THE BRITISH JOURNAL OF OPHTHALMOLOGY

APRIL, 1933

COMMUNICATIONS

CONCERNING UNUSUAL ULCERS OF THE CORNEA AND THEIR TREATMENT*

BY

DR. ADALBERT FUCHS

VIENNA, AUSTRIA

Translated by BERTHA KLIEN-MONCREIFF, M.D., *Assistant Professor of
Ophthalmology, Rush Medical College, Chicago*

WHILE the ophthalmologist practising in industrial districts and county towns has many opportunities to see and treat corneal ulcers, the physician whose private practice is limited to the city without a large proportion of industrial workers and farmers finds himself in this situation less often. The latter sees mostly those marginal infiltrates of the cornea which are commonly called "catarrhal ulcers." These may appear in the course of a conjunctivitis or as a complication of acne rosacea, eczema of the skin, sycosis barbae; most often, however, they are an isolated affection of the cornea without conjunctival irritation. Verhoeff believes that these marginal infiltrates, which recur relatively often, are a form of acne rosacea of the cornea without simultaneous acne rosacea of the skin.† They heal rapidly under treatment with

*From the Department of Ophthalmology of the *Allgemeine Poliklinik* in Vienna. Director: Professor Dr. A. Fuchs.

†I know, however, patients who suffer from recurrence of such corneal ulcers for years without ever having a skin lesion.

mydriatics, hot applications and collargol, eventually ray treatment, but it is very difficult to prevent their recurrence.

The second type of keratitis relatively often seen in the city is the herpetic form. The keratitis dendritica, usually not yet ulcerated, and recognizable only by the slightly elevated epithelium; the keratitis punctata superficialis, and the herpetic ulcer. Other corneal ulcers, including the serpent ulcer, are relatively rare in the city. Sometimes one encounters rather unusual types of ulcers, and of this kind I shall report a few instances. They are worth description, partly on account of the clinical symptoms, and partly for the success of the therapy. Most of those cases belong to my private clientèle.

Kerato-Mycosis Fascicularis

There are but few reports in the literature of this very unusual type of keratomycosis, which I have seen only once in my life.

Case I. History:—A female, aged 26 years, entered the first eye clinic in Vienna in 1919 complaining of an affection of her right eye, which she had first noticed four weeks ago. She did not have much pain, and could not recall any preceding trauma. She never had a disease of her eyes before.

Findings: R. E. slight ciliary injection. In the lower half of the pupillary area of the cornea there was a snowy-white, somewhat irregularly outlined area of pinhead size, which appeared dry and finely granulated under the loupe. A winding sulcus led to this area, coming, not as one would expect, from the nearest limbus, but transversely from the temporal and lower limbus (Fig. 1). Within this sulcus superficial vessels were following closely its winding course. One vessel only, which came from the lower limbus, was running over apparently normal cornea, joining the other vessels on their way to the white focus in the middle of the sulcus.

The white crumbly mass was removed with a spud and the eye bandaged. After a few days the irritation of the eye had disappeared, and the corneal lesion was healed. Unfortunately no cultures were made from the mass, but it was embedded and sectioned, and the microscopic examination showed it to be composed of mycotic threads. In this case we had to deal with a very rare but typical form of keratomycosis whose most striking feature is its similarity to the keratitis fascicularis of eczematous origin. That this is a typical picture of keratomycosis I conclude from a short note in de Schweinitz' text-book. Axenfeld also described briefly three similar cases.*

* *Bacteriologie des Auges*, Fischer, p. 285, 1902. A case of Martin is mentioned there also (*Arch. f. Augenheilk.*, p. 177, 1904). Similar cases were described by Serra (*Ateneo pharm.*, Vol. I, p. 549, 1929) and by Denti (*Lett. oftal.*, Vol. VII, p. 227, 1930).

My father could not remember having seen a case like this one. Professor de Schweinitz, whom I asked for details of his cases, could not furnish any. I should propose the name of "Keratomy-cosis fascicularis" for this condition.

The colony of the fungi probably wanders over the cornea, otherwise no real sulcus would result. Whether this form of keratomy-cosis is caused by a special variety of fungus or by a special condition of the cornea is unknown. Possibly the fungi settle down eccentrically first, and there one side of the colony is more exposed to corneal defence. The fact that only few cases of eczematous keratitis develop a fascicular lesion would speak for a special condition of the cornea inasmuch as it would be difficult to assume a special variety of the virus in eczematous keratitis.*

There are children suffering from keratitis fascicularis who show the characteristic linear scar of a previous keratitis fascicularis in the same or in the other eye.

It is remarkable that in my case the scar has a winding course, and that the simple removal of the mycotic concretion without cauterization brought about complete healing of the lesion.

Ulcus Maranticum

History:—A female patient, aged 73 years, had been treated for five weeks in Roumania.† Five weeks ago an ulcer with a progressive margin and a hypopyon had formed in the right eye. The patient suffered great pain. An extraction of a cataract had been performed in this eye 20 years ago. With the slit-lamp one could still see vitreous in the anterior chamber, and incarcerated in the post-operative scar. Hence an intra-ocular extension of the inflammatory process was to be feared.

