use at the present day, and are considered to furnish, on the whole, a larger percentage of success than all others. There are, however, two methods that have attracted a good deal of attention and found influential advocates. They deserve at least a passing notice. Liebreich's method of extraction is performed as follows, the knife used being similar to that in peripheric linear extraction, only somewhat narrower: The patient is in the recumbent position, the pupil under the influence of atropine. Supposing the right eye to be the one to be operated on, the surgeon stands behind the head of the patient. He raises the upper lid with the forefinger, and steadies the eye by pressing lightly against the sclera with the middle finger of the left hand. The right hand holds the knife, whose back is directed horizontally and backward, while the plane of its blade forms an angle of about forty-five degrees with the horizontal meridian of the eye. The point is made to enter the sclera about 1 mm. away from the edge of the cornea and 2 mm. below its horizontal diameter, and to emerge at a similar point on the opposite side. The knife is then made to cut its way out downward, forming a flap, the apex of which is 2 mm. above the lowest point of the cornea. The cut itself is formed with the least possible sawing motion, the knife being in the first instance thrust so far forward that the section can be completed as it is withdrawn; and at the last moment the upper lid is suffered to fall. Next, the capsule is carefully opened. "For the third act of the operation," says Liebreich, "we lay the Daviel spoon gently against the lower edge of the cornea; while the left forefinger, by which the upper lid is raised, exercises a slight pressure through the lid against the upper part of the cornea. The lens is thus slightly tilted, its lower edge presses against the posterior surface of the iris, folds it forward, glides over it to the edge of the pupil, overcomes the resistance of the sphincter, and engages itself in the wound, which contact with the Daviel spoon has already caused to open. The forefinger of the left hand slightly presses the upper lid from above downward over the cornea, and thus completes the expulsion of the lens. A similar manœuvre with the lid is again employed to extrude the cortical substance which has been left behind, after a little rubbing has been done to drive it from behind the iris toward the centre of the pupil. If, after this is completed, the pupil does not appear round but seems drawn toward the wound, its natural shape may be restored by rubbing upward with the lower lid. If this does not prove effective the Daviel spoon may be introduced."[14]

This operation commends itself by its simplicity, by the small number of instruments which its execution requires, and by its comparatively slight interference with the eye. No extended statistics of its results are accessible. The dangers attending it are obvious—the possibility of the iris healing in the wound, and the production of astigmatism due to the position of the corneal cut.

Lebrun's operation much resembles that of Liebreich. The points of puncture and counter-puncture are, however, at the edge of the cornea, 1 mm. below its horizontal diameter, while the cut is made upward, its apex reaching a point at the junction of the upper and middle third of the vertical corneal meridian. During the cutting process the edge of the knife is gradually made to change its direction; starting from an angle of thirty degrees with the basis of the cornea it ends at right angles to it. At the middle of the curve, therefore, the cornea is divided vertically (Arlt). The same objection may be made to this operation that was advanced against Liebreich's, though its application here is even more forcible. The danger of anterior synechia is greater, that of astigmatism is imminent, and corneal opacity, from imperfect or delayed healing of the wound, extremely likely to occur. In the opinion of the writer, and in view of the results that a careful collection of statistics has proved to attend the method of peripheric linear extraction, the operation of Lebrun is not to be advised at the present day.

Flap Extraction.—No article on cataract would be complete without a description of this method, which for so many years stood at the head of all operations for senile cataract, and whose complete eclipse by the method of von Graefe and by simple extraction is due to their increased percentage of success. The instances in which its performance at the present day might be desirable are so exceptional that it is mainly of interest from an historical point of view. The rapidity with which it has been thrust into the background is illustrated by the fact that, within the memory of the older generation of ophthalmic surgeons now on the stage, it was the only recognized operation for senile cataract.

