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NOYES (HENRY D.)

PAPERS PRESENTED

TO THE

Fifth International Congress of Ophthalmology.

BY

HENRY D. NOYES, M. D.,

NEW YORK,

PROFESSOR OF OPHTHALMOLOGY AND OTOTOLOGY IN BELLEVUE HOSPITAL MEDICAL
COLLEGE; SURGEON TO THE NEW YORK EYE AND EAR INFIRMARY.

*ON THE USE OF A NASO-BUCCAL FLAP FOR BLEPHARO-
PLASTY, WITH TWO CASES AND ILLUSTRATIONS.*

*ON ADDITIONAL MEANS FOR RELIEVING PRESSURE OF THE
EYELIDS IN DISEASES OF THE CORNEA, WITH AN ILLUS-
TRATION.*

*ON THE OPTICAL ERROR OF CONICAL CORNEA, AND REPORT
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ON THE USE OF A NASO-BUCCAL FLAP FOR BLEPHAROPLASTY, WITH TWO CASES.

It is perhaps hazardous to assert that the method of operating to be described is new in ophthalmic surgery, but it has certainly not secured for itself a recognized place. I find no mention of it in systematic works; but it must be supposed that cases have occurred in which surgeons have employed it without having called special attention to the subject.

The usual localities from which flaps are taken for restoration of the eyelids are the temple and the outer portion of the cheek, and the vessels upon which reliance is placed for nourishing the flap are the branches of the temporal artery. Less frequently flaps are taken from the middle of the forehead as for rhinoplasty, and the nutritive vessels are the twigs which come from the cavity of the orbit at the inner and upper part. It is to the vessels of this region, in their capacity for nourishing a flap taken from the naso-buccal furrow, that I wish to call attention. The flap is formed by incisions down the side of the nose and cheek, as far as the upper lip, or to the level of the mouth, if necessary; the free end is below, the attached end or pedicle is above. In both cases reported the pedicle was narrower than the free extremity. The incisions defining the pedicle must be made so as to include not only all the twigs which come from the orbit of the same side where the deformity exists, but to contain also some branches from the other side of the median line. The vessels coming from the orbit are terminal branches of the ophthalmic, and are more

numerous than may be supposed. There are: 1, the supra-orbital, which goes to the supra-orbital notch and the skin of the forehead; 2, the anterior ethmoidal sends a few twigs to the skin, and the palpebral branches; 3, superior, and 4, inferior, lie one above and the other below the tendon of the orbicularis; they are important feeders to the skin of this region; 5, the nasal branch appears above the tendon of the orbicularis and inosculates freely with the nasal and angular branches of the facial artery. The last-named vessel is the most important, by reason of its size, its situation, and its free communications with the facial. Even when, by the incisions, the blood supply of the flap can no longer be derived from its natural source through the facial, the existence of the free anastomoses prepares channels through which the supplementary circulation from above can be distributed to the lower end of the flap. Besides these resources, if the incision defining the median side of the pedicle be laid obliquely across the nose, below the naso-frontal suture, some vessels will be brought into service coming from the circulation on the opposite side of the median line. Without laying too much stress on this last-named supply, the incision should be placed as designated to increase the depth of the pedicle and diminish the abruptness of its turn when it is finally placed in position. Another matter is important to success, viz., to keep near to the bone in the angle of the eye in dissecting up the flap. The tendon of the orbicularis is not disturbed, but above it pains must be taken to include in the thickness of the pedicle as much tissue as possible. Special care must be exercised not to carry this dissection farther up than is absolutely needful for the suitable adjustment of the flap. Every stroke of the knife at this point is aimed at the fountain of nourishment.

By taking heed to these cautions, it is possible to obtain a flap fully three inches in length, reaching down almost to the commissure of the mouth, which shall preserve its vitality after transplantation to a degree sufficient for an extensive repair of tissue—I mean that, while at its extremity the surface of the flap may slough, its deeper and extreme part will live, and the proximal two-thirds will be unimpaired. Such was the experience of two cases which are related in detail.

The indications for this method are two-fold: 1. The repair of lesions about the inner halves of the lids; 2. The supply of material where there is no skin available for flaps either upon the forehead or temple, or outer portion of cheek. It is to the cases under the second indication that attention is called.

CASE I.—Juan Grace, aged twenty-eight, painter, was burned by kerosene-oil upon the entire scalp, forehead, and right cheek. He was received at first into Bellevue Hospital, and after some months was transferred to Charity Hospital, Blackwell's Island. I saw him first after he had resided three months in this hospital, and six months after the occurrence of the accident. A large amount of repair had been accomplished—the whole scalp had been restored, and a thin growth of hair had come in. Over the forehead there was a tense and shining cicatrix, which would, however, never become fully sound, because it was so tightly stretched by the contractile tendencies of the large area of new tissue that spots of ulceration continually existed. They would partially heal, and then break out again.

The most distressing deformity was the condition of the right eye. The upper lid was pulled far up to the forehead, being not only completely everted, but dragged up so that the ciliary border was found coincident with the eyebrow. The conjunctival surface was hypertrophied with a mass of granulations and papillæ, the eyeball in a state of great irritation, the cornea moderately hazy and vascular. The lower lid had not been damaged. The cheek in front of the ear was a firm cicatrix.

