
the physician as regulating the dietary or any habit of his patient.
Moreover, the family doctor will be constantly called upon to answer
such questions as "What is the best light to use in reading?" "What
do you think about the type of this school book?" "Would you
advise us to send John to the kindergarten?"—all of which demand
at least some acquaintance with ocular hygiene. It frequently hap-
pens, also, that the physician is elected to serve as school trustee or
as a member of the school board; how can he intelligently fill such an
office unless he is acquainted with the requirements of modern school
rooms, with all their details of lighting, seating, painting, etc.?—
matters of vital moment when one considers that the eyes are the
organs chiefly employed and involved in acquiring an education.

*Infants’ and children’s eyes* should never be exposed, even in
sleep, to the glare of strong light, artificial or natural, and this is
particularly imperative when the child is taken out in a perambulator
or carriage. The eyes should then be protected by an awning or
parasol lined with material that will not reflect the sun’s rays upon
the face.

They should not be encouraged to use their tender eyes for near
work and their playthings ought to be large objects, easily seen. Kin-
dergarten and primary schools should recognize this rule, so that the
occupations of the child do not injure the eyesight. No fine, difficult,
or prolonged visual labor should be allowed lest immediate eye strain
be produced or a foundation for later myopia be laid. Sewing, map-
making, perforated card problems, much reading, intricate drawing
*et hoc genus omne* should be banished from every primary school. As
Pyle properly observes: "If a child has red eyes, holds its book
close, complains of not being able to see at a distance, looks at objects
sideways or between partially closed lids, or squints or complains of
headache, browache, or pain in the eyes, it is the parents’ or teachers’
duty to send it to a competent oculist. If the oculist decides that
glasses are necessary, they should be put on at once in spite of any
foolish prejudice, for they will save and promote the physical and
intellectual development of the child and prevent many years of
suffering and perhaps irreparable ocular disease."

The so-called "stupid" child is too frequently one who has defec-
tive eyesight, and in consequence appears inattentive to his studies;
the adjective quoted might with great justice be applied to his
guardians.

The age at which a child should be sent to school depends largely
upon the condition of his visual apparatus. If he has no ocular de-
feets, is otherwise in good health and is never "crammed" or made to study out of school hours, half a day's schooling may be commenced at seven or eight years of age by the average child. The amount of work may be gradually increased until at ten he does a full day's work.

Children in poor health, especially if they exhibit ocular or aural defects or show a tendency to myopia, or present evidences of eye strain, should have little or no systematic schooling before they are twelve years old. That child will be happier and a better citizen, as well as a more successful man of affairs, who develops into a fairly healthy, though imperfectly schooled, animal at twenty than if he becomes a learned, neurasthenic asthenope at the same age.

School houses. These should always be located and built with particular regard to the eyesight. Ocular defects are most numerous in poorly lighted, badly drained and improperly ventilated schools. The window-space should be at least one square foot to every five of floor-space. There should be no obstruction to the entrance of sunlight and the nearest buildings should be at least twice as far away as their heights. Light should fall upon the pupils' desks from the left and rear so that there never is any light thrown directly upon or directly reflected into their faces. In this way no shadows are cast by the hand and arm (of right handed pupils) upon the writing pad or paper. There should be no annoying cross lights, or windows in front. The top floors are best illuminated from overhead sky lights.

Myles Standish (Opththalmoology, Oct., 1908) regards as the essentials of proper illumination of school rooms:

1. The walls should be painted a very light color, preferably an exceedingly pale green or buff. 2. The wooden finish of the room and desks should be light in color. 3. The window shades should be able to exclude direct rays of the sun, diffuse daylight freely, and also in the evening reflect a generous proportion of the light which falls upon them. 4. Direct illumination is desirable. 5. The lighting stations should be so arranged that no annoying shadows shall fall on the pupil's desk. 6. The newer forms of incandescent lamps and Zalinsky shades, when properly arranged, can give a candle-foot illumination of 2.5 on each and every desk in the ordinary school room, and finally, 7. That in most cities the expense of electricity, used in the manner above described, is not so much greater than the cost of gas as to be prohibitive.

Even on cloudy days it should be possible to read fine (diamond) print in any part of the school room without the aid of artificial light; indeed, no artificial light is ever used in the ideal school room.
A north light is preferable, but light from any direction can, at any time of the year, be regulated by shades and awnings, which are preferably of light colors—gray, buff, green or blue. Risley, our chief American authority on this subject, gives the following dimensions of the ideal school room:

Length of room ..................................... 32 feet  
Width of room ........................................ 24 feet  
Height of ceiling ..................................... 15 feet  
Window space (linear measurement) .............. 24 feet  
From floor to window-sills (beveled) ............. 3 feet  
Height of windows ................................... 11 feet

The room accommodates 45 pupils, giving 256 cubic feet to each. The walls and ceilings as well as the woodwork should be of the same softly reflecting colors as the window shades. The desks should be adjusted to the individual needs of the pupil and should be chosen with due regard to his comfort; the restless and uncomfortable pupil works the most mischief. If the seat is too high the child's feet are suspended in midair; if the desk is too high the elbows cannot rest without curving his spine out of shape, and the eye is brought too near; if too low he stoops over his work, compresses the veins of his neck, brings on cerebral congestion and becomes, in addition, round shouldered.

Blackboards should be of slate, or painted a dull black, so as not to reflect the light falling on them. Most of us have realized the misery of the child straining his eyes in the attempt to decipher, across the school-room, the not too plainly-written words or figures on greasy, shiny boards. Of course, they should never be placed between windows.

Regular medical examinations of the school children are urgently needed and preferably made at the beginning of the school year. These investigations of the ocular and aural functions are easily made, so easily that the teachers can be readily instructed by the school physician how to carry them on. The plan advised by Frank Allport is to be commended as the best and most practical. It is fully outlined elsewhere in this work by that author himself.

Children with defective eyes should be sent to an oculist or ophthalmic dispensary and should not be allowed to re-enter school until they have received proper advice and treatment.

School books. These should be easily read and ought to be small enough to be readily handled. For ocular reasons they should not contain smaller type than "10 point" (long primer). The lines
should be at least one-tenth of an inch apart, they should not contain more than 60 letters nor be more than 4½ inches long, so as not to fatigue the muscles in consequence of undue rotation of the eyeballs. The paper used in books and magazines should not be, as it often is, so highly glazed that it acts as a mirror to reflect the light into the eyes. It is not always possible to accomplish this where "half tone" illustrations are frequently used with the text. In this book, for instance, a compromise has been effected by the employment of a partially glazed, opaque paper. The type should be distinct and the printing well done. Bad paper, poor ink, and worse printing are too frequently encountered in our books and newspapers.

Examples of Spacing.

The conjunctival vessels on the globe are in most cases enlarged, but, in the milder types, there is no marked redness of the ocular conjunctiva, the thickening and redness being confined to the conjunctiva of the lids, particularly at the junction of the lids and the eyeball in the retro-tarsal folds. Sometimes there is a slight chemosis present.

Improperly spaced.

The conjunctival vessels on the globe are in most cases enlarged, but, in the milder types, there is no marked redness of the ocular conjunctiva, the thickening and redness being confined to the conjunctiva of the lids, particularly at the junction of the lids and the eyeball in the retro-tarsal folds.

Properly spaced.

[The printed text of this book is also an example of proper spacing.]

The hygiene of near work in adult life. Here also is a consideration of prime importance. The enormous increase during the past twenty years in the amount and variety of work which the full grown man and woman expects from the eyes, is largely responsible not only for the added need of glasses but for the great increase in the direct and reflex results of eye strain. If we expect to have comfort and to use our eyes to their fullest capacity we must select reading matter in large type, correctly spaced, printed with good ink in short columns, on unglazed paper. Other precautions are necessary, especially if the eyes are used constantly, as in the case of students, sewing girls, etc. The reader or writer should sit upright and a little forward; the book, paper or other form of near work (a heavy volume may be placed on an adjustable book-rest so that the top and bottom of the page are the same distance from the nose) must not be nearer than 12 inches nor more than 20 inches distant. The illumination should be from over the left shoulder or to the left and above the head. If it is impossible
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to have a proper arrangement of the light, the latter, if an electric or other form of lamp, should be covered so that sufficient light is thrown upon the work to be done, and an eye shade ought to be worn by the worker.

Hygienic value of yellow. The use of yellow, amber or orange-tinted glasses by persons who desire to protect sensitive eyes against brilliant light is recommended by Motaïs, of Angiers. He has been using these yellow glasses for twenty years.

These glasses, says the Paris Cosmos, give a remarkable illumination. The sky and objects are lighted up with warm tints, very agreeable to the eye. Besides, and despite this luminosity, they produce a quieting effect, so that with tints proportioned to the intensity of the light or to the retinal sensitiveness, the most sensitive eyes may be preserved.

They are the most agreeable, the intenser the light, and are consequently recommended to travelers in high latitudes or on the snowfields of mountain regions, where they are exposed to the blinding rays of the sun.

They also modify, in summer, the brilliancy of the sands on a sea beach. In the mountains, on an automobile excursion, their illumination enables the traveler to regard the widest views without fatigue. Irritable eyes, even when they have normal visual power, will find it advantageous to substitute the agreeable impression of yellow glasses for the gloomy tint of blue or smoked glasses. This substitution is desirable when the visual acuteness of invalids is notably weakened, as in the many affections, such as retinitis, choroiditis, progressive myopia, atrophy of the optic nerves, keratitis, etc.

According to the investigations of Javal, continued by Tschernig and Sarazin, the double illuminating and quieting action of yellow glasses, apparently so contradictory, is explained by their suppression of the chemical rays of the solar spectrum. It may be remembered that about 1888 an English scientist who had devoted much time to ophthalmology strongly advised all persons who were earning their living with the pen never to use white paper when yellow could be obtained.

Apart from the evidently high-strung enthusiasm of this writer I am, from several years' experience of them, in favor of amber-tinted lenses rationally employed, rather than of the usual smoke-tint, blue or gray-colored lenses in common use.

Injurious reading habits. It may be plainly stated that reading while lying down (especially in bed when convalescent from an acute disease), in a railway train, on street cars, out-of-doors (by direct
sunlight), by firelight, when tired or sleepy or when the eyes are fatigued or strained, is distinctly injurious. Fine sewing, embroidery, china painting, drawing, engraving, working on black goods and similar tasks should be performed only in the daytime by persons possessed of the strongest eyes and best health. Such work should also be interrupted with sufficient frequency. The habit of wearing dotted or figured veils is responsible for a good deal of eye strain. When they are used for protecting the face and keeping the hair smooth, or keeping the headgear in position, they should be thin, with a large, uniform mesh.

Artificial house and office lighting. This is a matter that should follow the regulations applicable to common school rooms. The illumination should be of proper amount and quality and should shine upon the work to be done and not directly or by reflection into the eyes of the observer. For the general illumination of any room the best light is that which imitates diffused daylight—the sort of illumination most satisfactory to the whole visual apparatus. If these facts be borne in mind any form of artificial light may, with proper modifications to suit individual requirements, be employed. The problem involved in many office buildings, stores, banks, etc., are not easy of solution but we may, perhaps, arrive at the best light available by recollecting the following aphorisms:

(1) Electric arc light should never be used for indoor illumination; it is too brilliant, too dazzling and too concentrated; (2) owing to the heat evolved, the danger of fire, and the vitiation of the atmosphere by gas, electric lamps are preferable; (3) the Welsbach or Auer light is too powerful for near work—if hung well out of range it is a good light for large rooms and show windows; (4) the naked filament or wire light of the electric lamp gives an irregular shadowed field of illumination upon the printed page or other near work; it should, in consequence, always be covered by a ground or porcelain glass when employed close at hand; (5) diffusion of this light, as well as that from incandescent mantles with gas of all sorts, has lately been accomplished by prismatic globes or holophanes, so disposed that the light rays are mostly deflected downwards; (6) apart from the heat and vitiated air engendered by it, there is probably no better reading light than the old fashioned argand burner (or "students' lamp") with gas or kerosene; (7) an imitation of the students’ lamp has recently been accomplished by using with a 16 c. p. electric lamp a dull aluminum reflector; it acts very well, throws parallel rays on the printed page and does not shine into the reader's eyes.

Lighting by means of prism batteries is of great value when, as in
our crowded cities, the lower stories and rooms in buildings are rarely or never reached by direct daylight. These prisms are arranged as ornamental panes or as canopies in front of the dark windows. For basements or cellars they are inserted in the pavement, with secondary screens below the sidewalk to assist reflection into rooms beneath. See, also, Arc lighting and Illumination.

Cargentos. This is a trade name for a preparation of colloidal silver oxide. It contains 50 per cent. of silver and is prepared by the action of a fixed alkali upon silver nitrate in the presence of substances (gelatin, casein, egg albumen, etc.) which insure the formation of silver oxide in colloidal form. It appears in the form of black scales of metallic lustre, freely soluble in water and glycerin. According to the proprietors, solutions of cargentos are not precipitated by sodium chloride or albumen; and, because of this fact and their high specific gravity due to the large silver content, possess decided penetrating power, giving cargentos an advantage over nitrate of silver for application to diseased surfaces where the bactericidal and other properties peculiar to the silver salts are desired.

A bactericidal test performed on staphylococcus pyogenes aureus, in comparison with carbolic acid by the Rideal-Walker method, showed that cargentos in 1 per cent. solution approximates the bactericidal power of 1 per cent. carbolic acid solution.

Cargentos is indicated in specific and non-specific urethritis and vaginitis, in diseases of the bladder, and of the eye, ear, nose and throat, such as purulent and catarrhal conjunctivitis, trachoma, corneal ulcers, otitis media, postnasal catarrh, laryngitis, pharyngitis, etc.

Carie. (F.) Caries.
Carie dentaire. (F.) Caries of the teeth.
Caries. (L.) Ulceration, especially of bone.
Caries der Wirbelsäule. (G.) Caries of the vertebral column.
Caries of the lachrymo-nasal bones. Destruction of the bones forming the nasal-lachrymal duct is frequently due to lues, and is generally seen in connection with a chronic dacryocystitis and obstruction of the lumen of the duct itself. The treatment of this condition is, consequently, bound up in the conduct of the lachrymal obstruction. See Lachrymal apparatus, Diseases of the.
Caries of the malar antrum. Although this disease belongs to the domain of rhinology and general surgery, yet it not infrequently is the source of eye diseases by extension to the orbit. Diseases of the walls of the antrum of Highmore, empyema and tumors—especially of the malignant type—may extend into the orbital cavity, and gen-
eraly call for surgical interference. The treatment of this condition then resolves itself largely into operations upon the orbital walls, which will be discussed elsewhere under that heading. See Orbit, Operations on the.

Caries of the orbit. The history of this disease is involved in the conditions that produce it. Almost invariably destruction of any part of the orbital walls is preceded by a periostitis which, in its turn, results from syphilis, traumatism, rheumatism, serofula, etc. The periosteal inflammation may end in an abscess with a variable collection of pus, undermining and detaching the periostium and thus encroaching upon the orbital space; or it may result in bone destruction (caries and necrosis), with the formation of sinuses and sequestra, which carry the disease into chronicity. Chronic periostitis may last for months or years, while intractable sinuses, retraction of the skin with alteration in shape and mobility of the eyelids, set up a train of symptoms which may continue long after the original disease has subsided. Caries generally attacks the margin of the orbit, and is most frequent in syphilitic and serofulous children, whereas necrosis is most frequent in the adult and follows acute periostitis or traumatism, such as fracture denuding the bone or its periostium. Large portions of bone may become exfoliated and great deformity may result. As in the case of the causation of caries so is its treatment involved in the periostitis that produced it. Locally, the indications are to limit the exudation and promote absorption and resolution. Although the application of cold is generally of use in the first stages of inflammation, practically it is not to be recommended in periostitis, heat being much more efficient as well as more grateful to the patient. Hot fomentations therefore play an important rôle. They must, however, be properly applied, the object being to maintain a uniformly high degree of temperature. Hot compresses replaced every half-minute for thirty minutes, repeated in an hour or two, will generally yield good results. A lukewarm or cold compress placed over the part for an indefinite time is useless. If pus is present it must be liberated. This is to be done by passing a long bistoury in such a way as to avoid the eyeball, the optic nerve, and the ciliary ganglion. The incision should be made through the periostium to the bone, and the mouth of the opening should be kept patulous with gauze packing. Sinuses should be carefully syringed, and any loose piece of bone presenting should be removed. It is well to form a definite idea of the size and extent of the loose bone before attempting its removal, always bearing in mind the proximity of the cranial cavity, the frontal and ethmoidal sinuses, and the
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antrum.—(J. M. B.) See Periostitis of the orbit, and Operations on the orbit.

Carnassier. (F.) Carnivorous.

Carné. (F.) Flesh coloured.

Carniforme. (F.) Having the appearance of muscular tissue.

Caroncule. (F.) Carnuncle.

Carotid arteries, Ocular relations of the. Unless the ophthalmic artery or its branch, the central artery of the retina, be involved, thrombosis, embolism, and aneurism of the carotid arteries do not much affect the eye proper. In an experiment of Elschnig, compression of the common carotid arteries of the neck did not produce any change in the retinal circulation or in the function of the retina itself.

A treatment for recurring hemorrhage into the vitreous, ligation of the carotid has been performed with decided success in some cases.

The relations of certain forms of aneurism of the internal carotid will be described under the caption Exophthalmos, Pulsating.

Carpain. This is a powerful alkaloid obtained from the leaves of Carica papaya, the so-called tropical melon-tree. Its formula is \( C_{14}H_{27}NO_2 \). It occurs as white crystals, soluble in alcohol, ether and chloroform. Its action is much like that of digitalis, and it is prescribed for mitral insufficiency and aortic stenosis, in doses of 1/6 to 1/3 of a grain.

Experiments with a 0.6 per cent. solution of the hydrochloride have demonstrated that it is to some extent a local anesthetic; instilled into the eye an anesthesia of the conjunctiva, cornea and sclera occurred that lasted half an hour. The pupil was unaffected.

Carpe. (F.) Wrist.

Carpenter, George A. A noted English pediatrician, who devoted much attention to ophthalmology. Born on Christmas Day, 1859, he died on Easter Day, 1910, at the residence of his mother, at Wadden, near Croydon, England. After a preliminary education at Epsom College, Surrey, and King’s College School, London, he received his medical training at St. Thomas’s and Guy’s Hospitals, London. In 1886 he received the M. B. (London) and four years later the M. D.

He settled for practice in London, soon limiting his work to the diseases of children. However, he was always known as an excellent diagnostician in every branch of medicine. His greatest services were rendered in the field of pediatric ophthalmology. He was a member of the Ophthalmological Society of the United Kingdom and of the French Ophthalmological Society. He was also active in pediatric societies, and societies of a general character.

As a writer, Carpenter was very well known, most of his composi-
tions appearing in "The Ophthalmoscope." Among his numerous books are: "Syphilis in Children," "Congenital Affections of the Heart," and "Golden Rules for the Diseases of Children." He was, for a long time, English Editor of the American journal, "Pediatrics," and he founded the "British Journal of Children's Diseases," a publication which he edited till nearly the time of his death.—(T. H. S.)

Carré. (F.) Square.

Carreau. (F.) Tuberculosis degeneration of the lymphatic glands of the mesentery in children; tabes mesenterica.

Carron du Villard's method for the removal of cilia. Celsus is said to have been the first to destroy displaced cilia by a red-hot needle. In modern times, Carron du Villard (Maladies des Yeux, I, p. 307) practised galvano-puncture in 1837 for, probably, the first time and for the same purpose. Harlan (Norris and Oliver's System, Vol. 3, p. 92) describes the modern method thus early introduced. He advises a constant battery of from 8 to 20 cells although the current from the ordinary supply of electricity may be utilized. "A gilt sewing-needle (No. 8) connected with the negative pole is pushed into the follicle by the side of the lash, and the sponge connected with the positive pole is placed on the patient's temple or held in his hand. When the circuit is closed, a slight frothing, from the escape of minute bubbles of gas, is seen around the stem of the needle, which is the sign for breaking the current. With eight ordinary-sized elements the desired effect is produced in from two to five seconds; with a stronger current less time is required. The lash comes away with the needle or is withdrawn by very gentle traction, if the application has been successful; otherwise the papilla has not been reached or the decomposition has not been sufficient and the operation should be repeated. This method often answers well when only two or three lashes are inverted, but is rather painful and tedious when more are to be disposed of. It can, of course, be done at several sittings, or an anesthetic may be used. The reaction is generally slight. When the hair is very fine or irregularly placed it is a difficult matter to strike its bulb accurately with the needle. Michel, however, claims that absolute contact is not necessary."

Carron oil. Linimentum calcis, U. S. Lime Liniment. This preparation, well known to surgeons and popular with the laity, is a bland, lime-soap emulsion which should be freshly prepared from equal parts of lime water and linseed oil. To recent burns it forms an excellent application on sterile lint or gauze to those accidents affecting the lid skin and neighborhood of the eye. If it should come in contact with
the ocular structures no harm is done. It takes its popular name from the iron works in England where it had its origin. It has long been in use as a popular dressing for superficial burns and constitutes a readily applied and effective non-antiseptic remedy that rapidly allays the accompanying pain. If there has been extensive destruction of tissue this remedy should be avoided, as it is not only difficult to remove, but forms a covering beneath which bacteria may proliferate safely from the reach of antiseptics.