It is not advisable to perform this operation without an assistant. Although the spring speculum may be used to separate the lids, the finger is far preferable, both on account of the ready closure which its withdrawal permits, and also owing to the diminished danger of pressure on the eyeball. The patient being in a recumbent position, the operator sits on the edge of the bed in front of him, generally on his right side. The left hand is employed for operating on the right eye, the right on the left. The knife used is shown in Fig. 1164. If we assume that the left eye is to be operated on, the assistant takes his stand behind the patient's head. He draws down the lower lid with his right forefinger, being careful not to evert it, and spreads his remaining fingers in such a way that they may interfere with the movements of the operator as little as possible. With the forefinger of the left hand he raises the upper lid, drawing it gently upward, parallel with, but not away from, the eyeball, pressure being made against the edge of the orbit. The operator fixes the eyeball, below the cornea, with the ordinary fixation forceps. Holding the knife with its edge downward, he introduces the point in the horizontal meridian of the cornea, just at its transparent edge, and having penetrated into the anterior chamber, carries the blade rapidly across it, keeping it parallel with the iris, until it emerges on the opposite side at a point corresponding to that at which it entered. The eyeball, being now held on the knife, is thus perfectly controlled, and the fixation forceps may be dispensed with. The handle of the knife is now slightly thrown back toward the temple, and the blade pushed gently but steadily forward, completing the cut, if possible, without withdrawing the blade at all backward; great care being taken to inflict no unnecessary violence on the cornea by pulling or twisting. As the cut is completed the assistant allows the upper lid to escape from his finger and gently descend. The peculiar wedge shape of the knife used thus gives us a semicircular cut, extending around the entire periphery of the lower half of the cornea, the length of the wound being about 9 mm. and its capacity of opening in the vicinity of 4 mm., thus affording ample space for the passage of the largest cataracts.

Fig. 1164.—Beer's Knife.

Great care must be taken not to draw back the knife before the counter-puncture has been made, and if possible before the completion of the cut; and the hand of the operator must be perfectly steady, in order to keep the blade always in the same plane. A neglect of either of these precautions might result in the premature escape of the aqueous humor and the folding of the iris over the edge of the knife. Should this latter accident happen, gentle pressure against the cornea with the middle finger will often cause the iris to recede. If it is impossible to effect this, the cut must be completed without regard to the slight deformity to the pupil that would result from the excision of a small piece of the iris substance.

The cut just described can also be made upward with equally good result. This course offers no special advantages; and the execution in this direction is, in many cases, somewhat more difficult.

The operator now himself assumes the raising of the upper lid, using for that purpose the thumb of the right

hand. Directing the patient to look down, he lifts up the flap with the back of the cystitome, which is so held that its cutting edge looks downward, and whose shaft now occupies the anterior chamber, while its point remains external to the eyeball, projecting inward from the inner corneal edge. Drawing the instrument, in this position, from left to right, he causes its point to glide into the anterior chamber. Once opposite the face of the lens, he makes a half-revolution by slightly twirling the handle between the thumb and fingers until the cutting edge is in contact with the anterior capsule. The knife being rapidly drawn along its face a horizontal opening is made. Another opening should be made at right angles to the first, the point of the cystitome having first been disengaged from the lens substance and passed upward to the spot at which the incision is to commence. The instrument is then laid over on its back and withdrawn from the eye, the process by which it entered being simply reversed.

To effect the delivery of the lens the patient is directed to look up. The surgeon raises the upper lid with the thumb of one hand, while he places the forefinger of the other on the lower lid. Gentle pressure on the eye, made with the thumb through the upper lid, causes the lens to turn on its horizontal axis and its lower edge to enter the wound. By now making the upper lid descend over the cornea in a succession of sweeping movements, the lens is, as it were, coaxed out and escapes from the eye. After its greatest diameter has once entered the wound, the rest passes with very little persuasion. If it was already dislocated into the anterior chamber, it will escape as soon as the cut is completed. After the removal of the lens the patient is allowed to take a brief rest. The eye must then be carefully inspected to see whether the pupil is free from cortical remains, whether the iris is well in place, and whether the edges of the wound are in proper apposition. Much information as to the state of the pupil may be gained by ascertaining whether fingers can be counted a short distance off. If there is a prolapse of the iris, it may often be made to recede by slightly rubbing the upper lid against the cornea; but if this cannot be effected it must be excised.