The upper lid of the opposite side, the left, was partly everted, but not to a considerable degree. Patient was reduced in health by the protracted suppuration and residence in hospital, but had a reasonable amount of vigor.

To relieve the repulsive and painful condition of the right upper lid was a difficult and formidable task. None of the usual proceedings could be employed, because there was no tissue in the usual localities which could be utilized. I finally decided upon trying the capabilities of the naso-buccal flap. The whole upper lid was to be restored, and a large piece of skin was needful.

The first step was to release the upper lid from its adhesions by a horizontal incision along the orbital edge and careful dissection until the superior and inferior tarsal edges could be brought together. From the inner end of the incision, which reached almost to the median line, a cut was carried down along the inner canthus upon the cheek as

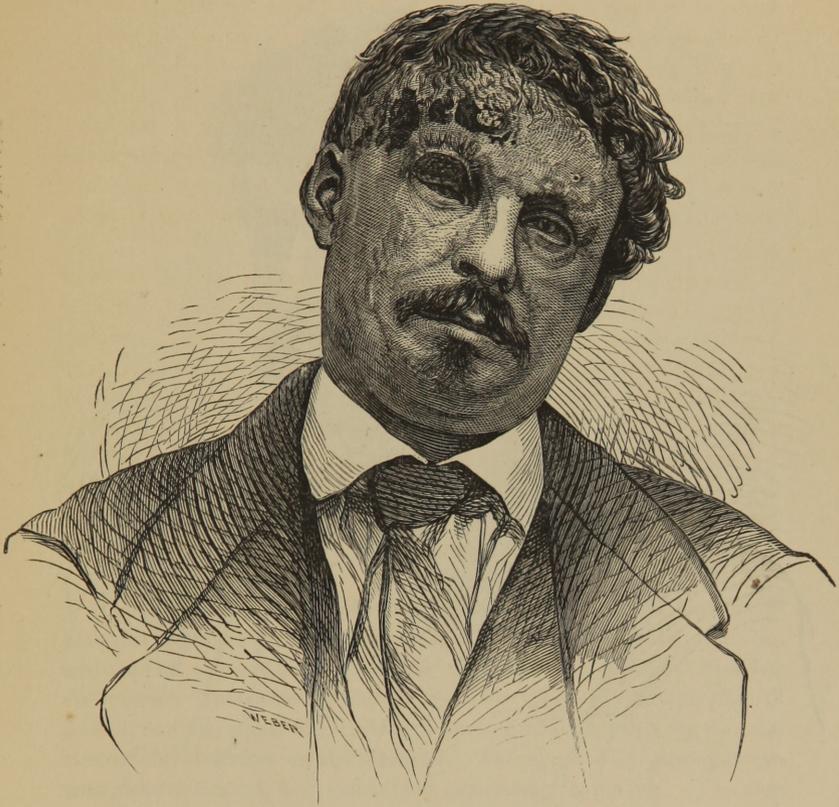
far down as the mouth, running obliquely downward and outward. Parallel to this another cut was made nearer the median line, which began above on the left or opposite side of the root of the nose, ran across it obliquely, and, keeping on the inside of the angular artery, passed close to the wing of the nose, and was curved outward to complete the outline of the flap by meeting the first incision. The flap, which was then dissected up, was club-shaped; its lower end was wider, and decidedly thicker than its pedicle. As much thickness was given to it as possible. The cautions before mentioned, about detaching the flap from subjacent parts at the inner angle of the orbit, were carefully observed. The piece of skin fitted well into its place, and was not subjected to any strain.

A wide gap now yawned in the face, to which attention was next given. The plan was to slide the whole cheek toward the median line. This was effected by making an incision along the inferior orbital margin almost to the ear by extending the original incisions a little farther downward toward the jaw and then dissecting up the whole cheek, using the fingers and the handle of the scalpel as much as possible. Of course, there was copious hæmorrhage, and the spectacle was sufficiently hideous. The parts were brought together without undue stretching, and the lines of junction kept secure by numerous silk sutures and pins. The pins were fine and buried deep in the skin. Without their assistance the parts could not have been held in close apposition. The last step in the proceeding was to guard against the mischief which would ensue if the flap should fail, by paring the edges of the upper and lower lids and uniting them to each other. This was done for the outer two-thirds of their length, and was intended to be useful, even if sloughing of the flap should not occur, by moulding the lids to a better form, by enabling them, after they should adhere, to resist the traction which must occur as cicatrization proceeded, and to more perfectly protect the eye.

The operation was tedious. It occupied two hours. The patient was not badly exhausted, although prostrated by loss of blood and the effects of ether.