**Car-sickness.** Car nausea. Railway vertigo. The well-known symptom-complex of sea-sickness may be produced by journeying in railway cars. It is occasionally accompanied by ocular symptoms and in an unknown percentage of cases the discomfort (panorama asthenopia) is due wholly or partially to ametropia, oculomuscular defects or to a combination of these. Treatment of the eye anomaly not uncommonly cures or relieves the car-sickness.

Car-sickness was at one time supposed to be an incident of hyperphobia but other ophthalmic defects are probably equally responsible for it in those cases in which it is due to any ocular anomaly. W. McL. Ayres has studied seventy-five cases of car-sickness and finds that of these thirty had plus astigmatism contrary to rule. In over nine hundred cases of hyperopic astigmatism (simple and compound), there were only fifty-eight cases contrary to rule, or fifty-one per cent. of the cases with astigmatism against the rule had car nausea, while only three per cent. of those having astigmatism with the rule complained of it. In myopic astigmatism, both simple and compound, the proportion is decidedly less, and in the few cases of minus astigmatism contrary to rule, only one-fourth of them complained of car sickness, or just one-half as many as found in plus astigmatism contrary to rule. Car sickness was found in every case associated with astigmatism with or without some other forms of ametropia, it was found in mixed astigmatism and it is to be noted that fifty-five per cent. of those unusual cases which had astigmatism with the rule in one eye and against in the other complained of it. Many cases were completely cured, and all were benefited by the adjustment of correct lenses.

**Carter's operation for corneal staphyloma.** Brudenell Carter devised an operation for the relief of this form of corneal protrusion, in which he detached the tendons of the straight muscles from the sclera. He then joined the internal to the external and the inferior to the superior rectus, drew the conjunctiva over all and united its edges by four sutures placed vertically.
CARTER'S TEST FOR THE COLOR-SENSE

Carter's test for the color-sense. This device takes the form of an instrument for the quantitative determination of the color-sense. As described by Thomson (System of Diseases of the Eye, Vol. 2, p. 345) it must be used in a dark room, and consists of an oblong box which has in the front side a collimator lens that makes the rays of light from a lamp enclosed in a separate box fall parallel on the opposite side of the little dark chamber, where a slide moves behind a round hole in this back wall. This slide is so arranged that different pigment colors either on a white or a blackened background can be exposed to view; while the amount of light that falls on these colors is regulated by a changeable diaphragm, the opening of which can be made to vary from zero to one thousand square millimetres. There are also on the front side two sight-tubes, so that both examiner and patient may look at the same time. The physician first determines with what diaphragm he is just able to distinguish the different colors on the slide; then the patient does the same for his eyes. At the outside of the box there is an index that registers the side of the square diaphragm used, in millimetres. Suppose the examiner had to use under the existing conditions a square diaphragm of 2 millimetres' side and the patient of 3.5 millimetres' side, then the color-sense of the patient as compared with that of the surgeon would be

\[(2)^2 = 4\]

\[\frac{(2)}{(3.5)} = \frac{4}{12.35}\]

stated before, is in inverse proportion to the amount of light necessary, and this quantity of light is directly proportional to the opening or the square of the side of the diaphragm used, the diaphragm retaining always the form of a square. While the instrument is thus used for reflected light, it can also be employed for transmitted light by using the colored glasses in the side and letting the patient look at them from the opposite side as before. Carter found in several cases of imperfect color-perception that while he could readily distinguish light-red and light-green dots with a diaphragm of four square millimetres, the patient had to use an opening of eighty square millimetres for the same thing. Of course the absolutely red-blind or green-blind could not see the colors, even in the fullest illumination possible, in the sense in which we see them: so that these instruments are more useful for patients with reduced color-sense, but very good for an examination of the central color-sense. See, also, Color-sense and Color-blindness.

Cartilaginous tumors of the orbit. Enchondroma or chondroma of the orbit was early recognized. Mackenzie (*Diseases of the Eye*, 4th Edition, p. 41) tells us that "'craggy or semi-cartilaginous'" tumors constitute one of three forms of exostosis of the orbit. Soelberg Wells (*Diseases of the Eye*, p. 701) remarks that true cartilaginous tumors (enchondroma) are rarely met with in the orbit. "Many of the cases which have been recorded under this name, were in reality instances of osteo-steatoma or osteo-sarcoma. This mistake is the more easily made, as some of these tumors in the course of their development undergo cartilaginous changes before becoming ossified.'" Although these cartilaginous tumors, as a rule, spring from the bone, they may also become developed from the softer tunics of the orbit. They are most frequently met with in youthful individuals. In a case of von Graefe's it occurred in a child only seven months old, it being stated that the tumor had existed since the first month after birth. This neoplasm is one of the least malignant of orbital tumors. It grows very slowly, and is so perfectly encapsulated that it is, as a rule, easily removed surgically. Its occurrence in the orbit is very rare, in which case it may be found in the orbital cellular tissue, or with greater frequency in the lacrimal gland. Clinically, it is hard and firm, and may be mistaken for osteoma. If, as enchondromata sometimes do, the tumor should undergo mucoid degeneration, a point of differential diagnosis between it and an osteoma would be the fluctuation in the degenerated mass. An enchondroma is usually accompanied by pain. There is but one treatment of this neoplasm—removal by surgical interference. In a number of cases it has been possible to extirpate the growth without sacrificing the eyeball. See, also, Orbit, Operation on the.

Cartesian lens. A lens so shaped that there is no spherical aberration; especially, a concavo-convex lens having one surface spherical and the other ellipsoidal. Such lenses were proposed by Descartes, but never successfully executed, and were later shown to be needless.—(C. F. P.)

Cartons. Like the ancient collyrium (q. v.), these remedies are in the form of compressed tablets containing enough of the remedy to make collyria of a certain quantity. For example, cartons of boric acid crystals are in the market which, when dissolved in sterile water, make a 2 per cent. saturated solution sufficient for a day's use of the antiseptic in question. Practically they are the same as tabloids or solubles (q. v.) except that they furnish a larger amount of sterile liquid.

Caruncle. Lachrymal caruncle. This may be described as an isolated patch of skin situated in the center of the lachrymal bay. The caruncular epithelium, modified by its surroundings, has two layers like
CARUNCLE, ANOMALIES OF

that of the tarsal conjunctiva, which is increased by several medial layers at its summit. This structure also presents gland depressions, goblet cells, and seaceous glands associated with fine hairs. Fat globules are present in the corium and, according to some observers, Krause's glands and sweat-glands can generally be demonstrated.

Caruncle, Anomalies of. See Caruncle, Malformations of.

Caruncle, Carcinoma of the. See Carcinoma of the caruncle.

Caruncle, Diseases of the. Affections of the caruncle are usually transmitted from the conjunctiva and should be treated in conjunction with it. Many tumors (papilloma, epithelioma, adenoma, sarcoma, etc.,) attack this small body and call for the same treatment they should receive in other localities.

"Wild" hairs and foreign bodies should be removed in the usual manner. Sometimes the hairs on the caruncle grow so long as to be a source of irritation. To this condition the term trichosis carunculæ or angular trichiasis is given. Epilation or, probably better, excision of the hair-bulb is the effective treatment.

Abscess of the caruncle sometimes appears and should have the treatment proper to this condition.

Both the plicæ semilunaris and the caruncle become infected or inflamed from the neighboring conjunctiva; the parts are red and swollen. If this inflammation is localized, or mostly confined to the caruncle itself, it may be given the name attached to it by the older writers, encanthis, which means a localized inflammation of the caruncle.

Thickening or hypertrophy of the caruncle may occur in syphilis, while trachoma follicles may be developed in it. Apart from adenomata retention cysts found in the sweat glands, multilocular and lined by epithelium have been described. Finally, sinking of the caruncle as an unpleasant sequel of tenotomy of an ocular tendon is not uncommon, especially if the belly of the muscle is cut through and the cheek ligaments divided.

Occasionally calcareous deposits are found in the substance of the caruncle. These should be incised and removed.

Primary tumors of the caruncle are rather numerous and include carcinomata, sarcomata, lymphangiomata, fibromata, cylindromata, papillomata, adenomata and dermoids. Their (surgical) treatment does not differ from the conduct of such superficial growths elsewhere.

Congenital abnormalities of the caruncle will be discussed under Congenital anomalies of the eye, as well as under sub-headings.

Detachment of the caruncle has been observed as a result of conjunctival tuberculosis.
Caruncle, Malformations of the. Although these have been referred to elsewhere it would be sufficient to mention here that dermoid tumors have been several times recorded as springing from the caruncle. They are precisely similar to dermoids met with more frequently elsewhere, as, for example, at the sclero-corneal junction. According to Parsons there is no indisputable case of true dermoid of the caruncle yet published. He says that in Boek's case "the tumor consisted of dense fibrous tissue, with fat, elastic tissue, medullated nerves, unstriped muscle, and sebaceous glands. A few hairs were present. The epithelium was partly a single layer of cylindrical, and partly two or three layers of large cubical cells, with many goblet-cells. This tumor may have been a mere hyperplasia or fibrolipoma, as described by the author." Congenital nevi, or other similar vascular growths, of a bright red color are occasionally seen. Microscopical section shows in them numerous thin-walled blood vessels separated by loose fibrous or areolar tissue. Wintersteiner claims that malignant growths develop from them more frequently than they do from conjunctival angiomata.

Caruncle, Trichosis of. See Caruncle, Diseases of the.

Caruncola. (It.) Lachrymal caruncle.

Caruncula oculi. (L.) Lachrymal caruncle.

Caruncule, lachrymal, Development of the. In the early stages of lid development, the lower punctum lacrimale lies more lateral than in adult life. Situated nasally to it are some tarsal glands and some cilia germ-cells. As the lower punctum approaches the lacus lacrimalis it pushes before it these structures and they form a deep-lying mound, covered with conjunctiva. This is the first appearance of the caruncula lacrimalis. It develops rapidly and contains the beds of several glands which usually do not develop, however. During certain stages of foetal life, the caruncle is relatively larger than during adult life.—(H. S. G.)

Carus nystagmus. (L.) (Obsolete.) Sudden loss of consciousness with rapid twitching of the eyelids.

Casaamata. An Italian oculist and peripatetic, who finally became, it is said, court-ophthalmologist at Dresden. Little is known concerning him or his work. We understand, however, that he boasted greatly of his pretended ability to cure strabismus by means of a simple ligature. It appears that he had a way, when operating, of sitting upon a table facing three chairs. On the lateral chairs he placed his feet, on the chair in the middle, the (probably awe-stricken) patient.—(T. H. S.)

Cas désesperé. (F.) A hopeless case.
Case-history. As a part of the examination of the eye the keeping of a case-history is all important. Although this matter will be further considered under Examination of the eye, yet a systematic plan cannot be too often recommended. There are numerous printed records in the market and almost every ophthalmologist follows a plan of his own. For myself I preface the record with the following routine questions, which may appeal to others. Of course the form of question may be varied indefinitely to suit the age and mentality of the patient:—(1) Early in life—when you were first going to school, or earlier—did you ever have any trouble whatever with your eyes? If so, in what way did they bother you at that time? (2) When was the next time or times that you had any difficulties with or defect in your eyes? (3) Have you been in the habit of holding your book or newspaper nearer your eyes than people generally do? (Status presents) (4) During the past six months have they bothered you in any way? Have you noticed any blurring of print or mixing of letters when reading? (Now ask age and occupation.) (5) How long can you read the newspaper without noticing any difficulty with your eyes; if difficulty, what is it? (6) Have you any headaches? If so, in what part of the head? How often do they come on? Do you have these headaches only in the daytime, or do they sometimes keep you awake at night? Do they affect both sides of the head at one time or are they generally one-sided? Are they made worse by the use of the eyes for reading, writing, or any near-work? (7) Do you suffer from nausea or dizziness? (8) In riding on the street cars or railway train and looking out the window at passing objects, are you affected in any way? If so, in what respect? (9) In going to church, theatre, concert—anywhere when you have to see distinctly in the distance for any length of time—does it affect your eyes in any way? (10) Do you ever see objects double, either for distance or near? (11) Do your eyelids smart or burn? Is there a feeling of dust in the eyes? Has anybody noticed that your eyes get blood-shot or red? Do the eyelids stick together in the morning? Is there any discharge from the eyes when you first wake up? (12) Are your eyes sensitive to light, that is, does gas, electric light or sunlight hurt them more than they generally affect other people? Have you ever pain in the eyes, or do they become tired easily, or do they ache? Have you ever worn, or do you now wear glasses? Let me see the glasses you are now wearing. (Make a note in the place set aside for them the formula of glass or glasses worn by the patient.) (13) Have you noticed anything further wrong with your eyes? (14) What is the principal thing that bothers
your eyes now? (15) What is the state of your general health? Do you sleep well at night time? How is your appetite and does your food generally digest? How much do you smoke and drink?

Then proceed to take the patient’s vision for both distance and near, and to make "red glass" and other tests of the eye muscle balance. Evert the lids, examine their edges, the conjunctiva, the caruncle, and the puncta. Refraction should be determined by at least one subjective and one objective test, meantime carefully using the oblique illumination and ophthalmoscope. Record the intraocular tension and the pupil reflexes. The perimeter, corneal microscope, tropometer, tonometer and other appliances, together with a nasal and systemic examination, will be indicated in a large proportion of cases.

**Caseous cataract.** Cheesy cataract.

**Cassaripe.** The concentrated juice of the roots of *Manihot aipi* and *Manihot utilissima* rendered innocuous by boiling. It is used not only as a condiment, but, as a 10 per cent. ointment, is recommended in treatment of corneal ulcer, purulent conjunctivitis, and some other ocular affections. Risley and Chandler found a 10 per cent. ointment of signal value in the treatment of ulcer of the cornea.

**Cassegrainian telescope.** A form of reflecting telescope in which the rays are reflected from a concave to a convex mirror, and back, through an aperture in the first, to the eye of the observer.

**Cassette.** (G.) Dark slide.

**Cassia absus.** (L.) A low annual plant of the East Indies and Upper Egypt. It bears brownish-black shining seeds that have been employed in Egypt and elsewhere as a specific for trachoma.

**Cassia auriculata.** (L.) A shrub growing in India. The seeds are employed in diabetes and rheumatism, and a powder made from them is insufflated into the eye in trachoma.

**Cassius, Felix, of Cirta in Africa.** A physician of the Greek middle ages who flourished about 450 A. D., and who composed, or rather compiled, a work entitled, "*Cassii Felicis de Medicina ex Graecis logicae sectae Auctoribus Liber Translatus sub Artabure et Calepio Consulibus.*" This work (judged by its title, composed 447 A. D.) Cassius expressly admits that he compiled from various authors for the benefit of his son, yet in it he seems to have included a number of first-hand observations. The book consists of 82 divisions, or sections, of which the twenty-ninth relates to diseases of the eye.—(T. H. S.)

**Casso, John de.** The well-nigh unknown author of a work on ocular hygiene, entitled "*Tractatulus de Conservatione Sanitatis Oculorum,*"
composed in 1346, and really a compilation from a number of Arabian ophthalmologists.—(T. H. S.)

Cassonade. (F.) Moist sugar; brown sugar.

Cassytha filiformis. (L.) A species growing on the branches of trees in India; parts of the plant are used as an application to inflamed eyes.

Castile soap. See Soap.

Castor. (F.) Beaver.

Castoreum. Beaver-testicle was employed by the ancient Greek and Romans as a part of their ophthalmic materia medica.—(T. H. S.)

Castor oil. Oleum ricini. This remedy is one of the oldest as it is one of the most useful ophthalmic remedies. It is a fixed oil expressed from the seeds of Ricinus communis. This is a viscid, transparent, pale-yellowish liquid with a faint odor and offensive taste. It deposits whitish flakes, after becoming turbid generally, as the freezing point is reached. Its chief adulterations are other fatty oils—rapeseed, cottonseed and corn oil.

That portion of castor oil that remains clear at the freezing point makes the best solvent for the alkaloids used in ophthalmology. Its bland, viscid properties also render it peculiarly valuable for instilling into the conjunctival sac. Green was the first to suggest that a solution of homatropin in castor oil, inasmuch as in the sac it gives up its alkaloid gradually, being slowly absorbed by the ocular tissues, made the best method of prescribing it in determining refractive errors.

J. S. Kirkendall finds the best results to flow from atropine when this oil is used as a solvent. He uses the following formula: Atropiae (alkaloid) gr. vi-viii; olei ricini. fl. ⅜i. To be dissolved by the aid of gentle heat; one drop to be instilled into the eye once or twice a day.

Castor oil internally—daily for 10 days in one fluid ounce doses—will be found of considerable value in supraorbital neuritis and other forms of ocular neuralgia.

I am so impressed with the necessity for having this drug properly administered that I furnish the patient with the following explicit instructions:

Directions to the patient for using the castor oil treatment in neuralgia.—Ask your druggist for twenty ounces of the best castor oil to be had in the market. Take two tablespoonfuls of it half an hour after breakfast every morning for ten days.

The first three or four doses will act as a laxative or cathartic but the remainder will probably have no such action. The fact is that the
CASUISTICS

oil is not given for that purpose at all but for the effect of the remedy on the nerves themselves.

Then wait ten days and take another series of ten doses. The total number of doses, as well as the rest of the treatment employed should, of course, be directed by your physician.

There are many ways in which the remedy may be taken to mask its odor and taste. One of the best is to pour it into a wineglass half filled with grape juice, lemon juice, English ale or porter. Drink it without previous shaking, in one draught, if possible. Some people prefer taking it in large, soft capsules about which your druggist will tell you.

Casuistics. The study or narration of histories of individual cases of diseases with a view to throwing light on the general history of the diseases themselves.

Cat, Claude Nicolas le. A member of a family of surgeons, and one of the most skillful and versatile of all physicians of all lands and times. Born at Blérancourt (Oise) Sept. 6, 1700, he studied for a time at Paris, was called to Rouen by the Archbishop, and received the degree of Doctor in Medicine at Rheims in 1732. In 1733 he settled at Rouen for the practice of medicine and surgery. The following year he became Master of Surgery, and Chief Surgeon of the Hôtel-Dieu at Rouen. He soon distinguished himself as a teacher of anatomy and surgery, and, in 1744, founded the Royal Academy of Sciences, Belles-Lettres, and Arts at Rouen.

From 1732 till 1738, le Cat competed for all the prizes offered by the Royal Academy of Surgery at Paris, and (according to Gurlt) was so successful that he was finally requested to compete no longer, in order that other competitors might have some chance to win.

He assisted in the exposure of the famous and infamous English ophthalmologist and quack, John Taylor. In 1762 he was ennobled. In 1768 he died.

Le Cat was a skillful operator in almost every division of surgery. He was also a writer of note on anatomy, physiology, surgery, mathematics, philosophy, and military architecture. He wrote, however, but little on ophthalmology, being distinguished, in this branch, more as a therapeutist and operator than as a writer. However, a book by him entitled, Traité des Sens (nouvelle edit., Amsterdam, 1744) is devoted chiefly (from p. 79 to the close at p. 328) to the physiology of the eye. Also, in the "Journal des Savants" for April, 1755, occurs an article by him on the surgical treatment of lachrymal fistula. In this article he recommends an incision of the lachrymal sac, followed by the introduction into the lachrymal canal of a golden canula.
Articles of less importance on ophthalmologic subjects appear in the *Journal de Médecine* and the *Mercure de France*.

Personally, le Cat was a very peculiar man, nervous and restless, physically, and, mentally, jealous and conceited.—(T. H. S.)

**Catacausis.** (F.) Spontaneous combustion.

**Catacaustic.** See Caustic.

**Catachasme.** (F.) Deep scarification.

**Cataclase.** (F.) Fracture.

**Catacleisis.** (L.) Literally, a locking-up. Occlusion or spastic closure of the eyelids.

**Cataclysm.** (F.) Douche; clyster.

**Catadioptic.** Relating to the ability of certain optical instruments to reflect and refract light at the same time.

**Catadioptrique.** (F.) Referring to a combination of reflection and of refraction.

**Cataglosse.** (F.) Tongue-spatula.

**Catalpa.** *Bean tree. Cigar tree. Candle tree.* The parts of catalpa used in general medicine are the bark and fruit, the latter two-celled pods a foot to eighteen inches long and of the thickness of the little finger. So far as I can learn the fresh juice from the root of this well-known tree is the only part used in ophthalmic therapeutics. Dropped into the eye as a collyrium it is said to be valuable in treating trachoma and other forms of chronic ophthalmia.

**Catalpa bignonioides.** The juice of the root of this tree has been used and recommended as a topical remedy in chronic ophthalmia, trachoma and pannus.

**Catalysotype.** A calotype process in which iodide of potassium is replaced by iodide of iron in the preparation of the paper.

**Catamysis.** (L.) Closure of the eyelids.

**Cataphoresis.** The action by which a substance in solution is made to penetrate the tissues and organs with the aid of galvanism, the positive electrode being applied after having been soaked or bathed in the solution.

This method has been employed by Krückman and others who used it for introducing mercury and other remedies into the system for syphilitic and other diseases of the eye. He found, experimentally, that currents of 1.2 to 1.3 milliamperes could be applied to the eyeball without producing necrosis or any change in the finer tissues of the eye. Of the various salts of mercury, sublamin 1-3,000, and succinate of mercury, 1-4,000, were found to be the least irritating. The method is to be recommended only for rapid and temporary use, a general mercurial treatment being required at the same time. It may be used
in the following syphilitic conditions: 1. In rapidly growing or early appearing nodular processes, e. g., tuberous syphilide and gumma resembling episcleritis. 2. In obstinate inflammation when the body is already oversaturated with mercury. 3. For diagnostic purposes, when the general symptoms have not appeared, and it is important that they should not be masked. 4. For very rapid action. 5. In the presence of mercurial stomatitis.