The after-treatment of flap extraction is similar to that already described under the head of Peripheric Linear Extraction, the dressings being identical. Less freedom, however, can be allowed the patient immediately after the operation, as sudden movements must be carefully guarded against, and the presence of a cough might be extremely prejudicial. In brief, the proper healing of the wound largely depends on the preservation of perfect quiet, on the part of the patient, during the first twenty-four hours. Occasional change, for a few minutes, from a recumbent to a sitting posture may be allowed. For several days the food should be liquid, or at least quite soft, and all chewing is to be avoided.

Some very few cases still remain in which flap extraction might with justice be preferred. Besides being applicable to dislocations of the lens into the anterior chamber, it is especially available when a foreign body is situated in the lens and requires to be extracted with it; also when a cicatricial condition of the upper part of the cornea prevents peripheric linear extraction in this region.

The description of a single remaining operation, wholly given up to-day in civilized communities, on account of the dangers to which it exposes the eye, but still in general use among the natives of India, will also be of interest in an historical point of view.

Reclination.—This is the oldest method known, and is referred to by both Galen and Celsus. It consists, in brief, in the removal of the opaque lens from the axis of vision by pressing it downward, or downward and backward, with a suitably shaped needle, introduced for this purpose sometimes through the cornea, but more generally through the sclerotic.

According to Arlt, the operation would be performed in the following manner: The pupil is artificially dilated. The lids being separated by a spring speculum, and the eyeball seized with the fixation forceps, the needle (Fig. 1165), with its convexity directed upward, is made to penetrate the sclerotic somewhat below the horizontal meridian, and about 4 mm. from the corneal edge. One cutting edge of the needle is directed toward the anterior, the other toward the posterior pole, and the point toward the middle of the vitreous humor. "After it has passed in up to its neck, the handle is turned on its axis (toward the thumb), so that the convexity, formerly upward, is now directed forward. The handle is now lowered toward the lobe of the ear, in order that the point may be pushed forward toward the edge of the lens, and farther, until it enters the posterior chamber. Steadily pushed forward, the needle now enters the pupil, where its metallic sheen is recognized, provided it emerges external to the capsule. When the point has once reached the opposite pupillary edge and passed behind it, the instrument is to be regarded as a lever, the fulcrum being situated in the sclerotic. The handle is now raised toward the nasal eminence, and the lens depressed downward and outward. The handle is to be raised no higher than is sufficient to form an angle of about one hundred and twenty degrees with the corneal basis. A brief pause with the needle in this position is necessary in order that the vitreous may settle down properly around the lens. The instrument, held thus, is withdrawn up to its neck, and then returned to the position which it occupied before its advance toward the edge of the lens. If a single performance of the manœuvre results in the lens remaining fixed, a thing usual when the consistency of the vitreous humor is normal (always provided the lens has been attacked at its centre of gravity), the handle is to be twirled round in the opposite direction, away from the thumb, and withdrawn from the eye in the line of the original puncture. Should the lens rise before the withdrawal of the needle, a second and third effort at replacement may be made. Further attempts would hardly accomplish the object, and might easily do harm by breaking up the structure of the vitreous."[15]

Fig. 1165.—Reclination Needle.

At the present day this operation for cataract is probably more largely performed in India than in any other part of the world. The armamentarium of the native travelling oculist consists of a sharp knife, the blade of which is wound around with some material so as to leave only the point free, and a copper probe or spatula. With the former an incision is made through the sclerotic, while the latter is introduced through this opening and the lens depressed. The inability of these self-educated practitioners to do extraction is, of course, one reason why this method is so generally used. But, in addition to this, we are told that suppurative keratitis is exceedingly frequent among the poor, rice-fed Hindoos after flap extraction. Thirty per cent. of the operations formerly performed in Calcutta are said to have failed in this way.[16] The writer here quoted also states that hardly a week passes that he does not see, in the hospitals of Calcutta, patients on whom reclination has been done, suffering from either inflammation of the choroid or from retino-choroiditis.

When reclination is followed by success, the lens probably becomes encapsuled in its new position. If, on the other hand, inflammation follows, it ordinarily involves the iris, choroid, or ciliary body, or may attack all three. The outcome is, of course, most serious. Secondary glaucoma may follow. But the lens, even when encapsuled, may subsequently act as a foreign body. For it is to be remembered that the complete absorption of a hard cataract in this position is not to be reckoned on. Destructive inflammation may come on years later and all vision be destroyed. Sympathetic inflammationn of the other eye may even ensue. It is, therefore, hardly possible to conceive of circumstances in which the operation of reclination may at the present day be regarded as justifiable.