After being put to bed, fomentations by hot water were begun, and nourishment frequently given in small quantities. To the vigilance and fidelity of the house-surgeon, Dr. W. O. Moore, who is now the house-surgeon of the New York Eye and Ear Infirmary, the success of the case is largely to be credited. There was necrosis of the extreme end of the flap involving only the superficial part, and about two-thirds of an inch in length. The swelling of the face was consider-

able. The incision under the lower lid healed by first intention; the lower edge of the flap adhered to the skin adjacent to the tarsus, but



its upper edge could only imperfectly attach itself to the thin cicatricial tissue of the forehead. Along the side of the nose there was imperfect coaptation; the lips of the wound separated, and would have retracted widely but for the restraint of the pins. The healing of the wounds occupied about six weeks. When discharged from the Charity Hospital the cornea had recovered its clearness, and the eye was free from irritation. The thickened condition of the palpebral conjunctiva was not treated, but it began to show decided improvement. The adhesion of the lids to each other was not disturbed. The cicatrix under the lower eyelid was hardly noticeable; that beside the nose was more

conspicuous. The ulcers on the forehead had entirely healed under the relaxation which the introduction of the flap had procured.



In October, 1874, the photographs were taken. In the front view the outline of the flap can be distinctly seen. The distorted condition of the lid of the other eye can also be observed. The furrowed and rough surface of the skin of the right side of the face is due principally to the burn. The cicatricial tissue shows distinctly. The line of the incision along the zygoma can also be seen, and that it reaches almost to the ear. At this period patient was disinclined to open his eyes, and he wanted me to divide the lids asunder so that they could open more freely. This I would not do, and, a year after, the wisdom of refusing was seen. The contraction of the skin of the forehead had

drawn so much on the flap that the palpebral opening was quite as large as needful.

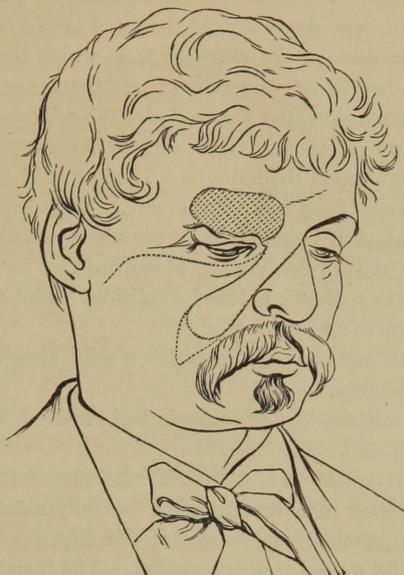


Diagram of the Incisions after the Upper Lid had been Lowered to its Place.

CASE II.—Alfred Campbell, a boy aged six years, was burned by kerosene-oil upon the face, scalp, and arms. Three months after the accident he came under my charge at the New York Eye and Ear Infirmary. This was on March 1, 1875. The ulcerations had all healed, and the upper lids had both become badly everted by contraction of the cicatrices on the forehead. The upper lid of the right eye was most deformed, and was turned completely inside out. The conjunctiva was greatly thickened. The corneæ were both clear. The eyes did not show a great amount of irritation. An attempt had been made to correct the deformity of the right eye by simply dissecting down the lid, but this had of necessity been entirely futile.

On March 1, 1875, I performed an operation similar to that described in the previous case, and consisting of the following steps: 1. Loosening the lid and bringing it down to its level; 2. Taking the flap, two and a half inches long, from the naso-buccal furrow—its greatest width was one inch, its width at pedicle three-quarters of an inch—then retaining this in position by sutures; 3. Dissecting up the cheek and crowding it toward the median line to fill up the vacancy.

The tissues were so elastic that the incisions did not need to be so extensive to bring the wounds together as in the former case. Sutures and pins were freely used to support and retain the parts.

The operation was done under ether, and lasted two hours. The length of the incision at the situation from which the flap was taken was three and a half inches, extending from the inner canthus downward. The incision along the lower edge of the orbit outward was three and a half inches in length. The parts all came together easily, and there was no strain upon the stitches. The loss of blood was considerable, and the shock of the operation severe. Stimulants administered.

Within twenty-four hours oozing from small vessels took place under the flap, apparently because the blood had lost its coagulability in consequence of the patient's reduced condition. This caused the outer three-fourths of the flap to slough.

On the fourth day after the operation a mild attack of pneumonia occurred in both lungs.

On the twelfth day the pneumonia had resolved, and the wounds were granulating well.

By the 24th it was evident that, if left to itself, the deformity for which the operation was made would be fully reëstablished. The pedicle, comprising about one-fourth of the flap, remained alive, and the surface of the wound was granulating. The incisions on the face and cheek had healed. The general health of the child had much improved. I therefore determined to check the disposition to ectropium by paring the edges of the upper and lower lids and uniting them by sutures. This was readily done under ether, and the middle portions of the lids were secured to each other.

On the 19th of April, just fifty days from the beginning of the treatment, the patient was discharged. A sufficient covering was formed for the lid. The eye was normal.

At the present time, September, 1876, the upper lid is perfectly in position; there is a fistulous opening through its middle leading to the superior fornix conjunctivæ. The new tissue forming the upper lid has acquired a dark-brown color, which makes it somewhat conspicuous. There is some fullness of the skin at the inner angle of the orbit where the pedicle is twisted. There is entire comfort in the use of the eye, and it is free from irritation. The scar which marks the place in the naso-buccal furrow from which the flap was taken can be traced as low down as almost to the lower jaw. It descends below the mouth, because the incision was lengthened in order to bring the cheek up to the side of the nose.