It is applied by especially constructed electrodes which can be attached to the street current. A current of 0.8 to 1.0 millamperes is employed for 20 or 30 minutes, and the current reversed every two and one-half to three minutes. The treatment may be repeated every other day, and from three to ten treatments are usually sufficient. The author reports 28 successful cases.

D. S. Sager believes (Wood's *Oph. Ther.*, p. 80) after cataphoresis, if the lower canaliculus is split, in washing out the sac. He makes it a point to turn the bent tip upwards, syringing so that the fluid, argyrol or other, regurgitates through the upper canaliculus, or at least so that the surrounding tissues shall be well medicated and cleansed. Where the upper canaliculus is slit open, as advised by Landolt, the procedure is already solved. Then again in trachomatous and chronic granular conditions of the eyelid, he suggests that the cataphoretic treatment on the lids be given a fair trial. He has succeeded with it when radium, X-ray, Finsen, high frequency, etc., have all failed. The method is accomplished by placing the positive end of a copper electrode in a solution of common salt, the negative electrode also in the solution, with no contact of electrodes. When a sufficient amount of copper chloride is deposited upon the positive electrode, after wiping the lid clean with absorbent cotton, or washing off the lid-surfaces, the positive electrode is applied directly to the lid-surface for a few seconds, even to half a minute. Sometimes the lid is cocaine-ized or otherwise rendered insensible (holocaine or eucaine). The reaction is probably considerably less than with copper sulphate stick, this depending upon the individual somewhat.

**Cataphoria.** Also written Kataphoria. This is a tendency of both eyes to assume too low a plane. It is the opposite of anaphoria (q. v.).

Double cataphorisis may be the result of hyper-development of the inferior recti or subnormal development of the superior recti, or it may result from the inferior recti having their attachment too far forward or from the superior recti being attached too far back; or it may be caused by a more powerful impulse sent from the second conjugate innervation center to the inferior recti than is generated by the first conjugate center for the superior recti. In either case the
double cataphoria will be associated with plus cyclophoria. Nervous
tension of the superior recti will counteract both the cataphoria and
the plus cyclophoria; while nervous tension of the inferior obliques
would counteract the cataphoria, but would increase the plus cyclo-
phoria. Hence, in cases like the above, the corrective nerve impulse
must be sent only to the superior recti. The position of the eyes most
favorable for effective action of the superior recti is a depression of
the visual axes below the horizontal plane of the head; hence such
patients will carry their heads high, so as to lessen the nervous tension
of the superior recti. Double cataphoria may be caused by imbalance
of the obliques, the superior being stronger than the inferior, either
because the former are hyper-developed or the latter are subnormally
developed, or because the former are attached nearer the posterior
pole, or because the sixth conjugate innervation is more powerful than
the seventh. In either case the double cataphoria would be associated
with minus cyclophoria. The corrective nerve impulse would be sent
to the inferior obliques, which would counteract both the double cata-
phoria and the minus cyclophoria. The position of the eyes most
favorable for corrective action of the inferior obliques is an elevation
of the visual axes above the extended horizontal plane of the head;
hence such patients would have their faces downcast, for this pose of
the head would help to relieve the nervous tension of the inferior
obliques. Hyperphoria of one eye and cataphoria of the other, inde-
pendent of malformation of the orbits and faulty attachments of the
lateral recti muscles, are always inherent in the vertically-acting mus-
cles, and never innervalional. For convenience of study the right eye
will be considered as hyperphoric and the left eye as cataphoric,
although the reverse is often found. The right hyperphoria is due to
the fact that the superior rectus is too strong for its direct antagonist,
the inferior rectus, or that the inferior oblique is too strong for the
superior oblique; or both of these conditions may unite in the develop-
ment of the hyperphoria. If the superior rectus alone is the cause of
the hyperphoria, it is because this muscle is hyper-developed or that
the inferior rectus of subnormal development or the superior
rectus is attached too near the cornea or that the attach-
ment of the inferior rectus is too far removed from the cornea. The
hyperphoria would be sthenic if the superior rectus is hyper-developed
or is attached too near the cornea; it would be asthenic if the inferior
rectus is subnormally developed or is attached too far away from the
cornea. In either case the hyperphoria would manifest itself in asso-
ciation with minus cyclophoria. If the inferior oblique alone is the
cause of the hyperphoria, it is because of hyper-development of this
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muscle or a subnormal development of the superior oblique; or because the inferior oblique is attached too far behind the equator or the superior oblique is attached too near the equator. The hyperphoria thus caused is sthenic in cases in which the inferior oblique is hyper-developed or is attached too far behind the equator; it is asthenic in those cases in which the superior oblique is subnormally developed or is attached too close to the equator. In either condition the hyperphoria would show itself in association with plus cyclophoria. When the hyperphoria manifests itself unassociated with either minus or plus cyclophoria, it becomes evident that both the superior rectus and inferior oblique enter into the causation. The left eye under test will show cataphoria, usually the same in quantity as the hyperphoria of the right eye. The cataphoria is caused by either a too powerful inferior rectus or a too powerful superior oblique; or both of these muscles may unite in the production of the cataphoria. In a case in which the inferior rectus alone is the causative agent, it is either hyper-developed or has its attachment too close to the cornea; or its direct antagonist, the superior rectus, is subnormally developed or is attached too far away from the cornea. The cataphoria would be sthenic if the inferior rectus is either hyper-developed or is attached too near the cornea; it would be asthenic if the superior rectus is under-developed or has its attachment too far removed from the cornea. In either case the cataphoria would be associated with a plus cyclophoria. In a case in which the superior oblique is the sole cause of the cataphoria, it is either because it is hyper-developed or because it has its attachment too near the posterior pole; or because its direct antagonist, the inferior oblique, is subnormally developed or is attached too near the equator. The resulting cataphoria is sthenic in those cases in which the superior oblique is either hyper-developed or is attached too near the posterior pole; it is asthenic when the inferior oblique is under-developed or is attached too near the equator. In either case the cataphoria would be associated with a minus cyclophoria. Cataphoria will be unassociated with either plus or minus cyclophoria only when both the inferior rectus and superior oblique are united in the causation. Nervous tension of the inferior rectus counteracts the right hyperphoria, if caused by the superior rectus; while nervous tension of the superior rectus will counteract the left cataphoria, if caused by the inferior rectus. Not only will the right hyperphoria and left cataphoria be thus neutralized, but the minus cyclophoria of the right and plus cyclophoria of the left would be suppressed by the nervous tension of the same muscles. The corrective impulse would come not from one conjugate center, as in
double hyperphoria and double cataphoria, but from two separate centers. Nervous tension of the superior oblique counteracts the right hyperphoria which is caused by the inferior oblique, while nervous tension of the inferior oblique will counteract the left cataphoria that is caused by the superior oblique. The plus cyclophoria of the right eye and the minus cyclophoria of the left eye will be suppressed by the nervous tension of the same muscles that counteract the hyperphoria and cataphoria.

Hyperphoria and cataphoria, like esophoria, are susceptible to exercise only by means of prisms. Given a case of left hyperphoria (right cataphoria) of not more than $1\frac{1}{2}^\circ$, there is a possibility of developing vertical orthophoria by means of rhythmic exercise. The muscle on the left side to be developed is the inferior rectus, and that on the right side is the superior rectus. The prisms used should vary from $1^\circ$ to $2^\circ$; most cases will not require a stronger than a $1^\circ$ prism. The base of the left prism must be up; that of the right prism down. As in exophoria and esophoria, the patient should exercise from two to ten minutes at a time, and two or more times a day. The object looked at should be twenty feet distant, and it should be seen through the prisms three seconds, then without the prisms three seconds, and so on throughout each sitting. Thus contraction and relaxation of the weak left inferior rectus and weak right superior rectus are effected in rhythmic order. If the hyperphoria is on the right side (left cataphoria), the base of the right prism must be up and that of the left prism must be down, when exercising. In every form of heterophoria the apex of the prism must point in the direction of the muscle to be developed by it.—(G. C. S.)

Where simple treatment, such as has just been indicated, proves ineffective, operative interference must be employed. See Muscles, Ocular.

Cataract. Cataract in general. Opacity of the crystalline lens. The nomenclature of cataract, ancient, mediaeval and modern, is, in all the European languages, a very extensive one. The names and synonyms of many of the varieties of cataract appeared at an early date in Greek, Arabic and in Latin, after which (with their imperfections still apparent) they were either adopted in their original form by British authors or were translated, more or less literally, into English. A percentage of these early terms were based upon, or derived from, erroneous theories of the origin and other relations of true cataract. In fact until the beginning of the eighteenth century all opacities (apparent or real) of the optic media were included under the term "cataract."
A few of the terms used to indicate varieties of cataract are quite fanciful, while still others indicate conditions that have nothing whatever, either directly or indirectly, to do with a loss of transparency in the lens or its capsule. Even the word *cataract* itself (derived from the Greek *kata*, down, and *arassein*, to fall) has a misleading etymology, based upon an ancient and mistaken pathology. The Greek *kataraktes* is probably a translation of the still older Arabic word for a spot in the pupil, which meant a "waterfall," i.e., "water entering the eye." This meaning of the word is further shown by a mediæval synonym for cataract, *aqua descendens in oculo*. Obviously incorrect and misleading, also, are such terms as *fibroid cataract* (opacity not in

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**Diagram:**

Section of the Eyeball to Show the Crystalline Lens System and Its Relations to Cataract; a. Cornea; b. Iris; c. Lens; d. Zonula of Zinn; f. Ciliary Body; g. Canal of Schlemm; m. Retina; j. Choroid; k. Sclera; H. C. Hyaloid Canal; l. Maculat; o. Optic Nerve; w. Anterior Capsule.
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the lens), _green cataract_ (a mediæval term for glaucoma), _grumous cataract_, _albuminose cataract_, _dry cataract_ (cataracta arida), _hyaloid cataract_, _choridal cataract_, _hemorrhagic cataract_, and other examples that will occur to the reader. Because of their obsolete character and for other reasons a considerable proportion of cataract nomenclature has ceased to be employed in the literature of modern ophthalmology. On the other hand, the student of medical history and of early ophthalmic literature will find the minor headings following this rubric of some assistance in his researches.

**Classification.** As proposed by Dor, all cataracts may be divided into three general divisions, i. e., congenital, traumatic and acquired. Beard (Ophthalmic Diagnosis, p. 150) gives a most useful classification, as to age, cause, etc. It is as follows:

1. According to the age at which it appears: Congenital, juvenile, adult, senile.

2. According to the cause: Spontaneous, traumatic, symptomatic, albuminuric, arterio-sclerotic, chemic, thermic, heat, cold, electric, diabetic, glaucomatous, malarial, phosphaturic, naphthalinic, spasmodic, ergotinic, ciliary cramp, tetanic, thyroïdismic, uveitic.

3. According to consistency: Liquid, soft, semi-hard, hard, ossific, calcific.

4. According to color: White, gray, greenish, amber, black, blue.

5. According to extent: Total, partial, nuclear, perinuclear, cortical, capsular.

6. According to the seat and disposition of the opacities: Central, nuclear, perinuclear, anterior cortical, posterior cortical, anterior polar, posterior polar, equatorial, disseminated, punctate, zonular.

7. According to the presence or absence of complications: Simple, complicated.

8. According to the period of development: Incipient or commencing, immature, mature, hyper-mature or regressive.

**Etiology.** Although cataract is generally considered to be (as it is in the majority of instances) a senile degeneration, yet almost all pathologic states that affect the nutrition of the eyeball may produce it. In that sense it is generally a secondary disease, and we know that nephritie alterations, diabetes, exposure to great heat, various poisons, arterio-sclerosis, ergotism, auto-intoxication, eye-strain, injury to the lens or surrounding parts, heredity, etc., are regarded as exciting causes of it.

**Symptoms.** There are no constant symptoms of cataract in general—especially in the early stages. Sight will not be much affected until the nucleus (in the area of the pupil) is involved. The patient then
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complains that images are distorted or multiplied (polyopia), or that there is a cloud, or floating body, before the eyes. During this period (incipient stage) the sectors or streaks of opacity, when viewed through the dilated pupil, appear grayish by oblique illumination, and black with the reflected light of the ophthalmoscope, the red reflex of the fundus showing through the clear portion of the lens. The fogginess increases very slowly until finally the visual acuity is reduced to the counting of fingers. In the early stages, before the opacity has completely invaded the periphery, vision is better in a dim light, because that moderate dilation of the pupil that occurs in a partially illuminated room, for example, permits the patient to see through some, as yet unaffected, peripheral parts of his lens. Occasionally a person blind in a bright light is able to read if he shades his eyes with his hand.

As the cataract advances the lens swells, becomes more convex, and the patient may be able to discard his reading glasses entirely (although the affected eye always sees worse in the distance), owing to the increased refractive power of the crystalline. He then develops the condition commonly known as "second sight."

When the cataract is ripe or mature the whole lens is opaque, and it can safely be removed from the capsule by operation without leaving any soft lens matter behind. Such a cataract should have a mother-of-pearl appearance by oblique illumination, and while the examination is being made (the pupil undilated) the iris should not cast a shadow on the lens surface. Shadows cast by the iris on the lens indicate that the anterior layers of the crystalline are still immature and transparent; the shadow being thrown on the opaque nucleus. There should also be no glittering sectors or facets brought to view as the patient is told to look in different directions during the examination.

Herbert (Cataract Extraction, p. 3), whose immense experience gives
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him a right to speak upon this subject, believes that it is most con-
venient from the clinical standpoint to divide the stages of development
of cataract into: (1) incipient, (2) unripe, (3) ripe or mature, and
(4) over-ripe. It may be roughly stated that in the incipient stage they
often require a dilated pupil or dark-room examination for their certain
detection—for their distinction, for instance, from simple senile sele-
rosis. Unripe cataracts are at once recognizable with the naked eye,
but there is still some transparent or semi-transparent cortical matter
remaining. In the ripe stage the whole lens looks opaque. Over-ripe-
ness is shown by certain secondary changes, and by the formation of
capsular opacities, recognizable by being whiter than any superficial
opacity of lens substance. The term "ripeness," indicating complete
opacity of the lens, implies also that the whole lens can be removed from
its capsule easily, "like a ripe fruit out of its shell," and that the cat-
aract is therefore ready for operation. The term is still retained to
denote the fullness of the cataractous change, though it has long been
recognized that many lenses are fit for removal while still preserving
much of their transparency. According to Hirschberg, this style of
indicating the stage of the cataractous process originated before the
operation of extraction was known—at a time, therefore, when lenses
were merely depressed. In the typical unripe lens of this class the
anterior chamber is frequently shallowed, owing to swelling of the
lens, and possibly also to an alteration in the shape of the lens. It may
become more nearly spherical by distension of the capsule and soften-
ing of the contents. The rounded apices of opaque, bluish-white, gli-
stening sectors of varied breadth are seen within the normal pupil,
separated by a little clear cortex. Since the opacity affects the super-
ficial fibres of the lens, the iris throws no shadow. There are other
cases less typical, in which the anterior chamber is less often shallow,
and the soft cortical matter is uniformly clouded and dull. The ripe
stage of this form of cataract appears to be a short one, as it is not
very frequently seen. In the over-ripe stage there is definite liques-
faction, at first of the superficial cortex only, but soon involving the deeper
cortex, and eating away more or less of the nucleus also. Thus we get
the Morgagnian cataract, with nucleus floating free in milky fluid. The
nucleus may be small, transparent, and amber-coloured, or larger, dark,
and opaque. The capsule is either quite transparent, or there is faint
diffuse opacity only, or this with numerous small brilliantly white dots.
The opacity may be limited to the anterior capsule or may extend more
or less over the posterior portion also. The anterior chamber may still
be shallow, and actual measurements taken in Bombay show that some
Morgagnian lenses are above the normal in volume. But absorption of
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the milky fluid tends to gradually progress until nothing remains but the nucleus in the collapsed capsule. Very rarely the nucleus disappears entirely in adults beyond middle age, while the sac is still distended with fluid. The fluid then has a creamy tint. In adults some of the very over-ripe lenses have still quite transparent capsules, others opaque. Some become tremulous, others do not. Those without tremor are not clinically recognizable through the undilated pupil. The capsule having retracted away from the iris, a narrow space is left through which a shadow may be cast by the iris. The nature of the cataract is sometimes not known till an iridectomy had been made during operation, revealing a dark space above the shrunken nucleus.

Pathology and morbid anatomy. The alterations in the lens proper as well as in its envelopes are mostly degenerative changes. Although some writers have spoken of a "phakitis," yet there is no direct vascular supply to the crystalline and no mesoblastic tissue; hence it is hardly proper to think of inflammatory alterations. The early changes are not so much in the lenticular fibres as in the interfibrillar spaces; actual fissures occur (from shrinking and separation of the fibres) the vacuoles being filled with fluid. These interspaces first appear at the equator, where the nutrition of the lens is at its best. The fluid thus exuded generally collects into rounded drops. As age advances the lenticular fibrils undergo sclerotic alterations, one cause of which is the hard lens nucleus seen in most cataractous lenses. This perfectly normal phenomenon may, as Parsons (Pathology of the Eye, p. 394) points out, "happen in the cortical fibres under pathological conditions. The earliest change is usually swelling, though this may be preceded by a granular cloudiness, due to fatty degeneration. Some fibres become spindle-shaped, others club-shaped, others assume grotesque forms. Round globules may be seen, and if these contain a nucleus they much resemble the vesicular cells. Vacuoles are seen, which run together and form cystic spaces, filled with fluid. Finally, the fibres break up into globules, much resembling Morgagnian globules; they are sometimes badly termed 'myelin' droplets. These are round bodies, which stain faintly with eosin, etc.; they are often polygonal through mutual pressure. When they lie in rows in a space, the latter often shows a double contour, so that the whole resembles a row of vegetable cells, such as are seen in algae. The Morgagnian globules do not stain with haematoxylin, and they are very resistant to reagents. Just as the nuclei degenerate under normal circumstances in the formation of the lens nucleus, so they undergo similar changes pathologically. They become long and narrow, and vacuoles appear, often forming a clear zone around them. The chromatin becomes arranged into transverse
bands, granules, etc., which stain very deeply with nuclear stains. When the nucleus is no longer to be seen, a clear spot frequently marks its former site for a considerable period. In more advanced cases globules which stain deeply with hæmatoxylin may be found. These are of two kinds: some do not dissolve in mineral acids, so that they resemble hyaline deposits elsewhere. Others dissolve under these conditions, giving off gas, and showing other reactions which demon-

Cataractous Lens, from a Shrinking Globe. (After Parsons.)

strate their calcareous nature. In the latter stages, too, the fissures and spaces increase in size and vary in shape. They contain various substances: clear fluid, albuminous coagula, débris, Morgagnian globules, droplets of fat, fatty crystals, cholesterin (Lang, Gunn), crystalline deposits (Axenfeld and Krukenberg, Baas, Besserer; Stock), etc. Albuminous coagula may resemble in every respect the globules formed by the breaking up of lens fibres; or they may appear as granular coagula, such as are found in other parts. The granules may be large, or they may be so small that the masses look homogeneous until they are examined with very high powers. Concentric lamination is rare. These coagula resemble Morgagnian globules in their resistance to reagents, but differ from them in staining deeply with hæmatoxylin. Carmin stains them yellowish brown, benzoazurin blue (Heinzel), carbol fuchsin and iodine green (Russell's stain) deep blue; Weigert's
elastie tissue stain does not stain them. The staining is often diffuse and irregular. In some degenerated lenses peculiar coiled-up fibres are seen, staining deeply red with van Gieson (Werncke). Fibrin-like masses have also been observed (Zia).

The epithelium of the lens in cataractous degeneration, apart from the changes incident to old age, shows fewer nuclei than normal. It may, also, entirely disappear—a condition that von Hippel believes to be helpful as it permits the aqueous humor to penetrate the lens substance by way of the vacuoles and thus aid the absorption of the fibres.

In certain forms of cataract—especially in anterior capsular cataract (q. v.)—marked changes occur in the anterior epithelium. These alterations appear, also, after trituration of the lens in other pathological states. Another result of these changes is the extension of the capsular epithelium beyond the equator so that both capsules show an epithelial lining—a condition attributed by Treacher Collins to diminished tension of the capsule brought about by shrinkage and degeneration of the cataractous lens fibres. Parsons (loco cit., p. 398) believes that the formation of vesicular cells (Blasenzellen or Bläschenzellen of Wedl) is a still commoner phenomenon. These may be formed "from the lens fibres, but they originate for the most part in epithelial cells. Thus they may be found anteriorly when the cubical cells have been separated from the capsule, or more often in new cells lining the posterior capsule. According to Becker they are due to 'hydropic' degeneration of the cells; this is not the true explanation, which is rather to be sought in the inherent tendency of the cells to produce fibres. The cells are large and swollen, spherical or polygonal from pressure; they contain each a faintly staining nucleus, which later degenerates and disappears, though its former site may be recognisable as a clearer spot. The nuclei never show mitotic figures, nor have these been seen in cells lining the posterior capsule in man, though they have been observed in rabbits (van Genus)."

