

LEPROSY  
AS A  
CAUSE OF BLINDNESS

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C. FRED. POLLOCK





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LEPROSY

BY THE SAME AUTHOR.

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The Normal and Pathological Histology of the Human Eye and Eyelids. By C. FRED. POLLOCK, M.D., F.R.C.S.E., F.R.S.E., Surgeon for Diseases of the Eye, Anderson's College Dispensary, Glasgow. With Two Hundred and Thirty original Drawings by the Author, lithographed in black and colours.

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# LEPROSY

AS A

# CAUSE OF BLINDNESS

WITH NOTES OF FORTY-ONE CASES

BY

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TO THE COMPANION,  
ALONG WITH WHOM THE LEPER HOSPITALS  
OF NORWAY WERE VISITED,  
MY BROTHER



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## INTRODUCTION

LEPROSY—the mickle ail—is rarely seen now in this country. In several parts of the world, however, its various manifestations can still be studied; and I am indebted to the kindness of officials and of patients for opportunities of making the following observations during a visit, in August and September, 1888, to the hospitals in Bergen, Trondheim, and Molde. The subject of these pages is the advanced stage of disease of the eyes and eyelids in cases of leprosy as found in Norway.

Leprosy, with its round-celled formations and a bacillus peculiar to itself, with its clinical history of immemorial interest, and a sure though intermittent progress to death, causes in numerous instances diseased conditions of the eyes; and these have a

marked tendency to end in loss of sight. Carter<sup>1</sup> says "Boeck noted, in 111 patients, 49 examples of eye disease of some kind. In India the complication is probably much rarer." The more detailed figures of Boeck's cases are as follows: In 111 cases of *Lepra tuberculosa* there were 49 with affections of the eyes, viz. Tuber in cornea, 23; opacity of cornea, 5; ulcer of cornea, 5; iris affected, 9; staphyloma, 2; atrophy of eyeball, 2; rupture of eyeball, 1; cataract, 2; and also lachrymation with ectropion, 2, and sclerotic shallow, 2. In 42 cases of *Lepra anaesthetica* he found lachrymation with ectropion in 20, and iritis with distortion of the pupil in 9. Of 30 cases of *Lepra anaesthetica*, which Day observed at Cochin, 3 were blind; and of 17 cases of *Lepra tuberculosa*, 1 was blind.

On going round the wards of the hospitals for lepers in Norway, one of the most obvious facts was that a large number of the patients had some affection of the eyes or eyelids. Most of the many wards — the very peculiar smell of which was

<sup>1</sup> *On Leprosy and Elephantiasis*, by H. Vandyke Carter, London, 1874.



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frequently obtrusive—of these hospitals are small. They each contain about half a dozen beds; and among the inmates of nearly all of them there were sufferers from more or less severely diseased eyes. In only too many instances had the ultimate stage of blindness been reached. Of the 463 patients who were resident in the institutions just mentioned, 41 were blind. That is nearly 9 per cent. These were mostly in bed; and, like their neighbours still possessing sight, they were quietly inactive, often lethargic or drowsy, and sometimes sleeping. But, even where the disfigured face was covered with an apron or jacket, as the person lay in bed, or was hidden behind the mutilated stumps of the deformed hands on the approach of a stranger, a simple “*ver so gud*” was sufficient to induce a ready acquiescence in an examination by a foreigner.

The cases of leprosy in the hospitals were of all shades of severity, from a boy with a single nodule, hardly to be noticed except during a careful scrutiny called for by suspected inherited predisposition, or a man in the prime of life with a few marks upon the skin, to men and women, with faces distorted

into the leonine type; with prominent bald eyebrows, and the forbidding aspect which is produced by the many bosses, folds, and furrows of the tuberos form of the disease, or rendered even more repulsive by the insidious ravages of the smooth variety, with features drawn and scarred, with ulcers yielding a foul discharge, with skin stained, blanched, and glossy, and with gaping mouths, or with faces hardly human, hairless, noseless, sightless, and utterly expressionless. Such marked heads were common among those patients whose eyes were much damaged, and they were an index of the advanced stage attained by the disease in other parts of their bodies as well. Thus the larynx was often so affected, that speech was hoarse and husky, or reduced to a forced whisper, or even abolished or unattempted, as when tracheotomy had been performed to prevent suffocation; the hands had lost fingers or parts of them from disappearance of some phalanges; the fingers were deformed and unbending from fixture or destruction of the joints; the feet were similarly mutilated; while open sores in many places heightened the picture of distress.