I have a photograph of his present condition, and the boy himself is presented for inspection.

The obstacles to success in the second case were certainly as great as could be encountered. It may be thought that the success obtained was not to be attributed to the use of the flap, but rather to the formation of a cicatrix after the eyelids had been attached to each other. This proceeding is recommended by some ophthalmic surgeon as sufficient. (See Bader on the Eye, p. 55.) But while it may serve for some cases, it cannot be adequate for those in which the entire forehead has been burned and the skin replaced by a cicatrix. To form an eyelid by procuring the growth of a cicatrix, is to establish a condition in which, by the slow contraction which continues at least a year, the eyelid will either be again everted, or so much shortened as to be of little use. It is against this tendency to contraction that it is needful to guard by introducing a flap. For the little boy, what was preserved of the flap served a useful purpose by the amount which it actually contributed to the lid, and also by aiding, as it evidently did, in the production of new tissue in the process of granulation.

The operation described is one adapted to exceptional cases, and such were the instances which I have reported. To show that these cases are capable of relief, is the object of this communication.

ADDITIONAL MEANS FOR RELIEVING PRESSURE OF THE EYELIDS IN DIS- EASES OF THE CORNEA.

THE importance, in treating inflammations of the cornea, of getting rid of the evil influence which pressure of the lids exerts, is recognized by ophthalmic surgeons, and seems to be little regarded by others.

How important this indication is considered in the New York Eye and Ear Infirmary, will be discerned by noting that the operation called canthoplasty was performed during the last eight years among 53,697 patients 932 times.

In other institutions the ratio would be found not less. Without dwelling upon this proceeding, which has been fully described and advocated in papers published by Dr. Althof, Dr. Allin, and Dr. Agnew, I beg to call attention to further means of carrying out the same indication.

Before doing this, I would like to offer some criticisms upon nomenclature. The term canthoplasty should mean an operation by which the palpebral angle is either constructed or enlarged. To a certain extent this is the effect of the method employed, the conjunctiva being drawn outward into the skin-wound so as to produce this effect. But this is in reality a minor result of the operation, and one which often disappears. The great efficacy consists in the dissecting up of the

commissural bands which attach the extremities of the lids to the orbit, and the conjunctiva to the fascia covering the insertion of the *rectus externus*. This dissection is made permanently effective by drawing out and stitching the conjunctiva to the skin. The utility of the proceeding depends upon the relaxation of the lids which is attained, and, as this is mostly secured by the subconjunctival and subcutaneous dissection, I would suggest for the operation the name *cantholysis*, and reserve the name canthoplasty for another proceeding, which I shall describe, in which a flap of skin is transplanted to the angle and permanently increases the extent of the canthus. If this innovation be not accepted, it will only remain to employ the awkward phrases conjunctival-canthoplasty and cutaneous-canthoplasty to designate the two proceedings.

It would still be necessary to use a term to describe the mere division of the angle without dissection or suture. The various operations practised may be styled as follows: 1. CANTHOTOMY, in which nothing but a horizontal incision is made. 2. CANTHOLYSIS, in which a lifting of the tissues at the angle from the subjacent parts is performed, and the conjunctiva stitched to the skin. 3. CANTHOPLASTY, as I shall describe it, wherein a flap of skin is interposed between the edges of the wound, after having made the same dissections as in the previous operation.

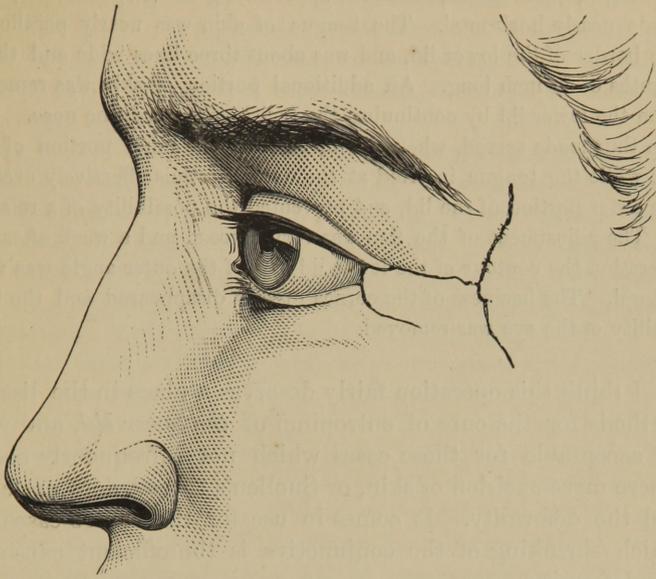
I proceed now to the description of the new method of canthoplasty. It is a proceeding to be adopted in cases of extreme severity. The indications for it are that, while the cornea presents conditions which call for relief by the usual method of cantholysis, the conjunctiva has so far atrophied that none is available in the operation. This condition appears in old cases of trachoma. The palpebral slit is sometimes excessively shortened, the conjunctiva so far shrunken as to almost obliterate the culs-de-sac, and no mucous membrane is to be had for transplantation. The cornea is in a state of opacity or pannus or ulceration. The indications for relief are clear and urgent.