Diagnosis. As Beard (Ophthalmic Semiology, p. 188) properly says: "To the well-informed and experienced ophthalmologist the recognition of cataract is not difficult, but to the young or the untutored, and to practitioners in other branches of medicine, the diagnosis is not always as easy. Among the things most often mistaken for cataract are central opacities of the cornea, the products of exudations upon the anterior capsule, the lens-reflex in glaucoma, and whitish reflexes in the vitreous, such as glioma, pseudo-glioma and total detachment of the retina. Then, too, amaurosis from optic atrophy and hemorrhage in the vitreous have sometimes been confounded with black cataract. Central opacity of the cornea is differentiated by its position
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at the very anterior pole of the eyeball, and by the fact that the pupil and the iris can usually be seen behind it. Inflammatory exudations from the iris and their products, known as false cataract, are distinguished by reason of their situation upon the anterior capsule instead of beneath it. They often are of a yellowish tint, and overlie the pupillary border, and encroach upon the lesser circle, or sphincter portion, of the iris. The greenish reflex from the pupil ["green" cataract] in glaucoma is attended by sluggishness or absence of the light-reflex, or, in the more advanced and in the inflammatory forms, by dilatation of and immobility of the pupil, pericorneal and conjunctival injection, and by hypertension of the globe. In glioma, pseudoglioma and total detachment of the retina, with a transparent crystalline, the opacity may be distinguished by its great depth within the eye, by the presence of all three images of Purkinje, and often by blood-vessels overlying it. In amaurosis from optic atrophy the fundus lights up brightly to rays thrown through the pupil by the ophthalmoscopic mirror. In black cataract the third image of Purkinje is lacking, while in hemorrhage in the vitreous it is present. Moreover, in black cataract strong focal illumination will reveal a brown reflex coming well up to the pupil."

Prognosis. As a general proposition, cataract having once affected the eye goes on until all the fibres of the lens are involved. There are, however, many exceptions to this rule. When the degenerative change is due to a curable condition, either local or general, even an improvement may occur—not to speak of spontaneous cure. Brettauer and others have reported examples of spontaneous absorption of senile cataract, followed by good vision. Pyle has classified these cases of improvement or cure, as follows: (1) Cases of absorption after spontaneous rupture of the anterior or posterior capsule. (2) Cases of spontaneous dislocation of the cataractous lens. (3) Cases of intracapsular resorption of the opaque cortex and sinking of the nucleus below the axis of vision, after degenerative changes in Morgagnian cataract, without rupture of the capsule or dislocation of the lens. (4) Cases of complete spontaneous resorption of both nucleus and cortex without reported history of ruptured capsule, dislocation, or degeneration of the Morgagnian type. (5) Cases of spontaneous disappearance of incipient cataract without degenerative changes or marked difference in the refraction.

The so-called Thompsonian cataract is one that affects mostly the periphery and the lower-inner quadrant of the lens, and then becomes stationary; indeed, different forms of stationary cataract have been
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recorded in connection with almost all the varieties of lenticular opacity.

The treatment of cataract in general naturally divides itself into constitutional therapy and local applications. The general health, especially in its hygienic relations, should be carefully studied. The diet, method of living and other conditions are of importance. Very often a correction of the frequently changing refractive error will, from time to time, improve the sight and check the advance of the disease. Mydriatics in the early stages sometimes improve vision—especially when the changes are central. The non-operative treatment of cataract has occupied the attention of ophthalmologists from the earliest times, both before and since its pathology was understood and a precise knowledge of the differences existing in its varieties has been acquired. In some cases of genuine cataract the opacity has disappeared without treatment, and there can be no doubt but that diabetic striæ not uncommonly disappear or the occasional cloudiness of the lens due to exudates between the fibrillæ may undergo absorption, but apart from these considerations the application of drugs produces little or no effect. For a number of years past the claims of the tincture of cineraria maritima have been urged in an irregular sort of way, but although a number of observers, including the writer, have given it a fair trial it has not been found to be of any value. Massage with various ointments, the subconjunctival use of potassium iodide, dionin and other local treatment have been resorted to, but with little or no effect. The majority of cases of cataract are progressive and when useful vision is lost a surgical operation is needed.

H. W. Woodruff believes in the internal use of the syrup of hydriodic acid or iodonucleoid for long periods of time with short intervals of rest. He says: "I did this at first without any faith in its influence, but more to be doing something. Now, however, since the subject has of late been discussed by various French and German ophthalmologists in connection with the local use of iodide of potassium, I have paid more attention to these cases and believe that the internal administration of this drug not only has more effect in retarding the progress of senile cataract, but even to some degree causes a diminution in the density of the opaque striæ in the lens. I have had no cases of incipient cataract in which I have been able to follow this treatment for a long period of time in which the vision has grown worse."

The non-operative treatment of cataract in its early stage is of greater interest to us than the conduct of cases of complete or mature cataract, inasmuch as the latter is entirely operative. All forms of
incipient cataract due to general conditions should be treated in conjunction with the general health. Every source of eye-strain should be removed, refractive errors, muscular anomalies and other organic lesions of the eyes should be strictly looked after. If the opacity is confined to the pupillary area dilatation of the pupil with euphthalmine or weak atropine drops, and the prescription of amber tinted or smoke tinted lenses, will increase the visual power. When the cataractous striae are chiefly in the periphery of the lens, the annoying diffused light may be shut out by the use of miotics, say, a weak solution of pilocarpin (one-half of one per cent).

A. J. Erwin applies iodine by means of the galvanic current for the cure of incipient cataract. He applies it over the eyelids for five minutes once a day for at least one month, using two to five dry cells. He prefers the liquor iodi comp., the latter no stronger than is sufficient to barely redden the skin. Internally he uses an iron tonic.

In incipient senile cataract Pflugk employs daily or tri-weekly subconjunctival injections of potassium iodide in the following formula: Potassium iodide, 0.2; sodium chloride, 0.2; distilled water, 10.0; to this is added 1 drop of a 1 per cent. cocain solution to each gramme of potassium iodide solution, and of this mixture one-half to one syRINGeful is injected at each sitting. In the intervals between the injections, dionin powder is insufflated into the conjunctival sac. After employing this treatment for four weeks, a rest of two weeks is taken, during which time only a solution of dionin is instilled. The result of this method of treatment showed improvement in the power of vision and absorption of the opaque striae of the lens. Pflugk (in the Feb., 1908, number of Graefe's Archiv.), says that a résumé of the published histories of incipient cataract in man treated by iodides, shows that of the 239 eyes thus treated a great improvement in vision occurred in the majority. The length of observations in which the opacity was controlled in the instances reported by Badal was five years, and in the 30 cases of the author, it was of varying length—as long as four years. As the entire harmlessness of the treatment of incipient cataract by the potassium iodide method is well known, it is urged in most cases. See also Cataract, Incipient.

A review of the cases treated by the iodide method shows that a much greater improvement is to be obtained in the visual power by subconjunctival injections than by instillations and baths, solutions of equal strength being employed.

By the use of the author's method of anaesthetizing the conjunctiva and the employment of acoin as an addition to the fluid to be injected,
as well as its use after the injection, it is possible to render the subconjunctival injection of potassium iodide completely painless.

Badal employs as a collyrium a solution of potassium iodide (0.25 to 10.0) and as an eye bath (7.5 to 300.00), the latter in a gradually increasing concentration. While Badal has abandoned the subconjunctival method, the author has found it by far the most efficacious and painless if employed as above directed in a 1 per cent. solution.

A resumé of 21 cases is reported by Verderau in which 2½ per cent. potassium iodid was used hypodermatically for the absorption of cataract. There was a marked improvement in every case treated, while in one of the cases there was complete disappearance of the lenticular opacity. Pons y Marquis Palama reports a failure in three instances treated by this method. Angieras reports two cases in which there was a complete disappearance of the lens, following an inflammation of the iris.

A. M. MacWhinnie reports one case in which there was a complete disappearance of the lens striæ following 20 intramuscular injections of benzoate of mercury, 1 cgm. daily. Cuts are given in which the clearing up of the lenticular striæ is shown. He believes that, barring traumatic cataract, sanitary surroundings and nutritional value are potent factors in the formation of lenticular opacity. The case is quoted to show that a lenticular opacity can be absorbed in its early stages in some persons, as there was rapid and complete disappearance of all evidences of the lenticular opacity, with return to normal vision.

LeRoy (Am. Jour. of Ophthalmology, May, 1909) found that "ammonia is the active primary cause or exciting factor in perhaps all diseased conditions" and that "if we were able to control the output of ammonia within our bodies and thus prevent this substance from accumulating in the secretions beyond the normal amount, we might prevent many diseased conditions and thus escape many of the dangers of ill-health and of premature death."

The writer has studied the solvent power of the thiocyanates and found that solutions of 1:40,000 to 1:100,000 of the thiocyanate of potassium would dissolve about four per cent. of the carbonate of calcium and magnesium. He observed that when the system is deprived of its usual supply of the earthy salts, it endeavors to make up the deficiency through the action of certain phagocytic cells which rob the more solid parts of the system, thus producing disease.

With these facts in mind, Le Roy entered upon the study of those diseased conditions wherein the salts of calcium, magnesium and
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silicon are most concerned, namely, arteriosclerosis, chronic syphilis and certain general conditions found in cases of senility. Employing the thiocyanates in a number of these cases and noticing the gradual fading away of the arcus senilus in many, he determined to try this form of treatment in cases of simple cataract. Sodium thiocyanate was given in one grain doses, well diluted with water, after each meal; later, the remedy was used hypodermically, combined with small doses of pilocarpin.

The thiocyanates must, to be effective, appear in the saliva somewhat in excess of the normal content before salutary results are obtained, yet the amount must be well guarded, for a quantity that is in excess of normal will cause untoward symptoms and perhaps death, for the thiocyanates are very active poisons when administered carelessly.

The first case reported had chalky cataracts for 36 years, the last ten being spent in total blindness. After ten weeks of treatment the lenses had lost their chalky whiteness and were even bluish, fading toward a normal color. The patient could then see "tree-tops."

The second case improved from total blindness, which had lasted two years, to "distinguishing between a book and a hat at five feet."

The third case had cataracts in both eyes; one-quarter of a grain of the remedy was given after each meal; after ten weeks there were practically no evidences of cataract.

In conclusion, he asks his readers, before rushing into print with attacks upon him, to try this treatment in cataractous cases, being careful not to overdo it; to examine the saliva daily; to use the sphygmomanometer and study the arterial pressure (since this must be kept as nearly normal as possible); not to rush cases, since there is danger in this, and not to give large doses of the remedy.

When in spite of all treatment the eyesight can no longer be considered useful some operative method is the only procedure that holds out any hope of visual improvement.

Statistics of extraction operations. As before stated the results of cataract extraction vary so much in each instance with the peculiarities of methods, selection of cases, preliminary and after-treatment, etc., that it is not of great value to compare statistics, especially of the degree of visual acuity acquired several months after removal of the obstruction to vision. Numerous statistical tables have been published by Knapp and many other experienced operators. As a sample, however, of an average experience, in the eye clinic of the University of Berlin, 1,284 cataract extractions with iridectomy were performed in June, 1900, to October, 1905, out of which seventy-seven
CATARACT

showed complications before operation. No attention was paid to maturity of the cataract. Normal vision of the second eye was no contraindication, but the decision as to operation was left to the patient.

The preparation of the eye, as set forth by Köllner (Zeitschr. f. Augenheilk., p. 506, 1906), consisted of cleansing with soap, irrigation with sterile salt solution, instillation of 10 per cent. cocain solution. The section comprised about one-third of the corneal circumference, 3/4 to 1 mm. distant from it in the sclera, and a conjunctival flap of 4 mm. length is formed.

In one case the lens was dislocated backward and upward and could not be removed with loop. It remained fixed at that place, V. = 1/4. In a case of cataracta acreta, all attempts at extraction under profuse loss of vitreous were in vain.

A binocle is applied which is changed after twenty-four hours, replaced by a monocle for the next forty-eight hours, and this is renewed every twelve hours. The patients do not alter their mode of living. Hyphema during convalescence was mostly traumatic. In diabetes and anomalies of the renal functions recovery was frequently disturbed by iritis and cyclitis. Diffuse opacities of the vitreous occurred quite often, but as a rule were more or less absorbed. Infection of the wound was observed in seven cases. It set in on the 3d, in one case on the 2d day. A number of patients complained of erythropia, one of kyanopia.

In the clinic 5 per cent., in private practice 10 per cent., secondary operations were performed. The correcting glasses were prescribed after four weeks.

Weber’s loop was used in thirty-eight cases. In the majority opacities of the vitreous and cortical matter remained.

Of 116 cases which obtained full vision after correction, in twenty-seven, cylinders were required, the least refracting meridian of the cornea coinciding with the axis of the coloboma of the iris. It could not be exactly determined how long the traumatic astigmatism remained constant. This was frequently observed after four weeks. Therefore, ordering astigmatic glasses was postponed longer than four weeks after the operation. See Cataract operations, Astigmatism following.

As to complications before operation, the results of extraction after former inflammations of the uvea were not favorable, as, e. g., cases of cyclitis showed severe relapses after operation, detachment of the retina became more complete. Vision in chronic glaucoma remained essentially the same. The course of operation in traumatic cataract
always was smooth, except in one case, in which loss of vitreous occurred. Köllner emphasizes the necessity of giving due considera-
tion in cataract patients to general diseases and their relations to
wound-healing and its complications.

In addition to these general observations regarding cataract purely
as a lenticular opacity, the different varieties of the disease will
be further considered under separate headings. See, in particular,
Cataract, Senile.

Cataracta accreta. Cyclicit cataract. Adherent cataract. Since
the lens system derives its nourishment from the ciliary body, it is
not to be wondered at that a prolonged inflammation of this body
(with subsequent changes in the vitreous humor) should be followed
by alterations in the lens. In consequence of a chronic iridocyclitic
inflammation, posterior synechiae and total cataract may develop—
hence adherent cataract, or cataracta accreta. Through process of
shrinking of the products of inflammation, which shuts in the lens
behind and at the equatorial region, there may arise a severance of
continuity in the capsule and a migration of leucocytes into the cap-
sular sac. Only in this sense may one properly speak of a phakitis,
since the lens is quite without blood vessels and cannot present the
picture of an inflammation.

Cataracta acquisita. (L.) A cataract which comes on during extra-
uterine life, as distinguished from a congenital cataract.

Cataracta adhaerens. (L.) Adherent cataract.

Cataracta adnata. (L.) A congenital cataract.

Cataracta adventitia. (L.) An acquired cataract.

Cataracta equatorialis. (L.) Peripheral cataract, i.e., one affecting
the lens fibres or capsule outside the papillary area.

Cataracta albuminosa. (L.) Obsolete. An accidental membrane
behind the iris.

Cataracta arborescens. (L.) Pigmented cataract.

Cataracta argentea. (L.) Cholesterine cataract.

Cataracta arida siliquata. (L.) Arido-siliquose cataract. Adam
Schmidt gave this name to soft, shrunken hypermature, generally
congenital or adolescent cataracts with wrinkled capsules because of
their fancied resemblance to a dry pea-pod.

Cataracta axialis. (L.) Nuclear cataract.

Cataracta brunescens. (L.) Black cataract.

Cataracta bursata. (L.) Bursal or capsulo-lenticular cataract.
Purse-like cataract.

Cataracta cœrulea. (L.) A cortical cataract that presents a number
of small dots or streaks.

Cataracta calcarea. Cataract gypsea. Calcareous lens. Almost any
form of hypermature cataract may undergo further degeneration. This is especially the case in complicated cataract when the lens mass may shrink, after conversion into a chalky or calcified concretion containing lime salts, cholesterol crystals and other débris. Calcareous lens generally takes on a peculiar uniform color which varies from whitish-yellow to chalk-white—a coloration that generally helps the diagnosis.

**Cataracta capsularis.** (L.) Capsular cataract.

**Cataracta capsularis anterior.** (L.) Anterior polar cataract.

**Cataracta capsularis lenticularis arida siliquata.** (L.) Arido-siliquose cataract, or one presenting the appearance of a wrinkled or pod-like surface.

**Cataracta capsularis lenticularis bursata.** (L.) Bursal or capsulolenticular cataract.

**Cataracta capsularis lenticularis cum zona.** (L.) Barred cataract.

**Cataracta capsularis lenticularis pyramidata.** (L.) Pyramidal cataract.

**Cataracta capsularis lenticularis trabecularis.** (L.) Barred cataract.

**Cataracta capsularis perfecta.** (L.) A variety in which the entire capsule is opaque.

**Cataracta capsularis posterior.** (L.) Posterior polar cataract.

**Cataracta capsularis punctata.** (L.) Punctate (capsular) cataract.

**Cataracta capsulo-lenticularis.** (L.) Capsulo-lenticular cataract.

**Cataracta capsulo-lenticularis anterior.** (L.) Anterior (central) capsulo-lenticular cataract.

**Cataracta caseosa.** (L.) Cheesy cataract.

**Cataracta centralis.** (L.) Nuclear or central cataract.

**Cataracta centralis capsularis anterior.** (L.) Anterior polar cataract.

**Cataracta centralis congenita.** (L.) Congenital central cataract.

**Cataracta centralis lentis.** (L.) Nuclear cataract.

**Cataracta centralis punctata.** (L.) Anterior polar, or central punctate, cataract.

**Cataracta cholesterinica.** (L.) An over-ripe, degenerated cataract containing cholesterol crystals that give it a silver-like lustre.

**Cataracta choroidealis.** (L.) Choroidal cataract. (Obsolete.) A circle or patch of dark pigment on the anterior capsule of the lens, caused by *posterior synechia* (q. v.) or adhesion of the margin of the iris to the capsule during iritis. The early ophthalmologists supposed this pigment deposit to be a prolongation of the choroid upon the lens.

**Cataracta completa.** (L.) Mature or fully ripe cataract.

**Cataracta complicata.** (L. and It.) Complicated cataract.

**Cataracta confirmata.** (L.) Ripe or mature cataract.
CATARACTA CONGENITA

Cataracta congenita. (L.) Congenital cataract.
Cataracta consecutiva. (L.) Secondary cataract.
Cataracta corticalis. (L.) Cortical cataract.
Cataracta corticalis anterior et posterior. (L.) Anterior and posterior cortical cataract.
Cataract, Acquired. In opposition to congenital cataract, the acquired cataract is one incident to those conditions that produce it after birth.
Cataract, Acquired anterior central capsular. See Cataract, Anterior capsular.
Cataracta cruenta. (L.) GRUMOUS CATARACT. An obsolete name for an opacity due to hemorrhage into the cornea, anterior chamber or vitreous. See Cataract, Grumous.
Cataracta crystallina. (L.) Crystalline (cholesterine) cataract.
Cataracta crystallino-capsularis. (L.) Capsulo-lenticular cataract.
Cataracta cum bursa ichorem continent. (L.) Bursal or cystic capsulo-lenticular cataract, with putrid or fetid contents.
Cataracta cystica. (L.) Cystic cataract; generally congenital but sometimes Morgagnian.
Cataracta dehiscens. (L.) Dehiscent cataract. An obsolete term used to describe a soft cataract in which there are gaps or spaces between the opacities.
Cataracta dendritica. (L.) Pigmented cataract.
Cataracta diabetica. (L.) Diabetic cataract.
Cataracta dimidiata. (L.) A form of cataract in which one-half of the capsule is opaque, or an over-ripe cataract in which the opacity appears to be divided into two equal or unequal parts.
Cataracta elastica. (L.) Tremulous cataract.
Cataracta ergotica. (L.) A soft cataract, of slow growth, supposed to be due to ergotism.
Cataracta fenestrata. (L.) A soft cataract in which the opacity is not uniform or homogeneous, but exhibits patches or islets of clear lens matter.
Cataracta fenêtrée. (F.) Cataracta fenestrata. (q. v.)
Cataracta fibrosa. (L.) (Obsolete.) Fibroid or over-ripe and hardened cataract.
Cataracta fibroso-calcarea. (L.) A form of hypermature-congenital, Morgagnian (q. v.) or other over-ripe cataract in which a layer of connective tissue has formed on the inner surface of the capsule, enclosing a fatty or chalky pulp with stony concretions or a sclerosed nucleus.
Cataracta fluida cum nucleo. (L.) The advanced stage of Morgagnian cataract (q. v.), with a hard nucleus.

Cataracta fluido-dura. (L.) The advanced stage of Morgagnian cataract.

Cataract, After-. See After-cataract.

Cataracta fusiformis. (L.) Fusiform cataract.

Cataracta gelatinosa. (L.) Soft cataract.

Cataracta glauca. (L.) Cataract or appearance of ("green") cataract with glaucoma. See Glaucoma.

Cataracta glaucomatosa. (L.) Glaucomatous cataract.

Cataracta gruminosa. (L.) Grumous cataract. An obsolete term intended to indicate a false cataract resulting from corneal hemorrhage or bleeding into the anterior chamber or vitreous.


Cataracta hæmorragica. (L.) Grumous or hemorrhagic cataract (q.v.).

Cataracta hyaloidea. (L.) Hyaloid cataract. This obsolete name is given to a false cataract which is presumed to be due to an opacity in the anterior portion of the vitreous body.

Cataracta hypermatura. (L.) Over-ripe cataract.

Cataracta ichorem tenens. (L.) An obsolete term for a variety of degenerated fluid cataract (generally congenital) supposed to contain pus. See Cataract, Cystic.

Cataracta immatura. (L.) Immature cataract.

Cataracta incipiens. (L.) Incipient cataract.

Cataracta interstitialis. (L.) Diffuse lenticular cataract.

Cataracta inveterata. (L.) Mature cataract.

Cataractajuvenum. (L.) Juvenile cataract.