After cauterization of the ulcer with the thermo-cautery the condition had improved, but suddenly the hypopyon had reappeared and the ulcer had become infiltrated again although the lacrimal sac had been irrigated and found to be free of infection.

After a second cauterization similar symptoms had followed. Severe pain deprived the patient of sleep and weakened her considerably. During the second attack also part of the post-operative scar had become inflamed and a small flake of pus was applied to the posterior surface of the cornea near the scar. A late infection was suspected, but this attack also subsided after

*Axenfeld found in keratitis fascicularis pathogenic pneumococci in great number, which he considered as a secondary infection. (*Zentral. f. z. Ophthal.*, Vol. XXII, p. 871).

†I wish to thank Dr. Mandicevska for her kindness in sending me this patient.

cauterization and subconjunctival injections of a solution of corrosive chloride of mercury. In the meantime the corneal ulcer had become very large and the cornea within it quite thin. In view of the severe pain, the old age of the patient and good visual acuity of the other eye an enucleation was considered.

When the old and weak patient was brought to my office the right eye showed marked ciliary injection. A circular, superficial loss of substance involved the entire temporal half of the cornea, the floor of the ulcer being dull but not infiltrated. The remainder of the cornea was dull also, appeared very dry and not very sensitive to touch. The amount of lacrimal fluid was diminished. The anterior chamber was deep, the post-operative limbal scar markedly injected. At the bottom of the anterior chamber there was a flake of pus. The intra-ocular tension was normal.

Because of the general debility of the patient, the diminished corneal sensitivity and the dry appearance of the ulcer, which was large, indolent, and showed little tendency to heal, I made the diagnosis of a previously infiltrated marantic ulcer. I ordered heat and an atropine-collargol ointment, and gave her a full teaspoon of ventreamon three times daily. For five days her condition remained the same, the ciliary injection was marked, the cornea, especially the ulcerated area, very dull. The pain was less severe. We were afraid of another relapse as it had taken place already twice.

After the lapse of five days, however, the condition improved surprisingly rapidly, the cornea became bright, the ulcer clean and epithelialized within a few days. Ten days after the onset of the treatment the floor of the ulcer began to show signs of cicatrization. The general condition of the patient had become worse. While previously her weakness had been ascribed to the suffering of severe pain and the excessive weeping following her husband's death, which deprived her of her night's rest, one had to look for another cause now.

The general examination did not reveal any other pathological conditions but a weakness of the myocardium. The urine had been found normal. The constant feeling of thirst directed the attention to the blood sugar, which was found as high as 232.0 mg. per cent. (hunger) *i.e.*, almost twice the normal amount. Insulin treatment was started but the blood sugar remained high, mounted to 274.0 mg. per cent. a short time afterwards and one per cent. sugar appeared in the urine. During the next few weeks the blood sugar became lower again and the patient was sent home at the end of the third week. The eye had been pale for one week already and the loss of substance in the cornea had been filled up almost completely.*

* The patient died a few months later.

This must be considered a case of a marantic ulcer, with repeated purulent infections. The dryness and insensibility of the cornea, the deficiency of lacrimal secretion, the general weakness and the increased blood sugar content support this view.

An interesting feature of this case is the repeated purulent infiltration of the loss of substance with imminent intra-ocular extension of the infection along the incarcerated vitreous. The lacrimal sac, first thought to be the source of infection, was normal.

What then was the cause of the repeated infection of the corneal ulcer? Possibly there was a disturbance in the secretion of the tears, as suggested by the dry appearance of the cornea.

The character of the lacrimal fluid seems to play a part in the development of keratomalacia. Besides the nutritional disturbance chiefly of the epithelium caused by the avitaminosis, an infection leads to the rapid destruction of the cornea in this disease. I mention here the "praexerosis" of Pillat, the initial stage of keratomalacia, with a normal content of bacteria in the conjunctival sac, but already severe changes of the corneal epithelium which are found also far away from the corneal ulcers. The rapid necrosis characteristic of keratomalacia is caused by the complete absence of corneal resistance and probably also by the lack of the bactericidal lysozyme, which Fleming discovered in the lacrimal fluid, which seems to be greatly reduced in keratomalacia.

In rats which were fed with insufficient amounts of vitamin A, Marshal Findlay* could prevent keratomalacia better by instillation of real tears than by irrigation with Locke's solution. Findlay sees the cause of this in the lowered lysozyme content in the tears of the undernourished animals. If the tears are heated to 70° C., which procedure lessens the lysozyme content, they prove less effective in preventing keratomalacia than the fresh tears of normal animals. Physiological solution of sodium chloride had no preventive effect.

Hallauer¹ recently examined the lysozyme content of the tear fluid of normal and inflamed eyes in 120 clinical cases. According to him the lysozyme content is diminished in general diseases.

One could assume that in our patient the nutrition of the cornea had suffered as a consequence of the general weakness, and that a marantic loss of substance had resulted. Through lack of lysozyme which normally keeps down pathogenic bacteria in the conjunctival sac, these germs may have gained virulence, and may have repeatedly infected the ulcer. This hypothesis is supported by the surprisingly rapid healing of the ulcer after ventreamon therapy.