The following method has been successfully employed in all cases :

The patient is etherized, a horizontal incision three lines long is made outward, beginning at the outer angle, the external commissural ligament both of the upper and lower lids is carefully severed until the lids may be easily lifted up from their orbital attachments, the conjunctiva is also loosened; a narrow tongue of skin is then formed, by making incisions upward toward the temple, just beyond the outer end of the eyebrow, constructing a small flap, which has its base below on the level of the commissural incision, and its apex above. This, being loosened, is turned downward and inserted between the edges of the wound. In fitting it to its place, room must be made at the palpebral angle by nicking the margin of the lids above and below. I avoid, if possible, cutting into the conjunctiva, wishing to spare as much of it as may be secured. In turning the flap down, the incision on its temporal side must be carried lower down than the line of the commissure, to prevent wrinkling. The angle of skin continuous with the upper lid must be dissected up to give room for the flap. In closing the wounds, the first step is to draw together the edges of skin where the flap was removed; i. e., to draw outward the angle of the upper lid and hold it by a very fine pin-suture. The next step is to insert the flap and attach its apex to the conjunctiva. By careful adjustment this may be done without making special deformity—the tendency is to make the flap too large. A good many stitches must be used to fit the parts neatly—not less than ten or twelve—and all the wounds must be closed. The appearance of parts after the operation will vary considerably in different persons, according to the laxity or firmness of the skin and the accuracy of the operation. Union takes place promptly, and the irritation of the eye is removed. In some instances a moderate deformity has been produced by the dragging of the upper lid outward. In other cases the flap has made a somewhat conspicuous fold, which would attract attention. It cannot be pretended that the operation ever beautifies the appearance, but in course of time the changes in the configuration of the region smooth off, and scarcely attract notice.

The effect on the condition of the eye has been extremely

satisfactory. The relief, which could not be gained by any other proceeding, has been in every instance most grateful.



The persons for whom this measure will be required belong mostly to the poorer classes, who, by neglect and inability to care for themselves, have been brought to a deplorable condition. To them, considerations of personal appearance have little value compared with the necessity for sight.

The usual indications for this operation are found, as has been said, in the late stages of trachoma; but two other classes of cases have occurred to me for which it has been satisfactory.

The one has been entropium of the *lower* lid consequent upon trachoma. The other is spasm of the orbicularis muscle, as will be related in detail in a case to be reported. The following is the first case :

Mrs. —, aged thirty-five. The operation consisted in making the usual incision and dissection of the outer canthus by which the lids were perfectly set at liberty. Instead of next removing a narrow strip of skin from the lower lid to secure eversion—and trusting en-

tirely to this—I constructed a small flap from the skin of the lower lid in precisely a similar way as described above; except that, in making it, the incisions, instead of approaching the perpendicular, were made nearly horizontal. The tongue of skin was nearly parallel to the border of the lower lid, and was about three lines wide and three-eighths of an inch long. An additional portion of skin was removed from the lower lid by continuing the incisions toward the nose. The gap thus made served, when closed, to evert the inner portion of the lid, while the tongue inserted at the outer canthus effectively everted the outer portion of the lid, and prevented the possibility of a relapse.

The adjustment of the flap was very correct, and a week after the operation the contour of the lower lid and of the outer angle was very natural. The haziness of the cornea greatly disappeared and the irritability of the eye was removed.

I think this operation fairly deserves a place in the list of methods for the cure of entropium of *the lower lid*, and will be acceptable for those cases which not infrequently occur where mere excision of skin, or Snellen's thread, does not control the deformity. It comes in use for the severe cases in which shrinking of the conjunctiva is the efficient cause of the deformity.

The number of cases for which this operation has been done amounts to eleven. The removal of the irritability of the eye was the object sought, and decided improvement in sight gradually ensued.

A different kind of case, and one of a peculiar character, deserves report in detail. It illustrates the effect of the combined action of mechanical pressure of the lids and nervous irritability of the orbicularis in causing ulceration of the cornea. It is the case previously alluded to.

It points out how we must sometimes have recourse to means for controlling nervous spasm in addition to the mechanical means of relief.

Henry K., aged forty, farmer, born in New Jersey, was operated on in childhood for cataract in both eyes, and obtained good vision in one eye. In the other there remained some capsule which I removed. In the autumn of 1875 his right eye became affected with keratitis. An ulcer formed at the outer margin of the cornea. It was obstinate

in healing, and treatment by atropia, hot fomentations, and finally canthoplasty, did not secure relief for several weeks. When he left the infirmary there was considerable opacity at the outer half of the cornea. The patient is a person of feeble mind, and in body looks prematurely old. He would be taken for sixty years of age; his skin is thin, loose, and dry; he is of small stature, his voice is childlike, and face deeply wrinkled.