Cataracta lactea. (L.) Milky or Morgagnian cataract (q. v.).

Cataracta lacticolor. (L.) Milky or Morgagnian cataract.

Cataracta lapidea. (L.) Chalky cataract.

Cataract, Albuminuric. See Cataract, Nephritic.

Cataracta lenticularis. (L.) Lenticular cataract. Cataract confined to the lens mass, not affecting its surrounding capsules.

Cataracta lenticularis corticalis. (L.) Cortical cataract.

Cataracta lenticularis nuclearis. (L.) Nuclear cataract.

Cataracta lenticularis totalis. (L.) Complete lenticular cataract.

Cataracta lentis. (L.) Cataract confined to the crystalline lens.

Cataracta lentis centralis. (L.) Nuclear cataract.

Cataracta liquida. (L.) Fluid cataract; Morgagnian cataract.

Cataracta liquoris Morgagni. (L.) Morgagnian cataract.
Cataracta lymphatica. (L.) An obsolete name for Morgagnian cataract.

Cataracta marmoracea. (L.) An obsolete term for a hard, degenerated, flattened, calcareous capsulo-lenticular cataract.

Cataracta matura. (L.) Mature or ripe cataract.

Cataracta maturescens. (L.) A cataract which is becoming ripe.

Cataracta membranacea. (L.) Membranous cataract.

Cataracta membranacea pupillaris. (L.) Membranous obstruction of the pupil. Closed pupil with anterior capsular cataract.

Cataracta migrans. (L.) An opaque, dislocated lens that moves with every motion of the eye.

Cataracta mixta. (L.) Mixed form of cataract.

Cataracta mollis. (L.) Soft cataract.

Cataracta mollis congenita. (L.) Congenital (soft) cataract.

Cataracta Morgagniana. (L.) Morgagnian cataract.

Cataracta natans. (L.) Tremulous cataract.

Cataracta natatilis. (L.) Tremulous cataract.

Cataracta nigra. (L.) Black cataract.

Cataracta nondum matura. (L.) Immature cataract.

Cataract, Anterior capsular. First Arlt and then Knies demonstrated

Anterior Capsular Cataract. (Treacher Collins.)

An anterior capsular cataract of less than six weeks' formation. The changes are entirely beneath the hyaline capsule.
Anterior Capsular Cataract. (Treačher Collins.)

An anterior capsular cataract of seven months' formation. A layer of cells is shown beneath the opacity, continuous with those lining the capsule elsewhere, and in front of this is a hyaline layer.

Anterior Capsular Cataract. (Treačher Collins.)

An anterior capsular cataract of eleven years' formation. A complete hyaline membrane, lined by cells, is shown behind the opacity, and the lens capsule in front of it.
Anterior Capsular Cataract. (Treacher Collins.)

An anterior capsular cataract of twenty-one years' formation. A hyaline membrane, lined by cells, is shown behind the opacity; it is equal in thickness to the lens capsule in front of the opacity.

Anterior Capsular Cataract. (Treacher Collins.)

Anterior capsular cataract of eleven years' formation; patch of degenerate lens substance (o) deeper than the mass at the anterior pole, giving rise to a second opacity.
CATARACT, ANTERIOR POLAR

that the ordinary anterior capsular cataract—especially the central variety—is either congenital, or forms in early childhood, in consequence of a central perforating ulcer of the cornea, mostly due to ophthalmia neonatorum. When the perforation occurs the aqueous humor escapes and the lens comes forward in contact with the corneal opening. About the edges of the ulcer plastic lymph is thrown out accompanied by a proliferation of the anterior cubical cells and degeneration of the lenticular fibrillæ in the immediate neighborhood. See Cataract, Pyramidal. When the pupil finally contracts and the anterior chamber is reformed the lens again resumes its normal position with the alterations just mentioned.

Treacher Collins has described this form of cataract. (See illustrations). He shows that, as one of the late results of these changes, the cells and lens débris become condensed into a structureless deposit, having a few flattened epithelial cells scattered throughout.

Cataract, Anterior polar. Pyramidal cataract. These terms are
generally confined to those cataracts in which the opacity is situated at the anterior pole of the lens, well inside the capsule. They are usually congenital and the opacification affects the lens fibres. In practice it is often difficult to distinguish between anterior capsular

Pyramidal Cataract. x 6 (Parsons.)

Perforation of hypopyon ulcer, following measles. There is a small anterior capsular cataract to the left of the summit.
CATARACTA NUBECULOSA

cataract (q. v.) and the anterior polar variety, since they may occur together. However, they are pathologically quite different, although the fibrillar changes in true anterior polar cataract are practically the same as those described under anterior capsular cataract, in which the degenerative changes have extended to the lenticular fibres.

It is the traction exerted upon the anterior lens fibres by the newly-formed connective tissue strands that connect the perforated cornea with the lens, which is responsible for pyramidal cataract. In other words, the dragging upon the lens distorts the latter, drawing it out into a pyramid that gives rise to the name.

In young subjects anterior polar cataract may, according to Tertsch, develop rapidly after perforation of the cornea. Probably a mechanical separation of the lens fibres from one another and an elevation of the epithelium of the capsule are favoring factors in its production. It has been demonstrated that polar cataract may also follow a peripheral perforation of the cornea. The mode of origin and the first phases of the development of anterior polar cataract are dependent on the severity of the infection with its related disturbance of nutrition of the lens. We find in those cases where, as a result of infection, a purulent iridocyclitis has resulted, that usually after an extensive degeneration of the epithelium an exuberant regeneration follows from which a polar cataract may originate. In cases where the uvea is not involved but only a mild irritation of the lenticular epithelium results, a polar cataract may begin without previous destruction of the epithelium. Disintegrated cortical fibres are found within the epithelial growth in those cases where a marked disintegration not only of the epithelium but of the cortical layers has taken place, because after the preceding degeneration the regeneration is accompanied by proliferation of the epithelium which infiltrates the broken-down cortex and encloses it.

Cataracta nubeculosa. (L.) An irregularly opaque or clouded cata-
aract.
Cataracta nuclearis. (L.) Nuclear cataract.
Cataracta nuclearis acquisita. (L.) Acquired nuclear cataract.
Cataracta ossea. (L.) (Obsolete). Osseous (chalky) cataract.
Cataracta partialis. (L.) Partial cataract.
Cataracta perinuclearis. (L.) Zonular cataract.
Cataracta peripherica. (L.) A cataract beginning at the periphery of
the lens; a common form of senile cataract.
Cataracta pigmentosa. (L.) Pigmented cataract.
Cataracta polaris anterior. (L.) Anterior polar cataract.
Cataracta polaris posterior. (L.) Posterior polar cataract.
Cataract, Apparent. This is a form of spurious or false cataract (q. v.) in which the appearance of the pupil indicates an opacity behind it (in the lens or its capsules) when the lesion exists elsewhere, or the cataractous condition is due to an optical cause only. The early stage of so-called "black" cataract (q. v.) and the appearance of the hardening (normal) lens of old age are examples of apparent cataract.

Cataracta progressiva. (L.) Progressive or advancing cataract.

Cataracta pseudomembranosa. (L.) An old term for obstruction of the pupil by inflammatory products—"closed" pupil—attached to the anterior capsule of the lens.

Cataracta punctata. (L.) Punctate or dotted cataract.
Cataracta punctata stationaria. (L.) Stationary punctate cataract.

Cataracta puriformis. (L.) (Obsolete term). Purulent cataract.

Cataracta putrida. (L.) (Obsolete). Purulent cataract.

Cataracta pyramidalis. (L.) Pyramidal cataract.
Cataracta pyramidata. (L.) Pyramidal cataract.

Cataracta recens. (L.) Immature cataract.

Cataract, Aridosiliquose. An over-ripe cataract with a shrunken, cor-
rugated or wrinkled capsule. It takes its name from a fancied resem-
b lance to a bean or pea-pod.

Cataract, Artificial maturation of. Bettmann's method consists in "direct trituration" of the lens with a spatula introduced into the anterior chamber. It is preceded by an iridectomy. See Vol. I, page 635 of this Encyclopedia.

Cataract, Artificial ripening of. See Artificial ripening of immature cataract.

Cataracta rubra. (L.) One of many names for black cataract.

Cataracta sanguinolenta. (L.) (Osolete). Sanguineous or hemor-
 rhagic cataract.

Cataracta scabrosa. (L.) Soft cataract.

Cataracta secundaria. (L.) Secondary cataract.

Cataracta senilis. (L.) Senile cataract.

Cataracta siliquata. (L.) Siliquose cataract. Arido-siliquose cataract. A hypermature, degenerated cataract with a wrinkled capsule or irreg-
ular surface, presenting the appearance of a silicle or silique, which in botany is a flat pod with seeds like a pea or bean.

Cataracta siliquosa. (L.) Arido-siliquose cataract.

Cataracta spuria. (L.) False cataract.

Cataracta stationaria. (L.) Stationary cataract.

Cataracta stellata. (L.) Stellate cataract.
Cataracta striata. (L.) A cataract in which the opacities are in the form of striae; the usual form of incipient senile cataract.

Cataracta tenax. (L.) Hard cataract.

Cataracta totalis. (L.) A cataract which involves the entire lens.

Cataracta trabecularis. (L.) A name given by J. A. Schmidt to a fancied form of opacity resembling transverse divisions or beams. Barred cataract.

Cataracta traumatica. (L.) Traumatic cataract.

Cataracta tremula. (L.) Tremulous cataract.

Cataracta tumescens. (L.) A cataract, either of the soft variety or in the first stage of hard cataract that is growing rapidly and in which the lens substance has swollen considerably, probably from imbibition of intraocular fluid.

Cataracta variegata. (L.) See Cataracta marmoracea.

Cataracta vera. (L.) Lenticular cataract. One in which the opacity is intracapsular, i.e., in the true substance of the lens.

Cataracta vesicularis. (L.) One of the numerous synonyms of Morgagnian cataract.

Cataracta vieta. (L.) An obsolete term for concussion of the lens with rupture of the zonule.

Cataracta virgata. (L.) A cataract with linear opacities.

Cataracta viridis. (L.) The "green cataract" of the older ophthalmologists; an obsolete term for glaucoma.

Cataract, Axial. A synonym of fusiform or spindle cataract, which occurs in the axis of the lens system. It is generally congenital, or shows itself early in life, is often hereditary and resembles the lamellar variety. When of the transmitted type it frequently affects successive siblings; more often the first born. Nettleship gives one extraordinary pedigree of five generations containing more than ninety individuals, thirty of whom are known to have had cataract. From the history, the cataract must have been congenital in every case and probably due to intrauterine changes.

Cataracta zonularis. (L.) Zonular cataract (q. v.); one of the forms of lamellar cataract.

Cataract, Absorption of. See Cataract.

Cataract, Black. An obsolete term for blindness or amaurosis—more recently a nuclear cataract, very dark in color. See Black Cataract.

Cataract, Bottle-finishers'. Also termed Bottle-makers' Cataract. Robinson (British Med. Jour., Aug. 17, 1907) describes the process of making ordinary bottles and shows that cataract is very frequent among the finishers of the commoner kinds of bottles. It is posterior-
Cataract, Bottle-Finishers'

cortical in its early stages, is due to the excessive heat to which the eyes of the bottle finisher are exposed while at work, and could be prevented by the wearing of goggles. He was led to extend the field of his inquiries on the appearance of a paper by Snell, who stated that there is not sufficient evidence to show that bottle-makers are liable to cataract to such an extent as had been asserted. Robinson now points out that his investigations, unlike those of Snell, were restricted to ordinary bottle-makers, that is, those who make bottles of heavy glass, such as whisky and wine bottles. An inquiry made some years ago led him to believe that cataract is not especially frequent among flint bottle-makers, who make medicine and other lighter and better class bottles. Ordinary bottles are made at huge tanks which are heated with coal gas and are excessively hot (2,500° F.), and into the fierce heat of these tanks the bottle-maker must look. In flint bottle works the mode of working is quite different, and the heat is not nearly so great, being generated by coal fires; the bottle-makers in flint bottle works are, therefore, not prone to cataract.

Of 400 men employed at the common bottle factories, 40 were known to have cataract; most of these were finishers; in two-thirds of these cases the eyes began to suffer from cataract by the age of 50. As the cataract nearly always begins close to the posterior pole of the lens the disturbance of vision is very great, though improvement in the sight may be effected by the use of atropin. Both eyes are almost always affected.

Although the disease usually begins as a posterior cortical cataract it, in some respects, differs from the ordinary posterior cortical cataract. Bottle finishers’ cataract is a primary disease, there being no posterior mischief except sometimes disturbance of the retinal pigment, and when it is successfully removed the sight is good, though the workman is rarely able to resume work as a finisher owing to the loss of power of accommodation. At its commencement it is like a cobweb in structure, is saucer-shaped and is best seen with a +10 or +12 lens by direct examination. The outline is irregular, and is not radial nor rosette-shaped.

Ordinary posterior cortical cataract is secondary to disease of the vitreous, choroid or retina, and consequently frequently occurs in the young, and after its removal the sight is bad. Moreover, the form of this cataract is at first rosette-shaped or stellate, its center corresponding to the posterior pole of the lens, while its rays are directed radially toward the periphery. A posterior cortical must not be confounded with a posterior polar cataract; the former is a progressive disease of the lens substance, while the latter is a mere dot on the
posterior surface of the lens capsule and represents the remains of the hyaloid artery when this vessel does not disappear completely; it is a congenital and stationary affection.

The writer named believes that the excessive heat of the gas furnaces is the cause of the disease, an opinion borne out by the fact that the frequency of cataract in bottle-makers is in proportion to the extent and length of exposure of the eyes of the different classes of workmen to the fierce glare of the tanks. A shrinkage of the lens substance caused by the prolonged exposure to great heat may cause a slight separation of the lens fibers from the capsule first near the posterior pole. This would account for the opacity being first seen there and for its peculiar saucer-like shape. The equatorial region being sheltered behind the iris, especially as the pupil is contracted by the bright light, escapes from the effect of the heat for a longer time than the cortex near the posterior pole. Cataract does not appear to be common among iron and steel workers, because the eyes of the men are not exposed to the heat which surrounds bottle finishers.

In his previous paper the writer before named recommended the wearing of dark-colored spectacles because glass possesses the property of allowing only 30 per cent. of the heat rays to pass, and if the glass be dark colored many of the light rays are intercepted also. This suggestion has been adopted by many of the workmen and there is already a belief that the glasses have done much good.

The frequency of cataract in glassblowers has been ascribed by Meyhoefer and Hirschberg to the influence of extreme heat, by v. Arlt to the bright light, by Leber to concentration of the aqueous by the constant evaporation on the surface of the cornea and the intense sweating, by Peters to changes of the aqueous in consequence of congestion in the vortex veins, produced by the act of blowing. The latter view, Cramer (Klin. Monatsbl. f. Augenheilk, January, 1907) believes is not sustained by the fact that glassblowers' cataract is always unilateral and that nothing similar has been observed in trombone players. There is no doubt that constant exposure to intense heat predisposes to premature cataract, as Cramer observed many cases in blacksmiths and founders at the end of the forties. They show, however, not the least variation from the course of senile cataract, as the cataracts of glassblowers do.

There is a difference between the main features of plate glass and hollow glass workers, as cataract occurs much oftener and earlier in the latter. The red-brown discoloration of the skin of the face and the cataract almost always begins (except in left-handed persons) on the left side, which is nearer to the oven. The cataract starts
with the formation of round opacities, more or less in a ring, around the posterior pole of the lens. By their confluence a very dark opacity of the strata in the area of the pupil develops, in which condition the lens may remain for years, while other cases take a more rapid course. Then irregular white opacities develop in the anterior cortex, which spread peripherally until they reach the equator.

This cataract can not be caused by the heat, as the lens is sufficiently protected against it by the aqueous. According to Finsen, blood and coloring matter are the greatest obstacles to the entrance of chemical rays into the skin. Both obstacles are abundantly furnished by the iris, so that, if the cause of the cataract is ascribed to the chemical rays, its first occurrence in the pupillary area of the lens, which is not protected by the iris, is easily explained. The posterior portions of the lens are first affected, being mostly exposed by the concentration of the rays in them through the refraction of the optical system. The red-brown patches of the skin are not the result of combustion, but of pigment formation in the upper strata, which, according to Unna and Wildmark, are produced by the chemical, chiefly the ultraviolet rays, never through heat. The coarse constituents of the common bottle glass are sand, carbonate of sodium and emery. The latter is a mixture of carbonate of lime and clay. Finsen showed that limelight is very rich in ultraviolet rays, and the author concludes that the constant exposure to these, supported by the influence of heat, is the direct cause of the cataract.

The impairment of vision is generally very great (1/10), on account of the opacities forming in the pupillary area, so that the desire for operation in these people is very strong. Cramer advises flap extraction of the lens, and warns against artificial ripening of the cataract, according to Foerster, or by iridectomy, on account of the diminished elasticity and greater frailty of the capsule he found in glassblowers.

Cramer did not see dacryocystoblenorrhoea and ozena in glassblowers, which is almost a racial peculiarity of that population. He attributes this to the germicidal influence of light, proved by Finsen.

A volume of water 7 mm. thick lets through only 8 per cent. of the rays of heat. Cramer, therefore, suggests for protection boxes of strong glass, filled with water and tunneled by the tube with the glass material. The water must be stained with fuchsins for better recognition of the glass mass around the end of the tube.

**Cataract, Calcareous.** A cataract characterized by the deposit in the lens of carbonate and a little phosphate of calcium. See **Calcareous lens**.
Cataract, Capsular. An opacity of the lenticular capsule, partial or complete, without opacity of the lens itself. See Cataract, Anterior capsular, also Cataract Posterior capsular.

Cataract, Central punctiform. Congenital punctate cataract. This is a well-defined form of congenital disease in which the opacity is situated at the exact center of the lens. It appears as a single, small, circumscribed dot, or sphere of regular contour, which is readily seen with the mirror. Like the congenital anterior polar cataract it often occurs in families, is uniformly stationary and, strange to say, does not greatly interfere with vision.

Cataract, Cheesy. An obsolete term applied to various forms of degenerated, congenital, secondary, and Morgagnian cataracts. Caseous cataract.

Cataract, Cholesterin. A form of cataract containing (or supposed to contain) crystals of cholesterol in the lens substance.

Cataract, Classification of. See the introduction to the major heading, Cataract.


Cataract, Concussion. In this form of cataract the lenticular changes are due to indirect injury. It is well-known that cataract may result from concussion as, for example, when a person falls or jumps from a height. It may also arise, more simply, when the patient sits down violently or slips upon a pavement. Blows on the eye or head, convulsions, tetanus, and lightning strokes are all forms of concussion cataract. The general conception of traumatic cataract is of cases in which a penetrating wound of the eye has occurred, with direct injury to the lens. The fact is that cataract from trauma without a penetrating wound is of comparatively rare occurrence.

Berlin demonstrated experimentally that by striking the cornea of a rabbit's eye with an elastic rod he not only produced abrasion of the corneal epithelium, with subsequent opacity of that membrane, but also a clouding of the anterior cortical layers of the lens, this clouding beginning opposite the point of injury of the cornea and usually spreading to a considerable distance. Deutschmann has reported two cases of partial transient opacity of the lens in wounds of the sclera near the sclero-corneal junction. Becker reports a case of cataract from concussion without rupture of the capsule. The eye received a blow from a falling icicle, which did not rupture the sclera but produced a rent in the choroid, distinctly visible through the then clear lens. Three weeks later there was an opacity of the lens about the size of a moderately dilated pupil.
Opacity may be partial and become stationary, or it may progress and become complete. It is not necessary that the blow should fall on the eyeball directly. A blow on the orbit or side of the head may be followed by opacity of the lens. Weeks reports the case of a patient, 25 years old, thrown from a carriage, striking on the right side of the head. Some months later vision in the right eye became impaired. Examination revealed the presence of minute opaque spicula at the periphery of the lens, extending from the equator toward either pole. The center of the lens remained free. Fifteen years later the opaque striae had not materially changed. Fuchs reports the clearing up of four traumatic cataracts. Edward Louder has given an instructive account of a case in the Cleveland Med. Jour., 1911, p. 850.

The question that arises in cases of this nature is,—Does the capsule of the lens rupture or does it not? In many of these cases it is likely that rupture of the capsule has taken place probably in the region of the equator of the lens, and, on the other hand, it is stated as a fact by some investigators that lenticular opacity is caused by simple concussion without opening of the capsule. Post-mortem opportunities have not arisen so that investigation could be made as to rupture of the posterior capsule.

The Editor has had a recent opportunity of seeing a complete, unilateral "concussion" cataract in a man of fifty, following the impact upon the ocular region of a golf ball. There was no rupture or penetration of the eye-coats and so far as could be made out, no break in the lens capsule.

**Cataract, Congenital.** The various forms of this lenticular opacity will be treated under their separate sub-sections, as well as under Congenital anomalies. In the accompanying cut Dor has given useful drawings of the forms best known to us.

It must, of course, be remembered that it is not easy to decide the ante- or post-natal character of any cataract and much has been written for and against the congenital theory of several of the cataracts included in Dor's table.

In the treatment of all forms of congenital cataract Treacher Collins (The Ophthalmoscope, Sept., 1908) advises us to wait until the child is 10 months old before operating. At an earlier age the cornea is so small and the anterior chamber so shallow that the necessary instrumentation cannot be so satisfactorily carried out as in a more fully developed eye. Moreover, the amount of aqueous humor is so small that it does not suffice for solution of the liberated lens substance. In some cases in which the pupil is small and does not dilate
Forms of Congenital Cataract.