Ventreamon² is prepared from the stomach of healthy animals,

* *Brit. Jl. exp. Path.*, Vol. VI, p. 16, 1925. Treacher Collins, *Trans. Ophthalm. Soc. U.K.*, Vol. L, p. 226.

the wall of the stomach being dried at a low temperature. This preparation was made primarily for the treatment of pernicious anaemia.

After Castle,³ Locke, and Townsend⁴ had found that during digestion of meat an anti-anaemic substance is formed in the stomach, Sharp, Sturgis and Isaacs⁵ were successful in the treatment of pernicious anaemia with carefully dried stomachs of pigs. Rosenow⁶ had similar success in treating this disease with ventreamon. Treatment with this preparation proved as successful as treatment with liver; the lower cost, however, and the smaller quantities to be taken seem to make it preferable to the latter. Liver was known for a long time as a popular remedy and later on became a scientific therapeuticum in hemeralopia, which is an avitaminosis; furthermore, cod-liver-oil plays an important part in the treatment of keratomalacia, and marantic ulcers have a close relationship to both of the above mentioned diseases. Therefore I thought of putting my patient on a liver diet. Lack of appetite, however, frustrated this plan. Then I thought of ventreamon, whose action in pernicious anaemia is similar to that of liver. From the rapid improvement of the eye condition I concluded that probably ventreamon brought about the deciding turn in the course of the disease, especially as also in hemeralopia the influence of the liver therapy becomes apparent within a few days, and in keratomalacia cod-liver-oil acts surprisingly quickly if it is given in time, and the infection is not too virulent.

Hemeralopia, keratomalacia, and marantic ulcers are closely related, the latter being probably a mild form of keratomalacia in the adult. In people suffering from diseases of the liver one finds occasionally marantic ulcers combined with hemeralopia.*

Ulcus Rodens

Case I. History:—A labourer, aged 38 years, had a severe marginal ulcer of the left cornea a year ago, which was diagnosed in the hospital as a catarrhal ulcer. It had subsided only after

* The treatment of essential hemeralopia with ventreamon would be very interesting theoretically. Unfortunately I have no opportunity to study such cases in Vienna, as hemeralopia seems to have disappeared entirely during the recent years, although they were quite frequent years ago. Therefore, I could not continue my successful and theoretically interesting experiments of treating hemeralopia and keratomalacia with ultra-violet rays. Essential hemeralopia is very common in the orient—India, China, Japan—and there it should be easy to study the influence of various food-fractions, organ-preparations and ray treatments. It would probably be of the greatest importance as to the knowledge of avitaminosis, and nutritional disturbances of adults. Also the possibility of the activating of vitamins by irradiation could be studied there.

several cauterizations. When I saw him he had quite a painful ulcer of the right cornea. This ulcer had been cauterized several times during the past week, and subconjunctival injections of corrosive chloride of mercury had been given.

Findings: R. E. Moderate conjunctival secretion, considerable ciliary injection. In the inner upper quadrant of the cornea there was a marginal bean-shaped loss of substance, which was infiltrated in two places (Fig. 2). The iris was not much affected, the pupil was dilated by atropine. No hypopyon. Fundus normal. Vision: 5/12.

FIG. 1.

FIG. 2.

FIG. 4.

FIG. 5.

FIG. 9.

FIG. 10.

FIG. 11.

L. E. There was a marginal scar in the inner upper quadrant of the cornea, otherwise the eye was normal. Vision: -3.50 D. cyl. ax. $160^\circ = 5/5$. Remarkable is the high astigmatism, which was evidently caused by the ulcer, as its axis corresponded approximately to the longitudinal axis of the corneal scar.

In spite of collargol ointment and hot applications the central part of the ulcer in the right eye became more and more infiltrated. A hypopyon, however, did not develop. The central margin of the ulcer was distinctly undermined, as shown with a probe, a fact which led my father and myself to the diagnosis of rodent ulcer.

A small puncture was made within the peripheral not infiltrated parts of the ulcer, and re-opened with a spatula the next day. This was repeated five times. On the 14th day of the treatment the ulcer was clean, and already covered by epithelium. A marked, oblique astigmatism had developed, which I tried to check with a pressure bandage, as there was no doubt that it was caused by softening of the cornea, a sort of *ectasia ex ulcere*. The vision then was $5/24$ with -1.0 D. sph. -5.50 D. cyl. 20°

The pressure bandage caused great discomfort and had to be discontinued. After another week the vision was $5/8$ with $+2.0$ D. sph. -5.5 D. cyl. 20° . Apparently the albumin content of the chamber fluid had decreased, and so the refractive power became lower.

The case is interesting on account of the bilateral oblique astigmatism. In the right eye it could be observed with the ophthalmometer while in formation, and also in the left eye it was unquestionably due to softening of the cornea, although the ulcer had remained peripheral, and had not been deep.