In May, 1876, he returned to the infirmary with more severe inflammation of the same cornea. The former ulceration had returned, and the whole tissue was densely white. The eye gave him so much distress that he begged to have it extirpated. Warm fomentations and atropia were again employed, but to little purpose. Then canthoplasty by a flap of skin as above described was performed. The depreciated health of the patient was evidenced in the tardy healing of the wounds. Great swelling occurred, the wounds gaped and suppurated, and the parts were not properly brought together for two weeks. Meanwhile the inflammation in the cornea continued. During all the time the spasm of the eyelids was excessive. Nothing could check it. The skin was not only very thin, but very mobile, and the facial muscles strong. The lids of the affected eye were habitually squeezed together like the fist. The attempt to examine the eye would bring on an increase of spasm, and no remonstrances could dissuade him from doing it. When the reaction from the operation had subsided, a beneficial effect was obtained upon the eye. The lids could not take so firm a grip on the cornea, and the ulceration began to improve. The progress of improvement was slow, and it became evident that something more must be done to obviate the uncontrollable blepharospasm. I resorted to the fluid extract of *conium maculatum* (Squibb's), giving 40 drops once daily. The intoxicating effect of the drug was produced, the patient would reel and be dizzy, and the spasm of the lids was less severe. This treatment was maintained for a week with manifest advantage. The effects of the remedy on the general nervous system would pass off in a few hours, but throughout the day the action of the eyelids would be less intense. The complete control of the spasm could not, however, be thus obtained, and I felt the need of some treatment which would permanently stop the morbid action. I determined to try what effect could be gained by division of the fibres of the facial nerve. The trunk of the nerve at the stylo-mastoid foramen is difficult of access, but could be reached, if needful. I have seen a case where it had been severed by a stab behind the angle of the jaw. This entailed paralysis of all the muscles of the face, and

I therefore concluded to attempt to divide only those twigs which go to the orbicularis. By means of a knife with short blade and long shank, similar to that I use for dividing lachrymal stricture, I made a subcutaneous incision along the zygoma both upon the bone and against the skin. I entered the knife nearly over the middle of the malar bone, and made the first cut, as stated, along the zygoma, going almost to the ear. I next turned the point of the blade upward to the outer border of the orbit, and again cut both upon the bone and against the skin. Lastly, a similar cutting was made along the lower border of the orbit. All of these incisions were made through a single puncture in the skin. A thrombus of moderate extent was produced.

The use of conium was discontinued. The reaction following the incisions was not severe. On the following day it was evident that the orbicularis had in a marked degree lost its contractility. The power of shutting the lids was preserved, but the violent action could not be performed.

In a few days the swelling caused by the incisions subsided, and the abatement in the power of the orbicularis was very manifest. The skin could not be wrinkled to any such degree as in the case of the other eye. This condition of the muscle continued until the time of his discharge, which was on the fifteenth day after the neurotomy. The condition of the eye began to improve more rapidly immediately upon the division of the nerve-fibres, and advanced so far that on the fifteenth day succeeding he was enabled to go out and return to his home.

THE OPTICAL ERROR OF CONICAL CORNEA, AND REPORT OF TWO CASES TREATED BY OPERATION.

It has been the prevailing belief that the form of refractive error which is caused by conicity of the cornea must be myopia. The increase of curve naturally suggests this idea. The irregularity of the refraction and the incorrectable character of a considerable part of the error have combined to induce ophthalmic surgeons to make little inquiry into the real nature of the optical fault. It is true that some measurements have been made with the ophthalmometer, but these findings have not fructified into beneficial practice. In the "Transactions of the American Ophthalmological Society" for 1874, page 132, Dr. Thomson, of Philadelphia, records the examination of four cases of conical cornea, and finds that, out of seven eyes, five possessed mixed astigmatism amounting to very high degree, one had compound myopic astigmatism, and one had simple hyperopic astigmatism. Vision equaled in two eyes $\frac{2}{3}0$, in three eyes $\frac{2}{3}0$, in two eyes $\frac{2}{4}0$.

I have found the existence of hyperopia in certain meridians of conical cornea enough to render correction by the suitable cylinder extremely satisfactory.

The following case was relieved by giving a simple cylinder for one eye, and by trephining the cornea of the other :

Miss R. P., aged nineteen, of slight figure, weighing one hundred pounds, came to consult me in April, 1874. She began six months before to have pain in the eyes, and about six weeks ago the right was first discovered to be almost useless. In the right eye there is a conspicuous, though not extreme, degree of conical cornea. The apex is quite pointed. Viewed in profile, and illuminated by the mirror, two dark ovals are formed upon the cone, one being the pupil projected forward by refraction, and, in front of it, another smaller oval, caused by caustic refraction from the apex. When viewing the fundus, the pupil being enlarged, the vessels seen through the apex form circles, ellipses, etc., while the margin of the cornea is emmetropic. No effort was made to estimate the real value of the refraction in this eye, with $-\frac{1}{48}^{\circ} V. = \frac{2}{200}^{\circ}$.

In the left eye there was no manifest alteration of the shape of the cornea. Examined under atropine by the ophthalmoscope, the vessels exhibited breaks in their continuity, as if seen through the edge of a prism, and showed that the refraction was irregular. The first trials with glasses could not secure any improvement in vision, which was $\frac{2}{70}$. Pain was distressing, and the use of atropine was continued for a month, but with no improvement of sight or special relief of pain. She used the syrup of the phosphate of iron, quinia, and strychnia. She possessed a remarkably placid and patient disposition.