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To a visitor, whose previous clinical acquaintance with leprosy was limited to one or two cases, it was somewhat noticeable that only a very arbitrary division into the tuberculated and the anaesthetic forms of the disease could be said to exist in the actual cases. Both Elephantiasis tuberculosa with its nodules and Elephantiasis maculosa with its smooth patches, though occurring separately, were sometimes present at the same time in the same person, or had been present at different periods; and both yielded many anaesthetic patients. Local anaesthesia is the usual fate of those who live long enough, and it is not one of the prominent symptoms. All stages and forms were mingled, for the types, produced by the comparative predominance of one set of symptoms or another, were not unfrequently combined. The cases were, however, classed in the cards at the head of the beds as Elephantiasis tuberculosa and Elephantiasis anaesthetica (*i.e.* non-tuberculated), not only when these varieties were so far distinct, but also when the former or the latter was most distinguishable, and some were noted as mixed, Elephantiasis tuberculosa et anaesthetica.



These headings are, therefore, mentioned in the notes of the cases quoted. Of the 41 blind patients, then, there were 11 cases of tuberculated, 27 of anaesthetic, and 3 of mixed leprosy; and of the middle series, though marked as anaesthetic, no fewer than 6 showed pronounced leprosy tubers of the eyes.

As to sex and age, 18 persons were males, and 23 were females; and the ages of the men ranged from 26 to 70, with an average of 45, years; while the ages of the women ranged from 29 to 78, with an average of 52, years.

With reference to the meaning of the term "blind," only those individuals are included both of whose eyes were so affected as to render them blind in the ordinary, which practically corresponds with the scientific, acceptation of the word, so "blind," that is to say, as to be incapable of distinguishing objects, whether large or small. As a matter of fact, an even more strict definition might have been adopted, for the blindness was found to be almost always total, there being not even perception of light except in one or two cases, where mention is

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made of this matter and the amount exactly described. The tension of the eyeballs, where these could be said to exist, was normal, unless the contrary is stated in the notes.

It seemed best generally to limit the notes of the cases to short descriptions of the actual condition of the eyes at the time when they were seen, in order to avoid the usual sources of error in a clinical history of a lingering disease, with its lapse of memory and dubious statements on the part of the patient, uncorrected by records taken at various dates by competent observers.

The destructive processes, through which the eyes and eyelids were passing or had passed, were in many instances peculiar to leprosy ; but in others, as will be seen, the secondary and serious changes were such as might have resulted from some other cause, though here, of course, also due to leprosy. It will be convenient to group the cases just so far as to afford adequate illustration of the various points which they seem to teach most clearly.

## EYELIDS

### ECTROPION

VARIOUS observers have found that, when leprosy attacks a nerve, a deposit of round cells occurs among the nerve fibres, and that the fibres themselves atrophy rather extensively.<sup>1</sup> When the disease has involved the branches of the nerve supplying the muscles of the face, the paralysis, which is thus produced, tells in none of these muscles with more obtrusive disaster than in the *Orbicularis palpebrarum*. As this sphincter of the orbit passes more and more into disuse from the growing paresis, a slowly progressive falling away of the lower eyelid from the eyeball makes itself apparent, until ultimately a more or less complete *Ectropion paralyticum* is established, and the face acquires that deplorable look, which is so notice-

<sup>1</sup> Cp. Virchow, *Geschw.* Bd. ii. p. 522.