Out of the multitude of therapeutic suggestions the paracentesis as the treatment of rodent ulcer has been emphasized again and again. Nesic,⁷ assured by the success of the puncture, cauterized the most infiltrated part of the ulcer until the thermocautery reached the anterior chamber and was stopped by a spatula, which had been introduced through a keratome section. He kept the fistula open for 15 days and had a striking success. Wibo⁸ treated a case of *ulcus rodens* in a similar way. He cauterized the ulcer over a keratome in the anterior chamber. The fistula remained open for six weeks, and an adherent leucoma resulted.

This kind of treatment with fistulae seems to me too radical, mainly as an anterior synechia can scarcely be avoided. This is an undesired result as was pointed out in the discussion of Wibo's paper. Wibo's case shows how long the fistula after cauterization may stay open. In a case of Nesic the fistula became 4 mm. wide. A trephine after Sonderrmann did not seem advisable in my case as the ulcer had not yet reached the pupillary area, and the rodent ulcer is a slowly progressing not very toxic process.

The often repeated punctures seem to me the most advisable first procedure in such cases. Should they remain without success a sclerectomy after Lagrange could be tried. Wibo⁹ used it successfully in a severe and very obstinate case of *ulcus rodens*, and Terson recommends it also.

Case II. History:—A Serbian gentleman, aged 55 years, contracted an inflammation of the right eye while staying in the country, and was treated by the local physician with a powder, later with hydrargyrum oxycyanatum and atropine. He consulted me after the vision had become so poor that objects could be seen only as through a mist.

Findings: The left eye was normal. The right eye was dull red injected. The cornea was dull and showed a yellow ring, somewhat wider, and slightly elevated on the nasal side (Fig. 3). This yellow ring was undermined. The centre of the cornea was transparent, the periphery exhibited a pannus-like vascularization. A true ulceration was not present. The intra-ocular tension was

normal. Right vision: Counting fingers at one-half metre. Wassermann Reaction was negative, although the patient had a previous luetic infection.

On account of the undermined margin the lesion was interpreted as a rodent ulcer. There could be no doubt that the yellow ring had been situated formerly more peripherally. This view was confirmed by the patient's own observation.

In order to prevent the progression of the ulcer the patient was treated with punctures of the anterior chamber. Fourteen were made in the nasal portion of the cornea, peripheral to the widest part of the ring. The punctures were performed every second or third day, and local treatment consisting in atropine, heat, mercury and collargol ointment was continued. After four weeks the ring was still unchanged, hence I tried two milk injections. They had no favourable influence. Although the ring-shaped infiltration seemed to clear up, the clear centre of the cornea became slightly cloudy after the injections. After two months the infiltration was absorbed, the cornea epithelialized, and the peripheral vessels in the cornea collapsed and became almost invisible.

A year later I saw the patient again. The cornea showed dense maculae, the centre was relatively transparent. The vision then was: counting fingers at several metres, and Jaeger III with a strong plus lens.

Also in this much more severe case of a rodent ulcer the often repeated punctures prevented the loss of the eye. The ulcer did not progress any more. This case shows, furthermore, that milk injections are contraindicated in infiltrations of the cornea, which is especially true when ulcerations are present, because rapid softening of the infiltrated parts may lead to a considerable impairment of the condition.

Keratitis Dendritica

Case I. History: A male patient, aged 41 years, had contracted a very painful inflammation of the right eye following an attack of influenza.

Findings: The left eye was normal. The centre of the right cornea was occupied by an irregularly outlined, lobulated ulcer (Fig. 4). The lower third of the anterior chamber was filled with a hypopyon. The pupil was dilated by atropine. The tear sac was normal.

By cauterization with the copper stick (an old, reliable method) most of the corneal epithelium was removed. Iodoform ointment, heat, and atropine were ordered. I had ordered a powder to relieve the pain, as usual, but the pain was so violent, that the powder was vomited.

I did not have to repeat the cauterization. The hypopyon disappeared after ten days, and the ulcer became regressive, although the eye still remained painful and injected. Under local treatment of atropine, heat and 10 per cent. of iodoform ointment, there was a gradual healing by cicatrization.

Six weeks later the patient returned complaining of redness and pain in the same eye of two days duration.

The eye was markedly injected. At the margin of the irregular, and somewhat uneven scar within the pupillary area a pinhead sized white ulcer, which I took for a small serpent ulcer, was present. During the following few hours a low hypopyon formed (Fig. 5). I cauterized the small ulcer with the electrocautery. Next morning the hypopyon had disappeared, and the ulcer was clean.

I saw the patient again after one year. As usual in such severe cases of herpes, dense maculae corneae occupied the pupillary area. The vision was 5/60 and may be improved by an iridectomy.

Doubtless this was a herpetic ulcer, complicated later on by secondary infection with pus germs. Such an infection usually is limited to a small circumscribed area, hence, resembles a serpent ulcer; but exceptionally (instead of a single spot) the entire herpetic efflorescence becomes infiltrated. It is quite unusual for the secondary infection to occur so long after the first ulceration. Cauterization with the copper stick again proved to be a successful treatment of the primary herpetic lesion.