In September, 1874, five months after first seeing her, finding she had no relief from pain, and that in the worse eye no valuable improvement of sight could be gotten either by glasses or by a stenopaic slit, I trephined the right cornea. Drs. H. Althof and W. S. Little kindly assisted. The plug of cornea was only in part separated by the trephine, and its remaining attachments were severed by help of forceps and scissors. Six weeks afterward, Miss P. came to the office; the anterior chamber had in part been reestablished, the hole was filled up by new tissue, the pupil adhered to the inner side of the opacity, which looks like a flat ulcer. There has been from the operation very little irritation; still wears a pad over the eye. Was allowed to go to her home in Pennsylvania.

A little more than three months afterward, I made iridectomy downward and inward. There was a circular opacity less than three millimetres in diameter, with well-defined edges, and surface perfectly smooth. Anterior synechia at upper and inner side.

In November, 1875, thirteen months after the trephining, found that, with $+ 12 c. 110^{\circ}$, $V. = \frac{2}{200}^{\circ}$.

In the other eye, a more searching examination brought to light

the existence of simple hyperopic astigmatism, viz., + 15 c. 180° V. = $\frac{2}{4} \frac{0}{0} +$.

I heard from her, in the following February, that she suffered no longer from pain, had great comfort with her glasses, and read a good deal.

CASE II.—Conical cornea; mixed astigmatism; excision of apex; union by sutures.

Mr. J. K. C., aged twenty-six, a well-built, healthy man, who had lived on a farm, and within a few years had devoted himself to study, came to me in April, 1875. At eleven years of age he discovered that his sight for distance was imperfect; he could not see figures on the black-board in school. At seventeen years of age he began to have pain in his eyes, and light became troublesome. He then left school, but at twenty-one he resumed his studies and worked diligently. He found his vision growing worse, and eyes more painful. Was for a time under care of an oculist in Detroit.

There is an evident concavity of each cornea, and the summit of the cone is not central, but points downward, and is dotted over with minute opacities.

The refraction is as follows:

O. D. + 14 c. 15° — 2½ c. 105°.

O. S. + 5 c. 60° — 3½ c. 120°.

This result was found by atropia, and the use of the ophthalmoscope and astigmatic tests.

In the right eye the apex of the cone was myopic — 2. The complicated formulæ which expressed the refractive errors were not attempted in glasses, being thought too difficult to construct, while with — 5 c. for each eye he attained O. D., V. = $\frac{2}{8} \frac{0}{0} +$; O. S., V. = $\frac{2}{8} \frac{0}{0}$.

For six months these glasses were worn, but the condition became worse. Vision fell off to O. D. $\frac{2}{8} \frac{0}{0}$ and O. S. $\frac{2}{2} \frac{0}{0}$.

I then deemed it wise to operate for the defect of the worse eye. Patient put under the influence of ether, which could not cause sufficient anæsthesia, and chloroform was substituted. With a very narrow knife the *left* cornea was transixed a little below the centre, making a horizontal wound eight millimetres long; by forceps and scissors an oval strip was then cut out whose widest part measured two and a half millimetres. The cornea was found reduced to less than one-half its proper thickness. On escape of the aqueous, and contraction of the pupil, the lower edge of the wound corresponded to the margin of the pupil. The next step in the operation was not a little difficult of execution. It was to pass sutures through the edges of the wound and

draw it together. I was led to attempt this usual proceeding, for two reasons: one, the hope that the amount of synechia might be greatly restrained by closing the wound, and, second, the hope that the union would be more speedy. I was persuaded that the cornea would tolerate the presence of the sutures, because that had been tested by Dr. H. W. Williams, of Boston, in his employment of the suture after flap extraction. The needles were such as he devised—very fine and curved, and about one-third of an inch long. The sutures were made by unraveling an extremely fine silk thread, and using one of the three strands which composed it. The suture was so delicate as to be troublesome to handle. The sutures were entered first into the lower lip of the wound, and the difficulty of passing the needles through its upper lip was in a measure obviated by lifting up the edge with a blunt iris-hook, which was passed flatwise between the capsule of the lens and the cornea. The whole was an anxious proceeding, but, after patient effort, was safely accomplished, and two sutures introduced. The ends of the thread were cut short. The line of wound was just at the lower edge of the contracted pupil. It was impossible to employ an ordinary wire or spring speculum, because of the weight and pressure on the globe. The upper lid was retracted by the wire retracting-elevator, which I have devised. A bandage was applied and retained for three weeks constantly. There was no unpleasant reaction. At the end of three weeks the extremities of the wound had united, but the centre was open. The sutures remain *in situ*, have loosened, but are not causing irritation; they have especially lost hold upon the lower edge of the wound. There has been a loss of epithelium from the edges of the wound. There has been no iritis; pupil is attached at its lower edge in the wound; the upper border is free; the anterior chamber is partially restored; no atropine used until the third week. On the twentieth day one suture was removed, and on the twenty-third the remaining.

The effect of removing the sutures was unfavorable. In two days the wound began to gape, and the iris prolapsed perceptibly. On the fourth day after removal of stitches I punctured the projecting scar, and let off the aqueous humor. This was repeated daily for sixteen days. On December 28th vision before puncture was $\frac{2}{100}$, after puncture was $\frac{2}{50}$. This improvement depended in part upon the diminution of the pupil, and in part upon the improved form of the cornea. Could read Jaeger 7 at ten inches.