History of Extraction.—It is uncertain whether the ancients were acquainted with this method; it is probable however, that they were, as passages in Galen and Pliny have been thought to refer to the removal of the cataract from the eye. At all events, if known, it fell into nearly complete disuse and oblivion; and not until the time of Daviel, in 1750, did it begin to be cultivated as a recognized procedure. This surgeon used numerous instruments, consisting of narrow sharp and blunt knives, and scissors; he made at first a small opening in the cornea, enlarged it afterward, and then removed the lens. His followers sought to improve his method by simplifying its application, and soon superseded the various instruments he had used by a single knife. This was subsequently modified, especially by Beer, to whom we owe the form of knife used in flap extraction at the present day. Gradually more exact rules were laid down for the performance of this operation; the situation and size of the cut, the best method of opening the capsule and pressing out the lens were all perfected. Despite the utmost care, however, used in carrying out the various steps of the operation and in the after-treatment of the patient, there was an appreciable percentage of loss; owing largely to one of three causes—diffuse suppuration of the corneal flap, defined suppuration of the same, and iritis. To diminish the danger of the second of these, but more particularly to guard against the last, Mooren proposed, in 1862, that a preliminary iridectomy be performed some two weeks before the extraction. The results which he obtained by pursuing this method were proved to be incontestably superior to those that had followed the simple operation. This was the first great step forward in the path now pursued. It allowed the lens to emerge more readily, and subjected the iris to less danger from pressure and bruising in the process. In 1863 Jakobson proposed the following operation: He narcotized his patient and made a lower section in the sclero-corneal junction, practising a broad iridectomy downward after the removal of the lens. He thus gained the advantage of doing the whole operation at one time, but incurred the disturbing effect of an iridectomy downward. Previous to the bringing forward of either of these methods, Schuft (now Waldau) had invented, and in 1860 published, a series of spoons intended to remove the lens through a small wound at the edge of the cornea. These were, however, large and clumsy, did great violence to the eye, and were, in 1865, superseded by others much more delicate, invented by Bowman and Critchett. Outspooning remained for a time a favorite method in England, but was afterward given up on account of the dangers which it involved. In 1865 von Graefe brought out the method that bears his name, and gave an account of it to the Heidelberg Society at its annual meeting. It quickly found its way into general favor, and, with the modification in the cut described in the course of this article, has remained the popular method up to the present day.

Other modern procedures demand a brief notice. In 1866 Alexander Pagenstecher described an operation for removing the lens in its capsule through a broad incision made with a lance knife, and by means of an iridectomy downward and outward. A specially constructed scoop was employed. In 1867 Weber devised a lance-knife, 12 mm. broad and somewhat concave on its back. With this he entered the anterior chamber at the lower or lower-inner edge of the cornea, in the plane of its basis, and made a wound 10 mm. in length. If he thought it best to remove any iris, he excised but a small piece, and that from the pupillary edge. The opening of the capsule and removal of the lens, which latter was effected by pressure, completed the operation. Kuechler, in 1868, proposed to remove the lens through the natural pupil, making an incision straight across the cornea in its horizontal meridian. Analogous to this are the operations of Liebreich and Lebrun, already described.

A consideration of the following figures will show why flap extraction has fallen into disuse, and why the peripheric linear method has taken its place.

Graefe's own statistics were as follows: Simple flap-extractions, 600—loss, 7 per cent.; flap extractions with iridectomy, 900—loss, 5 per cent.; linear extractions, 600—loss, 2.8 per cent. Horner gives: Linear extractions, 1,088—loss, 2.67 per cent. Noyes has collected from various sources: Flap extractions, 10,094—loss, 10.4 per cent.; linear extractions, 10,661—loss, 5.8 per cent.