Already in my father's text-book,¹⁰ long ago, cuprum sulfuricum was mentioned for cauterization of herpetic keratitis but it seems to have been almost forgotten. The disadvantages are the severe pain for one to two hours after the application, furthermore, the resulting dense scar. Hence its use is limited to ulcers which remain progressive in spite of energetic use of heat, atropine, iodoform, ultra-violet rays, or even Bucky rays. Also very extensive herpetic ulcers, and keratitis dendritica can be arrested immediately by its application. It is advisable to give atropine-cocaine ointment, and a bandage after the cauterization.

When cauterizing it is important to touch not only the parts, which stain with fluorescein, but to remove also the unstained, slightly raised parts of the corneal epithelium, if it is easily removable. The copper stick has to be sharpened as finely as a very fine, sharp pencil. It is effective also in those cases of dendritic keratitis in which not a real loss of substance is present, but only linear, irregular elevations of the epithelium. If such corneae are stained with fluorescein only a faint colour (if any) appears at first, but after a minute the stain begins to appear, quite contrary to ulcers in which the stain appears immediately after the application of fluorescein.

FIG. 3.

FIG. 6. (X170)

FIG. 7. ($\times 600$)

FIG. 8. ($\times 60$)

This difficulty in staining, and the necessity of cauterizing also the easily removable parts of the epithelium will be readily understood after studying the anatomical conditions.

Fig. 6 shows a section through a keratitis dendritica in a human eye. The cornea of an old woman's eye, which had to be removed on account of a carcinoma of the lids, had been inoculated with the contents of a vesicle of a herpes labialis four days before the enucleation. Two days after the inoculation, a shallow, dendritic, slightly opaque progressive loss of substance had developed.

The histological examination revealed Bowman's membrane deprived of epithelium in some places, in others the epithelium consisted of a thin layer of flat epithelial cells (*P*), while still in others an abrupt transition to thick layers of proliferated epithelium could be demonstrated. These latter plates represent the clinically visible raised lines of dendritic keratitis. The epithelial layer prevents the lines from being stained with fluorescein. At (*C*) there are slits in the thick layer of epithelium. Even if they are partly artefacts by fixation or sectioning, they show that the connection of the epithelial cells is looser here than in a normal epithelium. This explains also, why in some instances the raised lines stain with fluorescein only after one or two minutes.

The proliferation of the epithelial cells is not to be considered a process of repair, as we see it at the borders of other corneal ulcers, but the thickened epithelium is diseased and severely degenerated, as the degeneration of the nuclei, observed with the high power lens, proves (Fig. 7). The epithelium is very irregular, this alone would not be so unusual at the border of the defect. The important feature is the degeneration of the nuclei. The blue basophilic substance, which composes the entire nucleus, is retracted, forming a fine marginal membrane, while the centre of the nuclei is occupied by reddish, eosinophil, homogeneous oblong bodies (herpes corpusculès). This differentiation of the chromatin has to be interpreted as nuclear degeneration.

In cauterizing with the copper stick one has to remove also these degenerated epithelial layers. One removes the epithelium wherever it is easy to do so, leaving the remaining epithelium untouched and sponges the cauterized parts with a piece of cotton, moistened with a solution of sodium chloride. The next day the opacities within the cauterized area will appear more intense and the neighbouring parts of the cornea are also swollen. A further progression of the lesion is not to be feared, but the healing process is very slow.

Because of the dense scars left after the cauterization with copper, I use this treatment only when the usual treatment does not stop the progression of the keratitis. In those cases, however, in which the keratitis is limited to the peripheral parts of the cornea I use

the copper stick without hesitation. I was not convinced of a favourable or deciding influence of the various ray treatments; even with Bucky rays I could not shorten the course of healing in keratitis dendritica.

When, in the later stage of the keratitis a secondary infection with a virulent germ takes place, as in my first case, cauterization with the thermocautery is to be preferred.

Case II. History:—A patient,* aged about 48 years, had suffered severe pain from a highly inflamed eye for a few days.

Findings: The most striking finding was a hypopyon which filled three-fourths of the anterior chamber. The visible portion of the iris appeared dull and hyperaemic. By inspection of the corneal reflex† and with fluorescein a very shallow, scarcely visible, dendritic loss of substance was found, which was diagnosed as dendritic keratitis with purulent infiltration. We cauterized the infiltrated parts with the electro-cautery and gave collargol ointment and a bandage. The lacrimal sac had been found normal.

The next day the cauterized parts were infiltrated again, the condition by no means improved. I proposed a trephine after Sondermann, which was done with a 1 mm. trephine in the centre of the densest infiltration within the pupillary area. The trephine went easily through the entire thickness of the cornea but did not bring about a complete perforation. Descemet's membrane evidently had not been cut through. Finally, Descemet's membrane was incised obliquely with a discission knife, but scarcely any aqueous escaped. The operation was unsatisfactory on account of the resistance of Descemet's membrane, and it seemed that there was little hope of saving this eye. I had to leave the city the next day, and on my return after five days my friend showed me the patient again and gave the following surprising account of the events:

The morning after the operation the eye had been found less irritated, the hypopyon had disappeared entirely, the anterior chamber was not formed yet and the infiltration of the cornea had not progressed. The latter disappeared with surprising rapidity during the next few days and when I saw the eye again only slight ciliary injection was present, the anterior chamber had reformed, and at the former site of the infiltration I saw an epithelialized uneven area which looked like a cleansed ulcer. Soon afterwards the patient left the hospital and could not be observed further.