On January 13, 1876, the cicatrix had become firm, and the pupil was drawn into the tissue, so as to have only a small part of it above

the scar. It would not yield to atropia. I thought it inevitable that a greater entanglement would occur, and, to avoid ill effects from the adhesions, made a small iridectomy upward.

The eye healed well, but the effect on vision was prejudicial. Tested two weeks after the iridectomy, the refraction was found $+ 4$ c. $160^\circ - 8$ c. 70° V. = $\frac{20}{200}$.

This indicates that the horizontal meridian had been much flattened, while the vertical had been made convex. This was in marked contrast with the primary condition, when the meridian 120° was myopic $3\frac{1}{2}$, and the meridian 60° was hyperopic $+ 5$.

The ultimate result of the case is not yet known.

Comparing the two cases related, it is seen that to trephine is a better method of operating, for moderate degrees of deformity, than the use of sutures with an elliptical wound. No doubt, the greater size of the wound in the second case was a most important factor in the process. Without the use of sutures, the prolapse of iris would have been much greater, and their efficacy was demonstrated by the speedy production of union at the ends of the wound. There was not perfect coaptation of the whole wound, because the middle suture could not be introduced. For a case of extreme conicity, I think it advisable to employ sutures and the excision of an elliptical piece. My experience in this case showed that the great difficulty is to insert the middle suture after those at the ends are in place. If the apex of the cone be either above or below the horizontal meridian—and it often is below it—the line of union can be brought opposite to the border of the pupil, and the capsule will in some degree be protected. A Tyrrell's iris-hook is the best instrument with which to raise the edge of the cornea, that it may be seized with very fine-toothed forceps, and then pass the needle. It is impossible not to go through the entire thickness of the cornea when it has been much attenuated. It is better to put in first the middle suture—to leave it untied, and to use it to lift the lips of the wound, as in a loop—and then to pass the remaining two sutures, not tying any, until all are entered. If a state of perfect quiescence by anæsthetics cannot be obtained, the operation will be impracticable, because it would be hazardous to use fixation forceps. It is better not to remove the

sutures, even when they seem very loose, so long as they are not causing evident irritation. They afford support to the cicatrix, as the above case demonstrates, even when they appear to be of no service. It cannot be inferred from the fortunes of one case, how extensive, after this mode of treatment, would be the attachments of the iris to the cornea. After trephining, anterior synechia must inevitably occur. After excision and the use of sutures, the exactness of the coaptation will determine the degree of adhesion of the iris. I cannot doubt that so nice a fit is possible as to make this adhesion very small and unimportant. I have made but one experiment, and leave the matter to the judgment of further observations.

As to the amount of benefit possible by glasses, it is certain, from Dr. Thomson's experience and my own, that much more can be done than has been deemed practicable. The fact that hypermetropia, in a high degree, may exist in one meridian of conical cornea, was to me a veritable discovery, because, while Dr. Thomson had already perceived and made known the fact, I was not acquainted with it. The flattening of one meridian may, and often does, coincide with great convexity of another meridian, producing mixed astigmatism of extreme degree.

Moreover, there may be simple hyperopic astigmatism without myopia. The ascertainment of the exact optical condition calls for much patience.

The most accurate method would be the ophthalmometer, providing the errors of the crystalline did not interfere. In ordinary practice, the observer will depend mainly upon the direct ophthalmoscopic method, with enlarged pupil. The test by radiating lines, illuminated by transmitted light, is one well suited to these cases. It is advisable in these cases to simplify the test-card by using two radii, diverging not more than twenty degrees, on either side of the centre, rather than confuse the patient by many lines. This is true in examining all cases of astigmatism, but especially important when so much of the error is of necessity irreducible. In this case, one need only use the spherical glasses until the refraction of the principal meridians is made out. Another hint that may aid

examination is to employ a slit and to cover the middle with a plug of wax which will be a diaphragm to stop out the irregular refraction of the apex of the cone. The test by two holes in a disk, which is to be revolved before the eye, suggested by Dr. Thomson, will also be serviceable. It has the great advantage of simplicity, of stopping out the apex of the cone, and of presenting in the lamp or luminous spot, which the patient looks at, an object easily recognized. One must resort to all methods, to determine the refractive error in these cases.

It is eminently worth while to do this, because the need of glasses will exist after operating, and possibly the operation may be avoided entirely. The need of operating will be confined to the cases of progressive deformity, and no doubt the time for resorting to it may be much deferred.

The pain, of which patients complain, is to a great degree asthenopic or accommodative, and this will be greatly mitigated by proper glasses. In progressive cases, the pain must in some measure depend upon distention, as well as upon fatiguing efforts to see. It is certainly obligatory upon the physician to supply the best possible correction by glasses, both as a means of relief and as a measure for ascertaining whether the disease is progressive.

The value of atropia in these cases, I esteem negative. It may sometimes relieve accommodative pain, but it cannot abate the refractive error so as to improve sight. It is important to the investigation, but not in therapeutics.