The larger proportion of loss given, according to the figures of Dr. Noyes, would naturally be connected with the large number and varying skill of the surgeons whose results are thus grouped. *Hasket Derby.*

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CATARRH, NASAL. See *Nasal Cavities, etc.*

CATECHU.—Cutch; Black Catechu. "An extract prepared from the wood of *Acacia Catechu* (L.f.) Willd. (fam. *Leguminosæ*)" (U. S. P.). Catechu is similarly obtained from the wood of *A. Suma* Kurz. That of the present edition of the British Pharmacopœia is discussed under *Gambir*. This species of acacia is a crooked, straggling tree of thirty to forty feet in height, with a trunk about a foot in diameter. It grows commonly in India and Burmah, and yields a very durable, hard timber and a tan bark. The sap wood is whitish, the heart wood of a very dark brown. It is said that both are extracted for the catechu, the process being by boiling the chips. The decoction, more or less purified by straining, is evaporated by artificial heat and is then moulded into various forms. The moulds are commonly lined with leaves, the remains of which adhere to the outer surface of the dried masses. The latter are of various forms and sizes, according to the custom of the locality or the convenience of the maker. The best usually come in the form of slabs or blocks, of the size and form of an ordinary bread pan. In India a superior quality, of a light brown color, is prepared chiefly for mastication by introducing sticks into the thickened decoction, when the catechu collects upon them, after the form of crystals. Dymoch and Hooper ("Pharmacographia Indica," i., 558) describe a very high-priced sort which is collected from cavities in the trunk. This is called *Khersal* or *Khairsal*, and is of a very pale-brown or yellow color. The official description of catechu is as follows:

In irregular masses, containing fragments of leaves, dark brown, brittle, somewhat porous and glossy, when freshly broken. It is nearly inodorous and has a strongly astringent and sweetish taste.

If 20 parts of catechu be digested with 200 parts of alcohol and the liquid filtered, the undissolved matter, after being dried at 100° C. (212° F.), should not exceed 3 parts in weight.

The tincture, diluted with 100 parts of water, acquires a green color on the addition of ferric chloride T.S.

If 2 parts of catechu be boiled with 20 parts of water, a brownish-red, turbid liquid will be obtained which turns blue litmus paper red.

Upon incineration, catechu should not leave more than six per cent. of ash.

To this description it may be added that the color of some which is very good may be better characterized as a brown-black, and that a microscopical examination reveals the presence of a large quantity of minute crystals of catechin. Emphasis should be laid upon the fact that good catechu is nearly odorless. Much of what comes to our market possesses a vile odor. It is toughish, scarcely porous, and has a waxy or greasy looking surface instead of the lively, slightly sparkling lustre of that which is pure. Such is largely used for tanning and similar purposes, but is not fit for medicinal use.

About one-third of catechu consists of *catechin* ($C_{21}H_{14}O_9 + 5H_2O$), and about one-half of *catechu-tannic acid* ($C_{21}H_{14}O_9$). The latter can be obtained from catechin by heating, especially with the addition of water or alkalies.

Catechu, as its composition would indicate, is a pure astringent, which may be generally used either externally or internally, when this effect is desired. We have official a compound tincture, of ten-per-cent. strength, with diluted alcohol and one-half per cent. of cassia, the dose 2 to 8 c.c. (fl. ʒ ss. to ij.). The official troches contain each 6 cgm. (about gr. i.) of catechu, with tragacanth and sugar. *Henry H. Rusby.*

CATHARTICS. See *Laxatives* and *Purgatives.*

CATHETERISM OF THE URETHRA.—The term catheterism, often erroneously written catheterization, is employed to designate the various methods used in exploring and relieving the many pathological conditions of the urethra and bladder. The term is especially used to designate the introduction of hollow instruments through the urethra into the bladder for the purposes of withdrawing the urine, evacuating blood clots, removing fragments of stone after litholapaxy, exploring, irrigating the urethra and bladder; and the employment of solid instruments for the purposes of dilating stricture, of removing foreign bodies, and of crushing stone.

The word catheter, derived from the Greek καθίημι, meaning a "thing to send down," or "to let into," conveys no idea of the character of the instrument or of its use, nor whether it is solid or hollow, straight or curved, conical or cylindrical, large or small. But the derivation of the word may serve to explain why the term catheterism is employed to indicate the introduction of all varieties of urethral instruments for whatever purpose employed.