Later on an iridectomy would have been advisable because of the central location of the scar and a possible increase of the intra-

* This patient was sent to me by Dr. S. Gazepis of Athens, whom I wish to thank here.

† The best and easiest way to diagnose dendritic keratitis, is to inspect the corneal reflex image with the loupe from the side. Incipient cases are often easier recognized that way than with the slit-lamp, which gives a less general view.

ocular tension. This eye which had seemed lost was saved contrary to all expectations.

Undoubtedly here we had to deal with a "Wild gewordenen Herpes" as we call it, namely a grave secondary infection which has the character of a serpent ulcer, but its herpetic origin could be recognized by its dendritic irregular outlines. The malignancy of this ulcer was indicated by the height of the hypopyon and by the fact, that a thorough thermo-cauterization had proved to be without benefit. The healing of this lesion was accomplished in a sovereign manner by the central trephine of the cornea after Sondermann.

Sondermann¹¹ proposed a trephine opening in the centre of the ulcer, preferably in the centre of the pupillary area in malignant corneal ulcers, especially the serpent ulcer. At first he used a 1 mm. trephine, later on a 1 and 0.5 mm., mechanically working trephine. First he cauterized the ulcers and immediately afterwards trephined. By this method he accomplished almost instant regression of the purulent process.

Seidler recommended the trephine after Sondermann, but he soon omitted the preceding cauterization. He emphasized the resulting good vision and the absence of secondary glaucoma. Lindner tried this method, but gave it up again, as in one case the anterior chamber did not form for three weeks and the final result was an increase of the intra-ocular tension due to anterior root synechiae.

I have used the trephine after Sondermann in serpent ulcers often and with very satisfactory results. The advantage is the almost instant arrest of progressive processes; the infiltration is not always smaller the next day, on the contrary, it often appears more swollen, but the hypopyon is gone, the eye is less irritated, and usually the pain has disappeared. After a few days the infiltrate is absorbed, the eye recovers quickly; the resulting scars are smaller than those after cautery, hence the optical result is better than with other types of treatment.

The main advantage of trephining, however, consists in the rapid healing of the lesions. Apparently toxic substances are removed from the cornea and anterior chamber, hence the ciliary injection diminishes rapidly and the irritation of the eyes disappears sooner than after the two other methods of treatment, and this is undoubtedly of the greatest importance to these patients who usually belong to the working class. The necrosis of the iris and of the corneal lamellae, caused by the toxins in serpent ulcer, is apparently either prevented by the trephine or the tissues are stimulated to a rapid reorganization.

The method certainly has some dangers and this may be the reason why it has been given so little publicity during the last

few years. Sallmann¹² reported a case of serpent ulcer, which was trephined at another clinic. During the operation the lens was injured, and panophthalmitis followed. Such accidents may have happened elsewhere also, and this is probably the reason why the method has been abandoned. A badly performed operation, however, does not disprove the value of the operation, and I shall explain in detail later why in some cases the lens may have been injured. With a certain skill trauma to the lens can be avoided, and I should not call the operation a dangerous one.*

Another complication is the delay in the formation of the anterior chamber, which was pointed out by Lindner. It is certain that an increase of tension may occur in these eyes just as it may happen occasionally that the pupillary margin prolapses into the trephine hole. On the other hand we know that we have to do an iridectomy in almost every case of serpent ulcer treated by other methods, in order to relieve the increased tension which followed the perforation and the formation of anterior synechiae.

How long shall one keep the trephine hole open and how can a delay in formation of the anterior chamber be prevented?

We know from histological examination that the increase of tension in such cases is due to a firm adhesion of ligamentum pectinatum and iris periphery, which develops the more easily as these eyes are more or less inflamed. We know, furthermore, from experience, that an increase of tension takes place only seldom, if the chamber is formed within ten days, and almost always, if the chamber needs longer than ten days to form, whether it is an eye with a corneal fistula, or with an operation for glaucoma, or with a corneal section after a cataract extraction. That the dangerous time begins just after ten days is due to the fact, that the fibroblasts need, as the anatomical investigation shows, just ten days to form. Hence in treating the serpent ulcer it seems advisable to keep up the drainage of the anterior chamber for a few days in order to remove the toxins, afterwards, however, to propagate the reformation of the anterior chamber, if possible. After trephining I succeeded in doing so by putting xeroform on the trephine hole. So a plug is formed within the wound canal and a slight decrease in outflow is sufficient to give rise to the formation of a fibrin coagulum which closes the hole; this takes place the more readily as in these cases the aqueous contains more than the normal amount of albumin, hence more easily coagulating substances.