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able wherever any such sinking of the lids has occurred. The following is an example:—

CASE 1, J. K. F.—This woman, sixty-four years of age, with *Elephantiasis anaesthetica*, had been blind for five years. She was lying asleep when visited; and, when examined then without being disturbed, the under eyelids were so much everted and depressed that a large extent of the lower part of each eyeball, including some of the cornea, was exposed and dry, while the upper eyelids concealed the rest of the globes. On wakening her, little alteration occurred in this position of the lids beyond a very slight movement of the lower ones and a moderate lifting of the upper ones, which were left drooping. More of the cornea became exposed, owing to the cessation of the rolling upwards of the eyeballs in sleep. On raising the upper lids with the finger the whole cornea of each eye was found to be densely opaque, not, however, with the uniform shining cicatricial tissue of a leucoma, though that was present in several places, but rather with a dull and dirty gray opacity due to interstitial infiltration and pannus, blood-vessels

passing inwards here and there from the hyperaemic ciliary margin, and giving the areas over which they ran a reddish tint. The upper part, protected by the eyelids, was moist and smooth; but the portion beneath, exposed to the air, was dry and rough, with a surface honeycombed and uneven from diffuse and scattered points of ulceration. The tension was normal, and there was no pain, though the cornea remained sensitive. The xerosis of the cornea was accompanied by a corresponding dryness of the ocular conjunctiva, so far as it was exposed to the atmosphere; but the palpebral conjunctiva of the everted lids was moist and congested, lying in loose folds, and covered at some spots with the stringy discharge of muco-purulent conjunctivitis. The edges of the lids were encrusted with dried secretion. Xerosis, it may be mentioned in passing, was present in half of the cases, which illustrated blindness following the ectropion paralyticum of lepers, without actual leprosy of the globes.

This ectropion, which is analogous to the falling downwards and outwards of the lower lip in leprosy, is very common in patients whose disease has in-

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volved the peripheral nerves. Besides the cases where no damage, or comparatively little damage, had occurred to the eyeball, which of course do not come under review here, there were, among the forty-one blind persons, seventeen who showed it in a marked or a moderate degree. Eight of these were classed as tubercular, and six as anaesthetic, two of the latter having a tuberculated condition of the eyeballs. Three were classed as mixed. Of course it is just in a list of such far-gone and unfortunate patients that this change in the position of the eyelids occurs most frequently. It is generally symmetrical; in thirteen cases it was so. But sometimes it is unilateral, as was seen in the four other instances, in two of which it was confined to the right and in two to the left side.

The ectropion during the earlier stages may be limited to, or more developed in, the inner or outer half of the eyelid, according to the part of the muscle paralysed; but in the advanced cases dealt with here it was so great as to involve the whole lid. How far the extent and degree of the eversion are apparently due to the habit of the patients in

removing the excessive secretion of the conjunctiva by wiping it away from above downwards or obliquely it is impossible to say. Some of them seemed to be but slightly troubled with lachrymation; but others were much distressed with this overflow.

In eight persons blindness had resulted from the secondary changes which are apt to occur in an uncovered eyeball where there is ectropion from any cause; but the marasmus due to leprosy must be taken into consideration in estimating the risk to the exposed eye. Little comment regarding the different results is necessary, and a short description will suffice. The other nine instances are distributed among the cases where blindness was directly due to leprous processes in the eyeballs themselves, whether the ectropion played any part in the history or not.

In the example already given keratitis of a very pronounced kind was the most important factor, and a further stage of corneal inflammation was well shown in the eyes of

CASE 2, J. N. H.—a woman, seventy years of

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age, with Elephantiasis tuberculosa, presented a strange appearance as she lay in a somewhat dim light in a corner of a ward. The skin of the face was not much marred; but the orbits looked at a short distance quite like two dark cavities; and even on a nearer approach the bright red and spongy conjunctiva of the moderately everted lower lids seemed to border deep and almost black hollows. Good light showed that the deceptive aspect was caused by the two corneae, which were very similar to one another in character. They had atrophied under the influence of prolonged suppurative keratitis, and throughout the altered and opaque tissue the dark uvea of the iris was incorporated, rendering nearly the whole surface extremely dark. Here and there in the lower part small deposits of calcareous material indicated spots where some *débris* of the pus had become calcified, and this region was dry and dim, while the upper part was moist and glistening. The tension was normal, and the woman said she had still some perception of light; but I could not satisfy myself that there was any truth in the statement, and that



pathetic claim is often made by blind persons without foundation, as shown on careful testing.