1, Partial Zonular; 2, Complete Zonular; 3, Partial double Zonular; 4, Complete double Zonular; 5, Zonular with Opaque hard Nucleus; 6, Double Zonular with total Opacity; 7, Central Punctiform; 8, Anterior Polar; 9, Posterior Polar; 10, Bipolar; 11, Fusiform; 12, Pyramidal; 13, 14, Stellate; 15, Punctate; 16, Vesicular; 17, Cuneiform; 18, Bandlike; 19, Siliquose; 20, Siliquose with fallen Nucleus; 21, Siliquose with Graviated Débris; 22, Purse-like, fetid.—(Modified from Dor and Beard.)
well with atropin it is best to commence with an iridectomy. In nearly all cases it is well to begin with a needling, for valuable information can be obtained by this means as to the thickness of the capsule and consistency of the lens, even should it fail to liberate much lens matter to the action of the aqueous. If the cataract is a dense, white, anterior polar one, set in a ring of clear, or partially clear, lens substance and apparently flattened from before backward, the so-called disc-shaped cataract, then an attempt should be made to separate the central white opacity with a needle and let it fall into the anterior chamber. Two needles are sometimes required to effect this. If, on pricking the capsule, milky-white fluid escapes into the anterior chamber (congenital Morgagnian cataract), it is well at once to evacuate this fluid, for fear of increased tension ensuing.

In some cases of congenital cataract, the whole lens and capsule can be removed in a most satisfactory way by forceps. Very often, however, such a procedure is followed by escape of vitreous. It is difficult to differentiate which cataracts can be safely dealt with in this manner. They generally seem to be complete cataracts with a tough capsule and lens matter of a gelatinous consistency.

If after a needling and some absorption of liberated lens matter, a dense, tough, white, fibrous-looking membrane remains, there is probably some atypical development of the anterior part of the vitreous. Under such circumstances an attempt had best be made forcibly to displace the membrane downward and backward out of the axis of vision.

Cataract, Congenital central. See Cataract, Nuclear.

Cataract, Congenital posterior polar. See Cataract, Posterior polar.

Cataract, Coralliform. A synonym of fusiform or axial cataract. It is generally congenital, or shows itself early in life, is often hereditary and resembles the lamellar variety. When of the transmitted type it frequently affects successive siblings; more often the first born. Nettleship gives one extraordinary pedigree of five generations containing more than ninety individuals, thirty of whom are known to have had cataract. From the history, the cataract must have been congenital in every case and probably due to intrauterine changes.

Cataract, Cortical. Opacity of the crystalline, in which the cataract is confined to or mostly affects the cortex of the lens.

Cataract, Couching of. Various terms—displacement, depression, reclination, couching—have been used to designate the removal of the lens from the axis of vision into the vitreous humor. Couching and depression indicate the operative displacement of the lens into the lower part of the vitreous chamber. Reclination is the deposition of
the lens in a horizontal plane, level with the lower border of the iris. Depression was the chief operation done by the ancients to obtain a clear pupil in cataractous diseases. For almost two centuries after the introduction of extraction by Daviel, it held its own as the equal, if not the superior, method and many competent surgeons gave it the preference. A continual war of words was waged as to the merits of depression versus extraction, until the beginning of the latter half of the nineteenth century, when couching methods finally fell into disuse.

The operation is still practised in India by itinerant operators. Major Elliot, in a recent paper, describes these Indian operations and states that 40 per cent. of the eyes are lost through sepsis.

Drake-Brockman has written an interesting account of couching as performed by the "suttiahs," or Indian oculists, from the earliest times, with a description and drawings of the chief instruments used by them. During a long residence in India he saw much of these native operators and made a collection of their couching utensils.

The chief instruments (Drake-Brockman, "The Indian Oculist, His Equipment and Methods," *Indian Medical Gazette*, Vol. 45, No. 6, 1910) usually found in the North Indian "Suttiah’s" armamentarium are one or two "sillais," or couching needles; a "chimtee," or pair of forceps of very rough construction; a hook or "palak utarne ka kanta," this latter being used as a lid retractor, as well as for treating pterygium; and lastly the "nastar," or lancet, which is used for the sclerotic puncture, being protected to within about three mm. of its point by cotton thread wound round it (in order to prevent too deep penetration of eyeball), and which in most cases is usually filthy and as septic as possible. Col. Drake-Brockman has seen many of these as simple vaccination lancets that have been discarded and turned to this use. All the instruments are enclosed in a cloth or leather case to roll up and be easily carried. The native oculist in addition carries in the roll a few drugs, "soormas," "unjan," alum, etc., for application to eyes for various ailments. Few, if any, of them carry implements for venetian, cupping, etc., but the author has seen such in their kit, together with a few lancets for opening abscesses, etc., but possibly these form a more or less permanent part of the equipment of the Mohammedan Vydian, as being more compatible with the craft of the "Jarrah," who is usually a Mohammedan and belongs to the large class of "hakims" so prevalent in all the large Indian cities.

Quite recently Ekambram witnessed six operations in India. Most of these operators belonged to one village and traveled from place
to place throughout the country, prior to the harvest (during the dull season) and couched cataracts in a very crude manner.

During the last forty years attempts have been made by several surgeons to revive the operation. Despres, Elias, True, Holth, Power, and Roure have advocated depression in exceptional cases; for instance, in very old and feeble patients, in persons suffering from severe bronchitis or asthma and in hemophilia, or where one eye has been already lost by choroidal hemorrhage following extraction; in cases of ozena; in long-standing diseases of the adnexa and in the insane.

North Indian Instruments used by the “Suttiahs” for Couching.

a, Lancet for the sclerotomy; b and c, Couching needles; d, Lid retractor. (Drake-Brockman.)

Tyrrell states: "The operation of depression, like that of extraction, is applicable to cases of hard cataract; but should in my opinion, only be performed when the latter operation is impracticable or hazardous, namely: when the globe is very deeply seated in the orbit, when the palpebral aperture is much contracted, when the anterior chamber is very small, when adhesions exist between the pupillary margin of the iris and the anterior capsule of the lens, when the globe has lost much of its natural elasticity, when the patient is extremely feeble or when he is the subject of chronic cough or asthma."

None of these reasons would deter a surgeon from extracting at the present day. The sunken globe can be readily lifted forward by
fixing the superior rectus muscle. The narrow palpebral fissure can be very readily increased in size by cutting the outer canthus. The narrow anterior chamber offers no special difficulty when a preliminary iridectomy has been done, and the same holds good as regards posterior synechiae. With the patient in his best possible condition, neither cough, asthma, nor feebleness is a sufficient excuse for choosing any depression operation.

There is, however, one valid reason for not performing an extraction, namely, where the fellow eye has been lost by choroidal hemorrhage (see Axenfeld's operation) following the extraction of an opaque lens.

It is estimated that 50 per cent. of all cases of depression are lost through glaucoma, irido-cyclitis, or infection. The depressed cataract acts as a foreign body, setting up acute glaucoma, or by pressure bringing on an attack of irido-cyclitis, which may lead to occluded pupil, or to the formation of a cyclitic membrane with possible sympathetic inflammation of the fellow eye; or the eye, through sepsis, may be lost from a panophthalmitis.

Steps of the operation. Depression was continuously done in the following manner: The pupil was fully dilated, the lids were separated and held apart, either with a speculum or by the aid of an assistant. A cataract needle was entered in the sclera several mm. from the limbus below the horizontal plane on the temporal side. It was then passed through the sclera in front of the iris into the anterior, or behind it into the posterior chamber, depending on which route had been selected. If the former, the point of the instrument was pushed into the area of the pupil the handle was then depressed until the point reached the upper periphery of the lens. Gentle pressure downwards was made by elevation of the handle until the lens disappeared from the pupillary space. The handle was then held
in position for a minute or two, after which the point was slowly raised to see if the cataract had been permanently dislocated; if not, the depression was repeated.

The reclination operation of Willburg. Willburg, to obtain better results than those furnished by depression, modified the operation so that the lens occupied a horizontal position in the vitreous humor; the anterior capsule looking upwards and the posterior downwards.

The steps of Willburg’s operation are the same as in depression except that the point of the needle is placed above the antero-posterior axis of the lens and pressure made backwards and downwards, so that it disappears from the line of vision and occupies a horizontal plane in the vitreous. This operation gave somewhat better results than depression.

Reclination by means of scleronyxis. Axenfeld has sought to avoid some of the dangers of reclination by doing a preliminary iridectomy. The needle point is passed through the sclera in the usual way and the pressure against the lens is mostly exercised in the coloboma, as shown in the illustration. However, although the iridectomy may render less likely a secondary glaucoma it does not, unfortunately, preclude the possibility of expulsive hemorrhage (for which most couching operations seem to have their chief value) because secondary bleeding is known to follow excision of the iris.

Holmes Spicer also gives an account of a successful couching by means of a Scarpa’s needle passed through the sclera behind the ciliary body. The (one-eyed) patient was able to resume his occupation.—(P. A. C.)

Cataract, Curative measures for. See Cataract.

Cataract, Cystic. Purse-like cataract. Putrid cataract. Purulent cataract. Fetid cataract. In this very rare form of the disease the cataract has the shape of a bag, a portion of which projects hernia-like into the anterior chamber. This condition results from the liquefaction of the lens fibres in certain forms of congenital cataract. When advanced liquefaction occurs the mass sometimes becomes putrid and if the capsule be incised a disagreeable odor may be observed—hence the terms fetid and purulent.

Cataract, Depression of. See Cataract, Couching of.

Cataract, Diabetic. Just as diabetes in persons over 45 years of age is a much less serious disease than when it occurs in youth, so do cataracts occurring in elderly subjects with diabetes differ from the diabetic cataract of childhood. While nearly all cataracts occurring beyond middle age partake of the usual senile characteristics the lenticular opacities in juvenile diabetes have their special signs. As
CATARACT, DIPHTHERITIC

Beard (Ophthalmic Diagnosis, p. 177) very properly says, the chief indications of diabetic cataract in early life are "the rapidity of development and the aspect within the pupil. Corroborative ocular symptoms are enfeebled accommodation and bilaterality. In case of a diabetic child, total double cataract has been known to form in a few hours—often in a few days—and at this age it seldom requires more than a few weeks. The appearance in the pupil is that of skimmed milk, or bluish-white, the tint being perfectly even. In adults, and even up to middle age, the development, while it requires more time, is still relatively rapid. A peculiarity of the young adult diabetic cataract is the appearance in the lens of certain radiating streaks of matt white, that have been likened to mineral wool—'asbestos stripes.' In 15 to 20 per cent. of young diabetics the accommodation is diminished from two to five diopters. Swelling of the cataractous lens, and suddenly acquired myopia, although common to other forms of cataract, are more frequent in the diabetic type. Neither swelling nor opacity, however, is the result of the imbibition by the lens of sugar, as was formerly supposed. In both young and old, diabetic cataract is liable to a regressive metamorphosis similar to that of senile cataract, but much more rapid. In the younger subjects nucleus and all may liquefy and the residue be absorbed.''

Cataract, Diphtheritic. The possibility of the production of cataract by the action of the diphtheritic poison is based upon a few observations. Nikolukin, in 1899, published the case of a child, 8 years of age, affected by a serious attack of diphtheria, who presented a bilateral, soft cataract, which was removed with success.

Cataract, Direct massage of lens for artificial ripening of. See Artificial ripening of immature cataract.

Cataract, Discussion of. Needling of cataract. In all probability both ancient and mediaeval surgeons were little acquainted with incising the capsule with the express purpose and intent of permitting the aqueous humor to have access to and so to absorb or dissolve a soft cataract. We know that discission was practised, but as some claim, only as an aid to depression. The lens was considered the seat of vision, consequently if that were opaque or removed, sight would be lost.

Various erroneous views were held as to what constitutes cataract, namely, an obstructing membrane behind the cornea; a thickened fluid in the anterior chamber or vitreous; or an opaque substance behind the pupil. These ideas generally prevailed up to the beginning of the seventeenth century, while some surgeons even maintained them for more than a century later. The astronomer, Kepler, was one of
the first to demonstrate the fact that the lens focuses the rays of light on the retina and is not the seat of vision. Francois Quarré and Remi Lesnier confirmed this view of the function of the lens about the middle of the seventeenth century. Soon afterwards, Borel, Bonne, Blégny, Lucas Tozzé, Pollinus Bernard, Rohaut and Gassendi demonstrated that an opacity of the lens constitutes cataract. Notwithstanding all that had been clearly shown in regard to cataract, the views of the ancients still held sway until the beginning of the eighteenth century, when Maitre-Jean, Boerhaave, Méry, Heister and many others again demonstrated that changes in the lens constitute cataract. This opinion found general acceptance about the middle of the same century.

From writings of the ancients now extant conflicting deductions have been drawn, pro and con, as to their knowledge of operative procedures for the removal of cataract. Depression was almost universally practised for the removal of the obstructing membrane. Many claimed that discission, when done, was merely an aid to depression. Galen, however, recommended discission for the removal of cataract in the case of children. Pliny wrote in regard to the removal of cataract as follows: *Squamam oculi emmendam polius quam extra-hendam*, i. e., "If the cataract cannot be depressed, then it may be extracted"; but it does not follow that the ancient idea or method of extraction and the modern is the same. Still, it all goes to show that other methods besides depression were known, if not generally practised.

Depression held its own as an almost universal method to the middle of the eighteenth century, when Daviel introduced extraction. Towards the end of the eighteenth and the beginning of the nineteenth century, it was, nevertheless, depression versus extraction. Percival Pott, Callisen, Hay and Dupuytren were strong defenders of depression as the better method. In fact, Scarpa abandoned extraction in favor of depression. Baron Wenzel, Richter, Beer, Sir William Adams and Heister, on the other hand, favored extraction.

Middlemore, as late as 1835, wrote as follows: "Wenzel and Sir William Adams have given us a very gloomy and overcharged account of the evils resulting from depression which Scarpa and Samuel Cooper have very keenly ridiculed and ably refuted."

Although practised to some extent by the ancients as an aid to depression it is, however, to the merit of modern surgeons that the operation of discission has been established on a firm basis and limited to the removal of soft cataracts. Barbette says: "*Licet cataracta non satis intra pupillæ regionem sit depressa, dum modo in particulás*
CATARACT, DISCISSION OF

sit divisa, perfect viso intra sex aut octo septimanas (sapisimne), licet toto operatio absqueullo fructa peracta, videatur; quod aliquotus experientia edoctus loguer.

Banister states: "There are some cataracts which scatter and vanish when the needle is applied to them, because they are not hard and solid to bear the needle, which goeth through them as it would a piece of cheese, whereof, they are commonly called 'cataracta lactea,' because their colour and substance resembles milk. That the chirurgeon may meet this inconvenience, he must labour to loose it, pressing it with his needle on either side, for by this means, I have seen, and in the end the party hath recovered his sight."

The same fact had been observed by other surgeons (Read, Maître-Jean) in the early part of the eighteen century, but it remained for Percival Pott in 1775 to make use of an experience in depression, viz.: that if the capsule of certain cataracts that could not be readily depressed were freely lacerated, they would be absorbed by the action of the aqueous humor. He was the first to lacerate the capsule as a distinct method of removing cataract of the 'mixed kind.' He did not attempt anything further in the way of depression, but allowed absorption to remove the lens. He says: "I have sometimes, when I found the cataract to be of the 'mixed kind,' not attempted depression, but have contented myself with a free laceration of the capsule, and having turned the needle round and round between my finger and thumb, within the body of the crystalline lens, have left all the parts in their natural situation; in which cases, I have hardly ever known them fail of dissolving so entirely as not to leave the smallest vestige of cataract."

Gleize (1796) in attempting depression (owing to a movement of the patient having lacerated the capsule) had to withdraw the needle. He found that the lens had disappeared on the twentieth day. He then used this method subsequently, and found that soft cataracts disappeared. Conradi had a similar experience except that in extracting a lens he had made the corneal section and punctured the capsule with a needle; then was obliged to stop. At the end of eight to twelve weeks, the pupil was clear. He operated by discussion on a woman of seventy, but at the end of twenty months, no change had taken place in the lens. From these experiences, he proposed discussion through the cornea as a regular procedure. He made an opening in the anterior capsule and finally limited the operation to soft and fluid cataracts. Buchhorn called the procedure keratonyxis.

Langenbeck, Beer and Jäger, Sr., tried discussion, the first giving the most favorable reports of the method, while the two last were very
CATARACT, DISCISSION OF

unsuccessful. There is no evidence to show that any discrimination was made by any of these three surgeons as to the kind of cataracts to which they applied discussion. Scarpa confined the operation to milky, soft and cheesy cataracts. His method was to make a very free laceration in the anterior capsule and then to cut up the pulpy mass that remained. Contemporaneous with Gleize, Conradi, Langenbeck, Beer, Jäger and Buchhorn, was Saunders, who believed that he had discovered a new process of curing cataracts in children, namely, discussion. He refers to his procedure for curing cataract in children in a letter to the General Committee of the London Infirmary for Curing Diseases of the Eye, in 1809. In a previous report he stated that he had operated successfully on fourteen persons born blind, one of whom was only two months old. He particularly advocated operating on children when very young, so as to prevent the development of unsteadiness of the eye. His new procedure consisted in freely lacerating the anterior capsule within the area of the pupil and then gently sinking the needle into the body of the lens. This method of operating on children he continued until his death in his thirty-seventh year. He had intended to operate on hard cataracts, but his demise prevented him from following in the footsteps of all his predecessors and finding failure.

If any one surgeon deserves exceptional mention for the early development of discussion, that honor belongs to Pott. Possibly Conradi comes next, as he limited the operation to the anterior capsule. His failure to extract after discussion led to the disappearance of an opaque lens. The experience gained in this instance, and a failure of discussion in aged patients, led him to confine the operation to the young. Saunders comes next in order, as he firmly believed he was the first to discover discussion for the curing of cataracts in children. He started out right, but he was possessed of the erroneous idea that all cataracts would yield to the new process.

Forms of cataract amenable to treatment by discussion. Lenticular opacities occurring in the young, whether congenital or due to disease or traumatism, are to be considered as soft cataracts. It not infrequently happens that congenital cataracts of young persons go slowly on to absorption, so that after a lapse of time, the pupil may be partially clear, or a thickened capsule with little or no lens matter remains.

In passing, it may be pointed out that the traumatic type of cataract disappears much more quickly. The thickened capsule due to cellular proliferation is apt to have calcareous deposits upon it and these prevent a just estimate of how much of the lens remains. This
latter class really belongs to the type of secondary cataract and cannot be absorbed as a result of needling. These calcareous deposits are frequently the source of trouble, falling at the time of operation or subsequently, into the anterior chamber, where they are slowly absorbed. They act as foreign bodies while undergoing absorption, and at times set up an irido-cyclitis that may end in the loss of the eye.

*Extraction instead of discussion in certain forms of soft cataract.* If they are of long standing, little or no lens matter remains within the capsule, especially if the cataract be due to accidental traumatism, or to a previous needling. An ordinary discussion is of little use in trying to obtain a clear pupil. The pupil should be fully dilated and a linear extraction done in the following manner: The incision in the cornea should be made above, about 2 to 4 mm. from the limbus, large enough to permit the exit of the calcareous mass. A cystotome must then be passed into the anterior chamber and the periphery of the anterior capsule freed from the thickened membrane. The aqueous humor, if it has escaped, must be replaced by a normal salt solution. Then introduce into the anterior chamber a closed duck-bill forceps, which must be opened and one blade pushed behind the mass and the other in front; the calcareous mass is then seized and extracted from the eye.

Another method is to insert a de Wecker's scissors instead of the forceps; cut the thickened tissue in two halves, then remove them by the aid of forceps.

In young subjects the sphincter of the pupil contracts very quickly

![Diagram of Cataract Discussion](image-url)
CATARACT, DISCISSION OF

on the escape of the aqueous humor. In order to avoid the necessity for an iridectomy, push the calcareous mass downwards until the upper edge shows free of the pupil, when it can be extracted by either of the above methods. When small pieces of the calcareous mass break off in the manipulation, wash them out with a saline solution by means of an irrigator, as described in the article on Artificial ripening of cataract.

What is the age limit of discission? As a rule, until the twenty-fifth year the lens is susceptible of absorption when an opening is made in the anterior capsule, permitting the aqueous humor to come in contact with the lens fibres. The nucleus is not generally hard enough to prevent absorption, although frequent exceptions are found below this limit, while, occasionally, the lens is absorbed by discission up to the thirty-fifth year and even later. The density of the cortical layers varies considerably even in young subjects, so that it is always a safe procedure to regard the first discission as tentative and not make a large capsular wound, nor to go deeply into the lens substance.

Some surgeons follow von Graefe’s precept, viz.—to make an iridectomy prior to a discission. This seems to be totally unnecessary, and inasmuch as discussions are done for the absorption of soft cataracts in young persons, the cosmetic effect ought to be considered and no mutilation done that is not absolutely necessary.

A discission is easy to perform and when carefully done is followed by little, if any, reaction. In the case of infants with congenital cataract, a small capsular opening is quite enough to cause the entire disappearance of the lens in from three to six months. In the type where there is only partial opacity at or about the center of the lens, more than one needling is necessary.

In traumatic cataract, if seen soon after injury, the free use of atropine with ice-cold compresses should first be employed to prevent too rapid swelling of the lens.