Throughout this article the term catheterism will be confined in its meaning to the introduction of hollow instruments into the bladder, through the urethra, for the purposes of evacuating the urine; of examining the urethra and interior surface of the bladder; of introducing various medicaments for the relief of pain or for the cure of diseases; of irrigating the urethra and bladder; of distending the last-named organ with either water or air as a preliminary to operative interference, and of establishing continuous drainage in cases of cystitis after injuries or operations upon the urethra, prostate gland, or bladder.

A catheter is a hollow instrument either open at both ends or terminating at one end in a solid point with an opening placed laterally or on the superior aspect of the instrument; this opening is known as "the eye." Catheters vary in size from 2 to 30 mm. in circumference, and from thirteen to fifteen inches in length. They are either flexible or rigid, straight or curved, cylindrical or conical. If the instrument is cylindrical, a uniform calibre is maintained throughout its entire length; if it is conical, it tapers toward the vesical end and terminates either in a fine point or in an olivary tip, becoming smaller in diameter as the end of the instrument is reached.

The exact method of manufacturing the best grades of flexible catheter is a secret with the individuals by whom the instruments are made; especially is this true of the preparations employed for coating, as well as of the method of giving the high polish and satin finish which the better grades of instruments possess.

Soft rubber, bevelled-eye catheters, the so-called "soft caoutchouc catheters," are made from india rubber which has been vulcanized. There is also a more rigid form, the cheaper grades of which are manufactured from either cotton or linen; these materials are employed as a framework, and are coated with either shellac or resin varnish.

The objection to the cheaper forms of flexible catheter is the readiness with which they absorb water, making them liable to swell, as a result of which the coats crack and peel, the elasticity disappears, and the instrument is rendered stiff, brittle, and worthless. The use of antiseptic solutions causes the instrument to become rough on its surface and so brittle as easily to be broken.

Fig. 1166.—Woven Eye of Catheter.

The most expensive and reliable flexible catheters are made from either cotton, or Lisle, or silk thread woven into a web and usually coated with a gummy material. As soon as this material becomes dry it forms a translucent cover, takes on a high polish, and at the same time remains elastic and pliable. When properly coated the instrument should be able to withstand moist heat, steam, dry heat, or immersion in boiling water for at least five minutes, and should have the power to resist the action of ordinary antiseptic solutions, acid or alkaline urine, and pus. The frame should be perfectly smooth and free from irregularities, the end should be firmly stayed, and the whole instrument should possess the highest tensile strength.

Interesting statistics are given by Gouley in an article on catheterism which appeared in the New York *Medical Journal*, November 4th, 1899, in which he says: "The tensile strength of different qualities of web catheters was ascertained to be as follows: That of an English commercial catheter was 42 pounds; that of an American commercial catheter 54 pounds; that of an American Lisle thread catheter 56 pounds; that of an American silken linen catheter 60 pounds, and that of an English silk web catheter 85 pounds. An American silk web catheter of the best quality was then tested to 115 pounds without breaking, but the varnish was stripped off at each end."

Theoretically these instruments are supposed to be as highly polished on the inside as on the outside, so that they may be more readily cleansed and sterilized, and the danger of infection thereby lessened. Unfortunately, it is wellnigh impossible to arrive at this condition of perfection. The nearest approach is to be found in the high grade of catheter, but at a greatly increased cost. The eye of all flexible web catheters should be woven,

Fig. 1167.—Eye Cut with a Punch.

strengthened, and stayed, whereby the continuity of the frame is left unimpaired. In the inferior grade of web-catheters the eye is formed by cutting with a punch, which is most objectionable, as the catheter is very apt to fracture at that point.

Flexible catheters made of silk web are by far the most serviceable and the best. They cost more than those made from other materials, but are cheaper in the end; for they are more durable, and, with proper care, can be made to last a long time. They are not so liable to crack or break as are the cheaper varieties; they are more easily sterilized, and hence are the safest of all the varieties of web instruments that can be employed. The danger of infection from their use is lessened. They do not become sticky, nor do they blister in warm weather;