Sallmann opines that the successes of Sondermann may be ascribed, perhaps, to a low virulence of the germs in the ulcers which he treated. On the other hand, Sallmann, like Seidler,

* Naturally in trephining for *ulcus serpens* where glaucoma is present, the sudden diminution of the intra-ocular pressure may cause spontaneous rupture of the lens capsule and so panophthalmitis.

reports two cases, in which cauterization with zinc and the thermo-cautery proved to be useless, while trephining had the desired effect in spite of the large size of the ulcers.

My above mentioned case of infected herpes shows also, that trephining is superior to cauterizing,* and I made up for myself the following scheme of treatment :

I cauterize a beginning serpent ulcer with the electro-cautery, if there is a considerable part of the pupillary area still unaffected; if only a small part of the pupillary area is unaffected by the ulcer I trephine with the 1 mm. trephine; in case the ulcer is large and perhaps near perforation I use the 1 and 0.5 mm. trephine. The trephining should be done in the centre of the pupillary area if possible and within the progressive margin of the ulcer, which often coincides with the former. Should the progressive margin be near the pupillary margin I make the trephine so that the iris does not prolapse into the wound, as the chief aim of this treatment, namely drainage, would be annihilated by prolapsed iris. Anterior synechiae may, furthermore, give rise to later complications. When the ulcer occupies the centre of the cornea to a large extent, I make the trephine in its centre.

Why does injury to the lens occur during the trephining, as in Sallmann's case, and probably not infrequently in other cases? I should like to explain it as follows:

In cases of serpent ulcer there is frequently a deep corneal infiltration, as shown in Fig. 8, which may lead early to formation of a posterior abscess, as the following case illustrates:

History:—The left eye of a woman, aged 55 years, had become blind one year ago. Three weeks ago the left eye became inflamed and painful.

In the centre of the dull cornea there was a yellow disc, which was distinctly seen in spite of the very high hypopyon.

Histological Findings:—(Nr. 1,650.) The floor of the serpent ulcer (*U*) was swollen and infiltrated with leucocytes. The margin was not much infiltrated (right) and the epithelium extended somewhat over the floor of the ulcer (*E*). The deep lamellae of the cornea had lost their nuclei and appeared homogeneous. Descemet's membrane (*D*) was separated from the stroma by a purulent mass, but its structure and thickness, were not yet affected. In the anterior chamber there was a purulent exudate, the hypopyon (*H*). The clinically visible yellow disc was caused by the posterior abscess and not by the ulcer itself as the latter contained relatively few pus cells compared with the sharply outlined posterior abscess.

* There are, of course, corneal ulcers with such virulent germs that no therapy will influence them. Then also trephining is useless. The corneal ulcer caused by the bacillus pyocyaneus may belong to this group; in the animal experiments conducted by Safar, trephining was useless in these ulcers. *Zeitschr. f. Augenheilk.*, Vol. LXI, p. 26.

The yellow colour of the posterior abscess was also more saturated than the colour of the hypopyon as it consisted only of leucocytes, while the hypopyon consisted to a great extent of fibrin.

If one should attempt to trephine the cornea in such a case, one might push Descemet's membrane backward, detaching it without perforating it, exactly as it happened in my case described above. Not knowing of these pathological conditions and finding no chamber fluid escaping after having apparently gone through the cornea with the trephine one might be inclined to push the trephine deeper. Then, of course, one would press Descemet's membrane against the lens and while perforating Descemet's membrane one would also cut a nice hole in the anterior lens capsule and the lens. The fate of the eye is determined by the perforation of the lens capsule; within the avascular substance of the lens the germs grow without resistance and panophthalmitis begins. If one, however, knows the pathological conditions and proceeds as my friend did, the danger is eliminated. One may push a sharp needle obliquely through Descemet's membrane, allowing the chamber fluid to escape through the small opening.

At first it may seem strange to create a direct connection between anterior chamber and iris on one hand, and the highly infectious margin of the ulcer on the other hand by a wide trephine hole. But the streaming fluid washes the anterior chamber, and probably brings about a reversal of the corneal lymph stream; hence the toxins do not diffuse toward the marginal vessel loops but toward the trephine opening, and the inflammation subsides rapidly.

Case III. History:—The left eye of a boy, aged 9 years, had become inflamed after an attack of influenza three weeks ago. He never had an inflammation of the eye before.

Findings:—There was a moderate mixed injection of the globe. The cornea was dull. A grey, dendritic ulcer, which was fork-like, split up at both ends, extended transversely across the cornea. The chamber fluid was slightly cloudy. The iris was hyperaemic, the pupil was dilated (atropine).

After four days of consecutive treatment (heat, atropine and 10 per cent. iodoform ointment) which did not improve the condition, the ulcer was cauterized with a sharply pointed copper stick. During the following days the ulcer appeared more opaque and larger (as is usual after this kind of treatment) but did not progress and cicatrization set in soon. The upper margin of the ulcer had already reached the upper limbus.

One week after the cauterization I had to leave the city and when I saw the boy three weeks later, the appearance of the eye had changed as follows (Fig. 9): While the central portion of the ulcer was healed, two yellowish infiltrates had appeared on either side of the original dendritic ulcer. These infiltrates did

not improve in spite of a renewed cauterization with the copper stick, which was performed during my absence, but became worse. Both infiltrates had convex outlines toward the centre of the cornea. There was a pannus-like vascularization coming from the temporal upper limbus.