From the eighteenth to the twenty-fifth year, the process of absorption is much slower in all forms of cataract and if the surgeon wishes to depend on discission to remove the cataract he should proceed with caution, and thereby avoid complications. A second needling should be done from six to eight weeks after the first, if the process of absorption has apparently come to a standstill. The inclination of most operators is to hasten matters and consequently do too much. In this regard, possibly the importunities of older patients form an important factor. However, the question of time with children is of little importance; so that there is no excuse for hastening the process by numerous or extensive needlings. At the same time, the procedure that
entails the least risk is the one that should be chosen in all cases. Possibly an experienced surgeon, who has his patient under full control in a thoroughly equipped eye hospital, with trained assistants, nurses, etc., may take chances and do an extensive laceration of the capsule, but the inexperienced surgeon will be wise if he proceeds more cautiously. In any case, it is not proper to do too much and thereby court disaster, an event which sooner or later is bound to happen even to the most experienced operator.

*The instruments required for a discission.* The instruments required are an eye speculum, a fixation forceps and a Bowman’s needle. The eye speculum and forceps should be put into boiling water for five minutes, the Bowman’s needle for a few seconds; then all the instruments should be placed in a shallow tray containing absolute alcohol. Prior to use, they should be washed off in a four per cent. solution of boric acid.

*Position of the patient for discussion.* The patient should be reclin- ing upon an operating table. The surgeon when sitting behind the patient has much better control of the eye below, than in any other position, both as to seeing and operating. Local anesthesia is sufficient except in the very young or unruly, where general anesthesia may be necessary. The pupil of the eye to be operated on should be previously dilated ad maximum; the eyelids and eye brows should be made as sterile as possible. Then insert the eye speculum and flush the field of operation freely with a four per cent. boric acid solution. If ordinary daylight is not enough to give a clear view of the cornea, iris and lens, some form of artificial light with a condenser should be used. The surgeon then seizes the globe of the eye below, near the limbus, the eye is rotated downwards and the globe pierced with a Bowman’s needle. The point of entrance should be in the upper-inner (left), or upper-outer (right) quadrant of the eye, 2 mm. from the limbus, and in sclero-corneal tissue. The flat of the needle is held parallel to the plane of the iris, the point inserted under the conjunctiva, pushed through the sclera into the anterior chamber, the flat of the blade still carried parallel to the plane of the iris to the lower periphery of the capsule. Then the handle of the needle is raised and the cutting edge turned and brought in contact with the capsule, which should be cut by an upward pull of the needle to about 3 mm., penetrating into the lens fibers about 1 mm. (See the figure.)

The needle is then withdrawn in the same manner that it entered the globe. If the shank of the needle is properly made, the point of entrance is so completely filled that no aqueous escapes. Care is to be exercised that the point of the needle does not become entangled in the
iris in passing across the anterior chamber. In either event it is best to postpone operation until another occasion. The eye operated on should be bandaged and the patient put to bed in a darkened room.

Atropine must be used freely (to keep the pupil fully dilated) and continued during the entire period of absorption. If the eye is quiet at the end of the first week, gentle massage of the globe should be done several times daily over the center of the cornea, through the closed eye-lids. This greatly assists the absorption of the cataract. In case of beginning reaction, ice cold compresses should be freely used so as to prevent too free access of blood to the parts.

Discission Through the Clear Cornea.

The needle is directed forwards to a point about 1 mm. from the centre of the dilated pupil, pushed about a mm. into the lenticular substance and then a cut 2 mm. long is made through the central area of the lens.

Dangers and complications of discission. The untoward results liable to follow this operation are: First, glaucoma; second, iritis, irido-cyclitis and panophthalmitis; third, infection.

Glaucoma occurs from this cause in two forms, inflammatory and non-inflammatory. Acute inflammatory glaucoma is the most frequent result of a too free discission, due to the irritation of the rapidly swelling lens substance. It comes on usually within the first five days following the operation. If the attack be severe, with neuralgic pains in the head and globe, accompanied by nausea or vomiting, increased tension of the eye ball and a hazy cornea, a linear extraction (q. v.) should be made without delay, thus permitting the evacuation of the swollen opaque lens substance. This operation will dissipate all signs of inflammation, providing the operation is done at the onset of the symptoms.

A non-inflammatory or chronic form that may occur months or even years after operation, is due to the contraction and thickening of capsular bands that pull on the ciliary process. Cutting these bands
so as to end the traction, stops the process, and this is best done with scissors. I have seen six such cases where iridectomy proved of no avail and relief was only obtained by severing these capsule fibers.

Iritis may occur; likewise, irido-cyclitis may result from too rapid swelling of the lens substance. These sequelae are best treated by leeches to the temple, the free use of atropin and hot (from 120° to 130° F.) compresses, continuously applied to the closed eye-lids of the affected eye.

These conditions when severe are difficult to diagnosticate from the signs and symptoms due to infection, especially when the process results in panophthalmitis. It is, indeed, a question as to what role infection plays in post-operative uveitis; it is possible that germs may be introduced at the time of the operation.

Needling through the clear cornea. Some operators prefer to make the puncture, especially where a small central incision of the anterior capsule is desired, close to the limbus, but within the transparent cornea. The technique differs somewhat from the previous operation in that the length of the cut is less and the point of the needle penetrates the lenticular substance somewhat deeper, as shown in the accompanying diagram.—(P. A. C.)

Cataract, Displacement of. See Cataract, Couching of.

Cataract, Dotted. Punctate cataract. One of the forms of congenital cataract (q. v.) in which numerous minute scattered opacities are found, either in circles or as patches. As they usually form in the periphery of the lens they do not interfere directly with vision.

Cataracte acquise. (F.) Acquired as opposed to congenital cataract.
Cataracte adhérente. (F.) Adherent cataract.
Cataracte albumineuse. (F.) (Obsolete). Soft or albuminous cataract.
Cataracte argentée. (F.) Cataract having a shining-white or silvery appearance.
Cataracte aride-silicreuse. (F.) Siliquose or wrinkled cataract.
Cataracte à trois branches. (F.) A cataract with three radiating striae of opacity.
Cataracte azure. (F.) Blue cataract; cataracte caerulea. One form of cortical cataract in which there is a large number of very small dots or streaks.
Cataracte barrée. (F.) Barred cataract.
Cataracte blanche. (F.) A cataract in which the opacity is of the usual white color.
Cataracte bleue. (F.) The so-called cerulean or bluish cataract in which there are many small dots or streaks.
Cataracte branlante.  (F.)  Tremulous cataract.
Cataracte brune.  (F.)  Black—literally ‘‘brown’’—cataract.
Cataracte burséolée.  (F.)  (Obsolete).  Cystic or purse-like cataract.
Cataracte calciaire.  (F.)  Chalky cataract.
Cataracte calcifiée.  (F.)  Cataract that has undergone calcareous degeneration.
Cataracte capsulaire.  (F.)  Capsular cataract.
Cataracte centrale antérieure.  (F.)  Anterior central (or polar) cataract.
Cataracte centrale en pointe.  (F.)  Anterior polar cataract.
Cataracte centrale ou nucléaire.  (F.)  Central or nuclear cataract.
Cataracte commençante.  (F.)  Incipient cataract.
Cataracte, Complications qui surviennent après l'opération de la.  (F.)  Complications that arise after cataract operation.
Cataracte compliquée.  (F.)  Complicated cataract.
Cataracte crayeuse.  (F.)  Chalky cataract.  A term sometimes applied, owing to its white appearance and (supposed) dry condition, to the so-called arido-siliquose cataract (q. v.).
Cataracte crétacée.  (F.)  Cataract that has undergone calcareous degeneration.
Cataracte cristalline.  (F.)  Cataract showing crystalline (cholesterin) deposits in or upon it.
Cataracte cunéiforme.  (F.)  Cataract exhibiting wedge-shaped opacities.
Cataracte cystique.  (F.)  Cystic or Morgagnian cataract.
Cataracte déhiscente.  (F.)  Dehiscent cataract.
Cataracte demimolle.  (F.)  Partially ripe, or mixed, cataract.
Cataracte demi-mûre.  (F.)  Immature or ‘‘half-ripe’’ cataract.
Cataracte de Morgagni.  (F.)  Morgagnian cataract.
Cataracte dendritique.  (F.)  Pigmented cataract.
Cataracte des moissonneurs.  (F.)  Harvester’s (traumatic) cataract.
Cataracte des verriers.  (F.)  Bottle-finishers’ cataract.
Cataracte diabétique.  (F.)  Diabetic cataract.
Cataracte dimidiée.  (F.)  A form of cataract in which one-half of the capsule is opaque; also, an over-ripe cataract in which the opacity has the appearance of being divided or halved.
Cataracte diphtérique.  (F.)  Diphtheritic cataract.
Cataracte discoïde.  (F.)  Discoid cataract.
CATARACTE D’ORIGINE ASTIGMIQUE

Cataracte d’origine astigmique. (F.) Cataract produced by astigmatism.
Cataracte d’origine électrique. (F.) Electric cataract.
Cataracte dure. (F.) Hard cataract.
Cataracte, Eclaircissement de la. (F.) Clearing of, or absorption of the opacity in cataract.
Cataracte ergotinique. (F.) Cataract the result of poisoning by ergot.
Cataracte fausse. (F.) False or spurious cataract.
Cataracte fenêtrée. (F.) A soft cataract in which the opacity is not continuous or homogeneous, but in which there are patches or islets of clear lens substance.
Cataracte fétide. (F.) One of the numerous forms of Morgagnian and degenerated congenital cataract.
Cataracte fibrineuse. (F.) Fibrinous cataract.
Cataracte fibroïde. (F.) Fibroid cataract.
Cataracte fixe. (F.) Fixed or irremovable cataract.
Cataracte franche. (F.) Lenticular cataract.
Cataracte fusiforme. (F.) Fusiform cataract.
Cataracte glaucomateuse. (F.) The lenticular opacities associated with glaucoma; also, “green” cataract, so-called from the greenish appearance of the pupil in that disease.
Cataracte grise. (F.) A gray cataract.
Cataracte grumeuse. (F.) Grumous cataract, i. e., one associated with hemorrage.
Cataracte hémorragique. (F.) Hemorrhagic cataract.
Cataracte hyaloïde. (F.) (Obsolete). Hyaloid cataract.
Cataracte hypermature. (F.) Over-ripe cataract.
Cataracte incomplète. (F.) Unripe cataract.
Cataracte inflammatoire. (F.) Inflammatory cataract.
Cataracte interstitielle. (F.) Interstitial cataract.
Cataracte jaune. (F.) A cataract in which the opacity is yellow.
Cataracte lactée. (F.) Milky or Morgagnian cataract.
Cataracte laiteuse. (F.) Milky cataract—one of the many terms used in ophthalmology to indicate a phase of Morgagnian cataract.
Cataracte lamellée. (F.) Lamellar or laminated cataract.
Cataracte lamelleuse. (F.) Lamellar cataract.
Cataracte lamineuse. (F.) Lamellar cataract.
Cataract, Electric. Fulguration cataract. Cataract from lightning stroke. Cataract from electric flashes. This form of len-
CATARACT, ELECTRIC

Particular opacity may be produced by a sufficiently strong current of electricity, whether a lightning stroke or a high-tension artificial stream, that involves the eyes. One must distinguish between cataract from fulguration or electric shock, and that form set up by mere intensity of light.

The latter is a dystrophy and belongs to the same category as X-ray and ultra-violet cataract. Although the evil effects of very strong lights upon the eye are mentioned or discussed under other headings, it may be said that electric cataract from intense light is by no means unknown. Some observers would have us believe that the ordinary senile cataract is caused or hastened by exposure to the electric arc light and other sources of intense ultra-violet rays. Widmark's experiments on animals have, however, distinctly shown that organic lesions of the crystalline lens are produced by intense light. He exposed the lens of the rabbit to a 4,000 candle-power electric light, protecting it in some instances by a screen of quinine solution. In this case where the lens was unprotected a karyokinesis of the subcapsular cells was produced. Subsequently, indifferent globules appeared in the cell nuclei, and still later the globules entirely displaced the nuclei and filled the cells. This process finally spreads until it includes most of the lens-substance which becomes distinctly opaque.

Cataract from electric shock is really a traumatic cataract and resembles cataract from concussion (q. v.) or from convulsions. In it there is probably always a marked congestion of the ciliary body with violent spasm of the ciliary muscle followed by changes in the epithelium lining of the anterior capsule. These alterations in the lens are often complicated by unequal pupils, rupture of the choroid, traumatic uveitis and detached retina. This form of cataract is generally bilateral and quickly progresses until all the lens fibres are involved.

A few records of the traumatic form of electric cataract will serve to illustrate its method of production. A male, aged 35, received a shock from a direct current of 500 volts. A short circuit occurred from holding an end of the cable in each hand. Muscular contraction of his arms caused him to receive most of the burn on the left side of his face. He was blinded by the flash, and an hour after his vision was 20/40. The right eye, when examined by Ellett (Oph. Record, Jan., 1906), presented marked conjunctivitis, with iridic congestion. In a few days the eye was free from congestion, with vision 20/20. Three months later he returned with O. D. V.—20/200. Pericorneal injection and discolored iris. Pupil dilated with atropin and numerous small white dots observed in the lens beneath the capsule. No sugar in urine. In a few days the eye was white. In twenty days
A case of lenticular opacity thought to be due to electric force is described by Roche. The patient received a charge of 5,000 volts on the left side of the body. He was unconscious for half an hour. The cheek and arm were badly burned and the left half of the inferior maxilla was laid bare. A month later he noticed an impairment of vision of the left eye, which increased rapidly until in three weeks the eye was blind. A week after the blindness of this eye the right was affected in the same way. The lenses were white and much swollen, the anterior chambers being practically obliterated. After extraction in the right eye, the lens was found to be nearly clear, but the capsule was white and dense.

Hess, in his laboratory experiments, found the anatomical lesion to be a destruction of the crystalline epithelium, and the author thinks that the same lesion existed in his patient. The primary lesion was in the capsule and the lens was affected secondarily. This corresponds with the fact that electricity is known to have an elective action upon epithelial elements.

**Cataracte lenticulaire.** (F.) Lenticular cataract.
**Cataracte liquide.** (F.) Fluid cataract. A synonym of Morgagnian cataract.
**Cataracte, L'Opération de la, avec suture.** (F.) Suture of the conjunctiva in cataract extraction.
**Cataracte lymphatique.** (F.) Cataract due to deposits of lymph. Lymphatic cataract.
**Cataracte mălarienne.** (F.) Cataract due to malaria.
**Cataracte marmoracée.** (F.) An old (obsolete) term for a hard, flattened, calcareous lens.
**Cataracte membraneneuse.** (F.) Membranous cataract.
**Cataracte mixte.** (F.) Mixed (hard and soft) cataract.
**Cataracte molle.** (F.) Soft cataract.
**Cataracte mure.** (F.) Mature cataract.
**Cataracte myéloide.** (F.) Myeline cataract.
**Cataracte naissante.** (F.) Incipient cataract.
**Cataracte naphtalinique.** A cataract produced by naphthalin (q. v.) poisoning.
**Cataracte néomembraneuse.** (F.) Pseudomembranous cataract.
**Cataracte néphritique.** (F.) Cataract from renal disease.
**Cataracte noire.** (F.) Black cataract.
**Cataracte non mure.** (F.) Immature cataract.
**Cataracte nuancée.** (F.) Variegated or cloudy cataract.
Cataracte nubéculeuse. (F.) Irregularly opaque cataract.
Cataracte nucléaire. (F.) Nuclear cataract.
Cataracte, Opération de la, avec glissement de la conjonctive. (F.)
Cataract operation with a sliding flap of conjunctiva.
Cataracte osseuse. (F.) Bony cataract.
Cataracte partielle. (F.) Partial cataract.
Cataracte pierreuse. (F.) Calcareous (stony) cataract.
Cataracte pigmentée. (F.) Pigmented cataract.
Cataracte platreuse. (F.) Cataract affected by calcareous degeneration.
Cataracte pointillée. (F.) Punctate or dotted cataract.
Cataracte polaire. (F.) Polar cataract.
Cataracte polaire antérieure. (F.) Anterior polar cataract.
Cataracte polaire postérieure. (F.) Posterior polar cataract.
Cataracte primaire. (F.) Primary, as opposed to secondary, cataract.
Cataracte pyramidal. (F.) Pyramidal cataract.
Cataracte rouge. (F.) "Red" cataract, a synonym of Cataracte noire, or Black cataract.
Cataracte secondaire. (F.) Secondary cataract.
Cataracte sénile. (F.) Senile cataract.
Cataracte siliculeuse. (F.) Siliculose (wrinkled) cataract.
Cataractes par la foudre. (F.) Electric cataract; one produced by lightning.
Cataracte spontanée. (F.) Spontaneous cataract.
Cataractes, Succion des. (F.) Aspiration of cataracts.
Cataracte stationnaire. (F.) Stationary cataract.
Cataracte stratifiée. (F.) Zonular cataract.
Cataracte striée. (F.) Striated cataract.
Cataracte traumatique. (F.) Traumatic cataract.
Cataracte trop mûre. (F.) Over-ripe cataract.
Cataracte variée. (F.) Irregularly marked cataract.
Cataracte végétante. (F.) Anterior polar cataract.
Cataracte verte. (F.) Green cataract. An ancient term for glaucoma.
Cataracte vésiculaire. (F.) Vesicular cataract—one of the phases of Morgagnian cataract.
Cataract Extraction, Homer Smith method of. The following quota-
tion from the Lucien Howe prize article on this subject by the author indicates its chief contentions:

It was found that the knife-needle is rarely sufficiently sharp clear up to the point, that its shape made it catch in the lens and if great care was not used the lens was apt to be dislocated. To make it more effective for the purpose intended the point is ground off, making the blade the shape of a miniature scalpel. The shank is made of equal size throughout so that it shall fill accurately the puncture made by the cutting surface. Previous and immediate to the operation itself the pupil is fully dilated by a 2 per cent. solution of homatropine. The eye is then cocainized, the aseptic details completed and the speculum inserted. If for the right eye, the operator stands at the head of the patient. Taking a firm and deep grasp, with the fixation forceps, upon the conjunctiva just below the insertion of the internal rectus muscle, the knife above described is thrust through the cornea about the middle of the supero-temporal quadrant and the blade carried down to the lower edge of the dilated pupil, its edge being toward the operator. The handle is then made to describe the arc of a circle away from the surgeon, and a cut is made through the capsule up to the upper limit of the pupil, the blade then slightly withdrawn is carried over to the inner side of the mid-pupillary space, the same maneuver repeated and a cut in the capsule at right angles to the first. The blade is then turned into the same plane at its entrance and withdrawn.

If for the left eye, the operator stands on the left side of the patient; the fixation is just above the internal rectus and the knife is entered in the infero-temporal quadrant; the cut in the capsule then begins at the upper limit of the pupil. The procedure otherwise is the same. After the capsulotomy the conjunctival sac is flushed with an antiseptic lotion, the patient given a hypodermic of one-fourth grain of morphine and put to bed. He is allowed to remain there from four to six hours before the extraction proper is performed. This does not differ from the ordinary method, but the corneal section should be ample, for most immature cataractous lenses are large. The period of waiting and the method of the capsulotomy are the two essentials of the operation. What happens during the waiting period is this: The capsule having been amply divided curls away from the cortex and allows the aqueous to insinuate itself between this and what remains of the enveloping capsule, causing a separation between the two. That this is true is seen by the ease with which the later delivery of the lens is always accomplished, and its clean, full and smooth outlines when it does come out.
Cataract extraction in the capsule. See Cataract, Intracapsular extraction of.

Cataracte zonulaire. (F.) Zonular cataract.

Cataract, False. Spurious cataract. Cataracta spuria. Any opacity in the ocular media, whether it be between the iris and the anterior capsule or anywhere in the pupillary area and not in the capsule itself is described as false cataract. Moreover, the same name is given to uveal pigment, pus, fibrinous or coagulated lymph blood, etc., in the same region. In other words, spurious cataract is outside the capsule or on it.

Cataract, Familial. See Cataract, Hereditary.

Cataract, Fetid. In certain forms of hypermature or Morgagnian cataract some of the fluid contents of the purse- or bag-like sac may undergo a special form of decomposition so that the mass is putrid and has a gangrenous or fetid odor.

Cataract, Fibroid. A spurious cataract, not in the lens but consisting of an opacity in the axis of vision elsewhere.

Cataract from convulsions. See Cataract, Concussion.

Cataract from ergot. It has long been known that ergotism is a cause of cataract. Norris (System of Diseases of the Eye, p. 294) points out that "the frequency with which cataracts are met in some local areas immediately after an epidemic of poisoning by ergot would seem to indicate that this drug has a similar power of disturbing the nutrition of the lens. Meyer describes an epidemic in Siebenbürgen where the symptoms were violent cramps of the muscles, with consecutive contraction, anesthesia of the feet, and, as a later symptom, cataract. The cataracts formed slowly, always in both eyes, and a large proportion occurred in young people. He attributes this to spasm of the intra-ocular muscles. Longetsnikoff reports seventy-one cases, and also attributes the formation of the opacity of the lens to contraction of the intra-ocular muscles. Telpjaschin saw in one locality, one year after an epidemic of ergot poisoning, twenty-seven cases of cataract, most of them in individuals under thirty years of age. Kortneff, after an epidemic in the district of Nolinsk, found that cataracts thus produced required from three months to one year to become ripe, and that those occurring in individuals over thirty years of age had the appearance and consistence of senile cataract. The eye-grounds were pallid and the vessels contracted during the period of convulsions, but at other times there was often hyperæmia."

Cataract from excessive light. The early experiments of Hess (Experimenelles über Blitzcataract, Int. Ophthal. Congress, Heidelberg, 1888) demonstrated what we now know clinically, namely that the arc light
and other forms of intense electric illumination (including lightning flashes) are capable of producing cataract. Hess and others found that the lenticular opacity is due to early death of the intracapsular or rather subcapsular cells, after which the changes extended to the fibrillar mass. See Cataract, Electric.

**Cataract from salt.** This is one of the numerous, so-called toxic cataracts produced by experimentation on the lower animals. It has long been known that either common salt or sodium nitrate, introduced in large quantities in the large intestine or under the skin of frogs, dogs, kittens, etc., produce lenticular opacities. The same thing is true of strong solutions of sugar. It is a moot question whether these changes are due to the extraction of watery elements of the lens or to an introduction of chemical substances beneath the capsule.

**Cataract, Fulguration.** See Cataract, Electric.

**Cataract, Fusiform.** A synonym of spindle or axial cataract. It is generally congenital, or shows itself early in life, is often hereditary and resembles the lamellar variety. When of the transmitted type it frequently affects successive siblings; more often the first born. Nettleship gives one extraordinary pedigree of five generations containing more than ninety individuals, thirty of whom are known to have had cataract. From the history, the cataract must have been congenital in every case and probably due to intrauterine changes.

**Cataract, Green.** A name given to the grayish-green reflex of glaucoma. It is seen when the pupil is dilated and the ocular media are not entirely transparent.

**Cataract, Grumous.** Cataracta cruenta. An obsolete name for an opacity due to hemorrhage into the cornea, anterior chamber or vitreous.

**Cataract, Gypseous.** An over-ripe cataract presenting a white appearance due to secondary changes in the lenticular substance.

**Cataract, Hard.** See Cataract, Senile.

**Cataract, Hereditary.** When one considers that changes in the lens affecting its transparency are rather the rule than the exception in persons above the age of 60, deductions as to the heredity of senile cataract, at least, should be drawn with considerable reserve. Every now and then, however, one encounters familial cataract presenting characters, either in itself or in individuals affected by it, that point irresistibly to a true hereditary influence. Notwithstanding the references in many text-books to the possible heredity of cataract, and in spite of the studies of Rampoldi, Fromaget, Daunt, Nettleship, of the last especially, on this subject, there are still many questions touching family cataract yet to be answered. Until the publication by Nettle-
ship (in his monograph on the subject) of a history of cataract in the Betts family, Berry’s account of familial cataract was the most remarkable. Fifty-five individuals, spread over five generations, furnished no less than 20 cases of cataract, mostly presenile. This record is in some respects broken by the story of the Betts family just referred to. A pedigree of 100 individuals during five generations exhibited 30 cases of cataract. In the latter instance every cataractous child had a parent with a cataract. In both these families the cataract developed early in life or was congenital. It went on to maturity in Berry’s cases if the patient lived long enough or unless it was removed; in the Betts family it generally remained stationary.

Although Nettleship does not claim to have given a complete literature on this subject, neither he nor any of the other writers on familial cataract have quoted more than one American investigator. Of 57 references in the Nettleship monograph only one of our authors, Stricker, is referred to. The Editor has mentioned (Some Forms of Hereditary Cataract, Ophthalmic Record, April, 1906) among those articles that foreign authors have failed to consult, a case of familial cataract noted by Howard Hansell (Ophthalmic Record, June, 1896). In this instance a large proportion of the descendants of a cataractous great-grandfather had congenital cataract. One grandmother, in the direct line, had congenital cataract. It was very marked in the “sibling” to which she gave birth. This woman had six children, three sons and three daughters; of these, two daughters and one son had double cataract. Her eldest daughter, with cataract, had three children. The first and third child died in infancy, but had no cataract. The second child, at that time a boy of two years of age, had double cataract.


A. R. Baker (Journal of the American Medical Association, September, 1892) gives an account of three brothers with zonular cataract, another brother and three sisters having normal eyes. The parents were cousins; one grandfather had senile cataract. This catalogue by no means completes the cases recorded by American observers.

The age at which cataract occurs in members of a family affected by cataract is generally about the same, although Nettleship makes out a good case for “anticipation” in these instances; that is to say, cat-
Cataract in a given generation shows itself earlier than in the preceding one. It must be remembered, however, that, other things being equal, the beginnings of cataract are more likely to be discovered the nearer one approaches the present time. This is true, not merely because methods of observation are more precise and medical men are more prone to make careful examinations of eye conditions than formerly, but because the younger patient knows there has been an unusual number of cataractous eyes in his family and is more likely to be on the watch for early signs of oncoming blindness than one whose family eyesight in the past has been fairly good.

The sex question is another matter that arises in this connection. Nettleship answers it by showing (1) that family cataract more often descends through the female members, and that (2) hereditary cataract tends to select one sex to the exclusion of the other. He also observes that when cataract affects more than one generation, it matters not from what variety or at what age acquired, it usually descends from parent to child and does not skip a generation.

The accompanying diagrams do not follow the device of Nettleship. For graphic description the old "family tree" idea is probably best. There are defects in all these ancestral "trees," because one must rely
for one's data upon the doubtful memory of some old people or on incomplete reports furnished by members of a younger generation.

The first diagram (Charlton family) affects a woman, 33 years of age, with lamellar cataract, whose great-grandmother had been blind from cataract, and whose mother at the time of this report also has cataract. The patient herself has five brothers and four sisters afflicted with juvenile cataract. Altogether it is a most remarkable series, because in this family we have 31 individuals representing four

Familial Cataract, Hussa Family.

In three generations (of 44 to 48 individuals) 12, and perhaps 14, had cataract, all of the juvenile type. Only "childships" affected by cataract are pictured in this diagram.
generations, of whom 11 members have had cataract, almost all of them of the presenile variety. No. 3 on the diagram has been seen quite recently, and there seems no question but that the cataract, in

![Diagram]

- Male without cataract.
- Male with cataract.
- Female without cataract.
- Female with cataract.

Familial Cataract. Ira Smith Family.

In two generations of 33 (perhaps 37) persons, six have had cataract of presenile varieties. Only "childships" affected with cataract are pictured in the diagram.

his case, was noticed when he was 12 years of age as a "small spot in front of each pupil," and that this spot had gradually increased in size, so that at 40 years of age the lens is almost completely opaque. There is sufficient immaturity, however, to show the character of the cataract, which consists mostly of blurred striae, radiating from a large central opacity in each lens. In every member of the family about
whom we could obtain definite information, the cataract showed itself distinctly in adult life, and the patient complained of "weak" sight or "short" sight during, and even before, his school days. "White spots" were also noticed at the pupillary area in each eye by various lay observers, and the diagnosis of cataract was, in most instances, made before adult age by various physicians who were consulted by the patients. In two cases the cataracts were operated upon with success.

Although the number of cataractous members of the Ira Smith family (see illustration) is not large, there are some peculiarities about the lenticular disease worth noting. In the first instance, the opacities did not develop, or at least did not give any considerable trouble, until comparatively late in life, although they were noticed in both eyes at or about puberty. This is true of every member of the family affected by the disease. In five of the six instances the patients were operated on after they had reached 60 years of age. With one exception, these operations were failures, and, with this exception also, the blindness set in from glaucoma without apparent infection and after the primary wound had healed. Three cataractous eyes were not operated on. Nevertheless in these three instances the patients became totally blind from secondary glaucoma. In three, Nos. 6, 7, 8, there was a temporary return of vision, i. e., the cataractous lens regained sufficient transparency to enable the patient to go about without difficulty.

The Editor removed the cataractous lenses from No. 7 and sent them to Adolf Alt. His report corresponds very closely to the observations made upon the cataracts in situ. He says: "The lens contained a number of beautiful crystalloid nests, probably lime deposits, base out, apex toward the center of the apparently spherical cavity." Alt regards this condition as rare, since he has never seen but one other specimen which showed similar crystalline formations in the lens, and especially in the nucleus, which otherwise appeared normal. I venture the assertion that the clearing up of the cataract in the three members of the family—transparency that almost always preceded the glaucoma from which the patients became ultimately blind—occurred from the absorption of interfibrillar exudates between the nests of lime-salts, due to active changes (probably associated with swelling) occurring within the capsules.

So far as could be determined, in none of the three series just detailed was there a common incident, apart from the occurrence of cataract; no consanguinity of parentage; no marked tubercular, syphilitic or scrofulous habit. None of the cases examined had glycosuria. They were as free of congenital defects as the average patient; those
that reached old age seemed to be as well as people of their time of life generally are.

Nettleship disposes of the allegation that familial cataract is one of the results of consanguineous parentage; nor has the Editor ever had a hint of it except in the secondary cataract of retinitis pigmentosa, due to or coincident with the issue of blood relatives.

Few authors have discussed the actual part played by hereditary predisposition in familial cataract, and it must be admitted that therein lies the chief difficulty. What are the principal factors? Do they consist in anomalous development of the nutritional apparatus of the lens system, or are they systematic peculiarities common to members of the afflicted kindships? Again, are they organic defects in the lens structure (as is probable in the case of the cataract examined by Alt from the Ira Smith family), and handed down from one generation to another? Precise answers to these questions undoubtedly call for further examinations, not only of the ocular structures, but of the subjects exhibiting hereditary cataract.

**Cataract, Heredity in.** See Cataract, Hereditary; Congenital anomalies of the eye; also Cataract, Lamellar.

**Cataract, Hypermature.** OVERRIFE CATARACT. MORGAGNIAN CATARACT.

The opportune time for the extraction of cataract is the date upon which it becomes mature. The ripe cataract is one that has passed through a certain degree of degeneracy, so that at length the capsule is readily separable from the lens proper. As Beard (Ophthalmic Diagnosis, p. 174) very properly says, "Just as in case of a perfect apple, for example, having reached its full size and development in a state of greenness, or of living union with its sources of life in the tree, it becomes a thing by itself, and proceeds to ripen by changes occurring within. Then the stem withers and it falls to the ground. Now other forms of degeneration ensue. By one it hardens and shrinks; by a second it turns black from oxidation; by a third it softens till all but the core becomes a complex fluid. These correspond to phases of hypermaturity in the cataract. By one process, the opaque cortical masses rid themselves of water, and by very slow condensing, hardening and (partially) clearing, it becomes of the consistency and appearance of the nucleus around which it tightly clings, eventually—after years, perhaps—having the semblance of freshly hardened, yellow gelatine. From having been blind the eye may now regain a modicum of vision. In this state it may remain indefinitely. Such is the sclerosed lens of aged subjects. In accordance with the second phase we have what is known as black cataract. Here the process is almost identical with that of the first phase, save
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that the color passes on from amber to brown, and, in extreme cases, to that little short of inky blackness. Formerly it was believed that the color was derived in some manner from the blood, but late researches, among them those of Gatti and Hess, have demonstrated that it is due to oxidation of the tyrosin, which is set free by decom-
position of the albumins of the crystalline body. At a glance, the pupil in many cases of black cataract seems to be normal, i. e., there
is apparently no reflex from it, but on strong focal illumination there
comes to view a dull gray through which shimmers a tinge of dark
brown; or the brown alone may be seen. In conformity with the
third phase, as illustrated by the apple, the liquid resulting from the
decomposition of the cortical fibres, either because of unusually imper-
vious walls, or some other reason, does not escape from the capsule.
The fibres undergo at one and the same time all the stages of hyaline,
fatty, cholesterin and calcific degeneration. Broken-down remnants
of fibres, globules of fat, crystals of cholesterin and granules of lime
first compose a mass whose consistency grows less and less until
there remains only a bag of liquid, to the bottom of which sinks the
nucleus, together with such of the heavier constituents of the mixture
as do not cling to the sides of the sac. This is hypermature liquid
cataract, or Morgagnian cataract. Here the aspect of the pupil, on
cursory examination, differs but little from that of well-advanced
cortical cataract, though it is sometimes strikingly white. Focal
illumination and the loop, however, fail to show any traces of radia-
tion or other markings in the gray or white pupillary field that are
peculiar to the cortical form. Instead, one may find what look like
patches of thickened capsule, or glistening white dots (lime granules)
lying against the capsule. There is likely to be iridodonesis, particu-
larly if part of the Morgagnian liquid has been absorbed. On dilating
the pupil, and having the patient make sudden and extended rota-
tions of the globe, glimpses can often be had of the brown nucleus
as it comes in contact with the anterior capsule in downward move-
ments of the eyeball. It is often quite deeply oxidized. With a
candle an image can sometimes be seen from the convex surface of the
nucleus, thereby giving an idea of its size, hence, also, of the necessary
extent of the corneal section to be made for its extraction. All three
of these forms are well suited to surgical intervention. Yellow
sclerosed lenses may be safely extracted when the vision is 20/200
or 20/100. Both these and the black cataraets are suitable for simple
extraction. For the Morgagnian type a small preliminary iridectomy
is desirable, as the nucleus is prone to be erratic, and lavage is needed
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to free the forward chambers of the insoluble contents of the capsule." See, also, Cataract, as well as the section on Cataract, Senile.

Cataract, Incipient. BEGINNING CATARACT. As long as the striae and other obstructions to normal vision observed in beginning cataract do not invade the pupillary area the patient may not be conscious of the lenticular disease.

Many of the relations of incipient cataract are discussed under Cataract; some additional observations, however, will be made here.

Changes of refraction produced by incipient cataract. It has been known for a long time that the cloudy lens is accompanied by increased refraction, so that in the case of a previously emmetropic eye so-called myopia arises. Machek (Abstract in Ophthalmology, July, 1909) has observed in one of his patients an exactly opposite condition, i. e., a lessening of the refraction in the early stages of cataract.

The patient was myopic 2 D; 20 years later the left lens began to opacify, the myopia being reduced to 1.75 D.

The contemporaneous change in the refraction with the opacification of the lens shows that the refractive change depended upon the lens, and the writer believes this to occur often, but it is generally overlooked. Observation of the refraction in cases of beginning cataract is usually made only where the opacity occurs in the equatorial zone; even in this stage the visual acuity may not be reduced sufficiently for the patient to consult an oculist. The author named cites the work of Hess, who had observed in beginning cataract that the capsular epithelium of the lens became sclerosed and in closer connection with the lens fibers; from this cause the lens is flattened and its refraction is reduced. The same observation has been made by Priestley Smith, who with both normal and opaque lenses showed that the latter had lessened power.

The coefficient of refraction of the lens is the greater the more it is differentiated from the coefficient of the cortex; the layers from the nucleus. Should the refraction coefficient of the opacifying cortical masses appreciably increase, so must the lens in toto lose just this much.

Deutschmann and Jacobsen have shown a loss of liquid in the first stages of cataract formation, which causes a partial loss of lens refractive power. The filling up of the lens by imbibition occurs much later, when the increasing opacification not only reduces the acuity but likewise causes changes in the refraction impossible to estimate.

M. Handmann, (Klin. Monatsbl. f. Augenheilk., December, 1909) in his examination of 845 eyes with incipient cataract, in which he kept records of the exact localization of the opacities of the lens found
that, in most cases, senile cataract commences from below and more to the nasal side (see Cataract, Thompsonian); more frequently from the equator and the posterior cortex than from the anterior cortex. The clinical observation corresponds with the anatomico-pathologis evidence that senile cataract is caused by disturbances of nutrition more pronounced in the lower segment of the eyeball than in the upper.

The difference in intensity of disturbances of nutrition above and below is due to the fact that pathologic products, in consequence of gravitation, damage the lower portion of the lens more than the upper, and that the physiologically active rays of the natural and artificial sources of light during the whole life, strike the lower halves of the lens and retina more than the upper portions, which are shaded by the upper lids. He found in the literature only two similar observations, by Hirschberg and Greene. The opacities of incipient cataract in glaucoma and diabetes show a more equal distribution over the whole lens; in myopia there is nothing characteristic.

*Does the opacity of incipient cataract ever regain transparency?*

Records of the striæ observed in beginning of cataract have been made by Leartus Conner (*Jour. Am. Med. Assoc.*, July 6, 1907), who has observed partial or complete clearing in seven cases. In a diabetic case, both lenses became transparent and remained so until the patient's death. This clearing up is rare, yet 51 observers report 147 cases. It is most frequent in the earlier stages of development. In the discussion of this paper, attention was called to the rôle of chorioiditis and of disturbances of general health in causing lenticular opacities. These cases were benefited by correction of ametropia, regulation of diet, and treatment of the chorioiditis. Improvement of vision might be due to gradual fading of incipient cataract, but was more often due to clearing of vitreous opacities. High arterial tension, with or without renal disease, gastrointestinal autointoxication, and the uric acid diathesis seem to be important etiologic factors. Lenticular changes due to imbition of aqueous, as in traumatic cataract, is most easily absorbed, whereas changes due to shrinkage generally persist. Hess called attention to experimental naphthalin cataract in rabbits. Ingestion of this drug destroys the lens epithelium and thus allows fluid to enter and spread between the fibers, producing opaque striæ. If the drug be stopped the epithelium is reformed and the opacities clear up. Similar conditions probably occur in man.

It is well to remember that in diabetic cataract the opacity is due to an exudate between, rather than to an actual change in, the lenticular fibrillæ; consequently it is easy to understand how, in the
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former instance the opacity may disappear and in the latter case its disappearance is, to say the least, highly improbable.

Marked betterment of vision in incipient senile cataract by the local use of a half per cent. resorcin ointment in vaselin is claimed by Etue. The application daily over a period of from three to four weeks is sufficient to bring about appreciable results. He has observed in this time an increase from Jr. 16 to Jr. 9. He states that developed cataract cannot be cured by this treatment, but cataract may be arrested in its incipiency, especially where the peripheral opacities have not reached the pupillary space. Even when this has taken place, practical results are secured. An improvement of from 8 to 4 numbers of Jaeger's test type is the rule. If the vision with test lenses is under Jr. 12-14, it is useless to try the experiment.

The effect of potassium iodid on incipient cataract. Pflugk (Graefe's Archiv. f. Ophthal., February, 1908) gives the following as a summary of his findings:

In rabbits the epithelial cells of the lens capsule overlying the interior sectorial lines differ in their anatomical structure as well as in their physiologic function from the surrounding epithelium.

With the aid of the palladium chlorid reaction it is possible in rabbits, cats, dogs, guinea-pigs and frogs to determine the route of entrance into the lens of subconjunctival injections of solutions of salt. The reaction appears earliest and most markedly in the line of the anterior sectorial lines of the lens in the form of a sharp blackish streak. Later as the result of the penetration of the potassium iodide through osmosis it affects uniformly the anterior surface of the lens. The first changes in the epithelium of the lens capsule takes place in naphthalinated rabbits in from 1½ to 2 hours after the administration of the emulsion. These changes are most pronounced over the sectorial lines.

By the simultaneous injection of weak solutions of potassium iodide these changes in epithelium of the rabbit's lens could be postponed several hours. By the administration of the potassium iodide solution for several days a decided limitation of the growth of the capsular epithelium in the naphthalin lens of the rabbit could be observed.

The acknowledged parallelism between naphthalin cataract of rabbits and human senile cataract makes it probable that the improvement of vision following the administration of preparations of potassium iodide (collyria, baths, subconjunctival injections) which has been observed by a long list of writers (Badel, Dufour, Boisseuil, Dransart, Lafon, v. Pflugk) is the result of action upon the epithelium.
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of the lens and its surroundings by the penetration of the potassium iodide.

Reports of clearing up of well observed lenticular opacities are to be found in literature in large numbers in records free from criticism. Inasmuch as the possibility of clearing up of lenticular opacities with an accompanying improvement in vision is demonstrated, the doubt cast on the correctness of the observations of Badal and his pupils is not warranted.

A résumé of the published clinical histories of cases of incipient cataract in man treated by the iodide method shows that of the 239 eyes treated in a large number a very great improvement in vision occurred. The length of observations in which the opacity was controlled in the isolated cases of Badal was 5 years and in the 30 published cases of the author it was of varying length—as long as 4 years. As the entire harmlessness of the treatment of Badal has been confirmed by an unusually large number of observed cases, the treatment of incipient cataract by the potassium iodide method is urged. A review of the cases treated by the iodide method shows that a much greater improvement is to be obtained in the visual power by the subconjunctival injection than by instillations and baths of equal strength solutions. By the use of the author's method of anesthetizing the conjunctiva and the employment of a coin as an addition to the fluid to be injected as well as its use after the injection it is possible to render the subconjunctival injection of potassium iodide completely painless.

Badal employs as a collyrium a solution of potassium iodide (0.25 to 10.0) and as an eye bath (7.5 to 300.0) the latter in a gradually increasing concentration. While Badal gave up the subconjunctival method the author has found it by far the most efficacious and painless if employed as above directed in a 1 per cent. strength.

In incipient cases 3 drops of a solution of 0.25 to 10.0 is instilled into the eye twice daily. More advanced cases are treated by eye baths of increasing concentration, 7.5 to 300 to 20 to 300, twice daily in an eye-cup 2 to 5 minutes. The solution is to be warm. As a guide to its employment the author says that after the visual acuity is improved the treatment must be kept up at least one month. If then, after a period of nontreatment, the opacity seems to have come to a standstill, the treatment is, after about 3 months, renewed in a milder form for a period of several weeks. If, in spite of this treatment, the opacities increase, the subconjunctival injections are employed. See also under general caption of Cataract (treatment).

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