I interpreted the infiltrates as an eczematous keratitis complicating the keratitis dendritica. This assumption proved to be correct. Within the following days a number of miliary phlyctenules appeared. Subconjunctival injections of 0.1 c. cm. of a 10 per cent. solution of bichloride of mercury quickened the absorption of the infiltrates and the inflammation subsided within a very short time.

The keratitis dendritica evidently had elicited a keratitis *eczematosa sive phlyctenulosa*.

It is well-known that any irritation, *e.g.*, a foreign body on the cornea or in the sulcus subtarsalis, even a slight traumatic conjunctivitis may cause an attack of eczematous conjunctivitis or keratitis in a predisposed eye.

The diagnosis in this case was made by the presence of miliary phlyctenules and by the appearance of the infiltrates, which, although they were yellowish, differed in the absence of a progressive margin from those caused by bacterial infection. In infected herpes the progressive margin appears to be more superficial and resembles an *ulcus serpens*, while here the infiltration extended into the middle layers of the cornea. Furthermore, the irritation of the eye was not as violent as we are accustomed to see it in secondary infection, and there was no hypopyon, which we should expect in such complications.

Excepting for the eczematous keratitis fascicularis any cauterization is contraindicated in eczematous keratitis as it is not only useless but also injurious. This includes electro-cautery as well as cautery by chemicals. In my case cautery was done in my absence in the mistaken assumption that there was a herpetic exacerbation. While cautery had an ill effect, subconjunctival injections of bichloride of mercury brought about a rapid improvement.

Herpes corneae is a rare occurrence in children. Besides the above reported case I saw only two others. My father, who especially recorded all rare cases of clinic and private practice, had listed only one case of juvenile herpes corneae. In 1907, a girl, aged 7 years, had been treated for herpes corneae at the second eye clinic and had been discharged in an improved condition after a short time. The fact that my father specially recorded this case, and later on did not add another one shows the extreme rarity of juvenile herpes corneae.

I shall briefly describe here my last case of juvenile herpes corneae, on account of its treatment:

History:—The left eye of a girl, aged 8 years, had become inflamed two weeks ago. No illness had preceded.

Findings:—The left eye showed a typical keratitis dendritica (Fig. 10) and a herpetic ulcer in the nasal and upper quadrant.

The first eye clinic kindly administered two treatments with Bucky rays in two weeks. During this time the lesions had progressed considerably, were extremely painful, and at the end of the second week occupied most of the pupillary area (Fig. 11). Immediately I employed the old and reliable method of cauterization with the copper stick, and within a few weeks the lesion was healed, leaving, however, a scar.

In this case the herpetic keratitis progressed relatively fast, and only the treatment with the copper stick arrested the process.

REFERENCES

1. Hallauer.—*Arch. f. Anat.*, Vol. CIII, p. 199.
2. Ventremon.—Manufactured by Degewop, A. G., Berlin.
3. Castle.—*Amer. Jl. Med. Soc.*, p. 748, 1929.
4. Locke and Townsend.—*Amer. Jl. Med. Sc.*, p. 764, 1929.
5. Sharp, Sturgis and Isaacs.—*Jl. Amer. Med. Ass.*, p. 749, 1929.
6. Rosenow.—*Klinische Wochenschrift*, p. 652, 1930.
7. Nescic.—*Serb. Arch. f. d. ges. Med.*, Ig. XXVIII, ref. *Jahresber. f. Ophth.*, Vol. XVII, p. 397.
8. Wibo.—*Bull. de la soc. belge d'ophtal.*, Ur. LIII, p. 38, ref. *Jahresber. f. Ophth.*, Vol. XVIII, p. 322, 1927.
9. ————*Bull. de la soc. belge d'ophtal.*, p. g. ref. *Jahresber. f. Ophth.*, Vol. XX, p. 354, 1928.
10. E. Fuchs' textbook, 12 Aufl., p. 60, English translation by Duane, p. 67.
11. Sondermann.—*Klin. Monatsbl. f. Augenheilk.*, Vol. LIX, p. 759, and Vol. LXXII, p. 460.
12. Sallmann.—*Zeitschrift f. Augenheilk.*, Vol. LX, p. 284.

THE EFFECT OF DIET ON THE NATURE OF THE OCULAR LESIONS PRODUCED BY NAPHTHALENE*

BY

MARGHERITA COTONIO BOURNE

FROM THE DEPARTMENT OF PHYSIOLOGY AND BIOCHEMISTRY,
UNIVERSITY COLLEGE, LONDON

SINCE Bouchard, in 1886, observed that the administration of naphthalene to rabbits caused cataract, a large number of ophthalmologists have been attracted to the possibilities of this substance as a means of producing cataract experimentally. Certainly, the knowledge of a means by which cataract could be produced at will in a laboratory animal would seem to provide an excellent opportunity for attack on the problem of the aetiology of cataract.

* This research was carried out for the Committee on the Physiology of Vision of the Medical Research Council.