Another condition was presented by

CASE 3, L. A.—a woman, forty-five years of age, with Elephantiasis anaesthetica, and ectropion of both lower lids. The upper part of both corneae was leucomatous; but the lower portion in each eye, amounting to more than the half, was infiltrated with pannose tissue, while the conjunctiva over the adjacent sclerotic was thickened also; and this large area, which was slightly more elevated than the rest of the globe, was ulcerated all over. The exposed conjunctiva of the everted lids was very vascular, and had several ulcers; and mucopurulent discharge, mingled with tears, kept the inflamed surface moist.

The ulceration may end in perforation of the cornea, followed by advance and adhesion of the iris to the opening, or prolapse of the iris through it with subsequent adhesion, the process yielding in the end a Leucoma adherens, either of the common partial kind or of a much more widespread and total nature. This last result had been attained in

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CASE 4, J. M. H.—a man, thirty years of age, with Elephantiasis anaesthetica, and very great ectropion of both lower lids. In the left eye, the white shining cicatricial tissue of leucoma was confined to the lower portion of the cornea, the upper part of the membrane having a bluish black character, streaked with whitish bands, the outcome of the irregular blending of the pigmented tissue of the iris with the posterior layers of the altered cornea. In the right eye, the cornea was all changed into a state of leucoma with scattered districts of darker colour, and the ocular conjunctiva was dry, hard-looking, and partially ulcerated. The tension was normal in both eyes.

Another form of Synechia anterior was present in

CASE 5, E. P. W.—a woman, sixty-five years of age, with Elephantiasis tuberculosa. She had been blind for four years. On the left side, the lower lid was ectropic, and, while the under half of the cornea was quite opaque, the upper part was clearer though very hazy, and close behind it the iris was stretched so as to form a veil with the inferior border fixed

to the dense leucoma below. The tension was normal, and the patient asserted that she possessed some slight perception of light. On the right side the ectropion was very considerable. The eyeball was reduced to a soft stump with a small bluish gray spot in the former position of the cornea, and with four deep furrows in the usual position of such depressions, corresponding with the insertions of the Recti muscles. This right eye showed the great degeneration which may be brought about by the destructive progress of events when corneal ulceration terminates in perforation; and a further illustration of such a case in the history is afforded by the next case.

CASE 6, K. J.—This was a woman, forty years of age, with Elephantiasis anaesthetica. On the right side there was ectropion of the lower lid; and the opaque cornea, which was vascular but yet dry all over, was roughened on the surface by extensive ulceration or superficial sloughing. The left eyeball was represented by a minute stump or movable nodule, and from the extremely small size of this the orbit was almost as empty as after enucleation

of the globe. The eyelids, the lower one of which possessed the characteristic ectropic bending forwards of the tarsus, had sunk backwards, and the conjunctiva was no longer exposed. The patient's inability to move the lids corresponded with that loss of control which the absence of the eyeball involves; but their shape, along with the condition of the right eye and eyelids and the clinical history, indicated that ectropion had been the starting-point in the loss of the eye. That the sunken eyelids may continue to exhibit their conjunctival surfaces when at rest, even when the eyeball is almost entirely gone, is shown in Case 32.

Another result, which may succeed purulent or ulcerative inflammation of the cornea following ectropion, is the production of bulging of the front of the eyeball. Such a Staphyloma anterior was seen in the two next cases.

CASE 7, J. A. O.—A man, forty years of age, with Elephantiasis anaesthetica. This man's face was terribly disfigured owing to the complete destruction of the nose, in the place of which there was an irregular opening with ragged margins which

were still being attacked by the mutilating advances of the leprosy. The state of the one eye corresponded closely with that of the other. The under lid was considerably everted, and the lower half of the cornea was densely opaque and staringly white; but the upper half, though it also was quite opaque, was stained a dark hue by the tissue of the iris on its posterior aspect. The whole cornea protruded slightly as a total staphyloma corneae. The tension was normal.

CASE 8, G. H. H.—This man, fifty years of age, with Elephantiasis anaesthetica et tuberculosa, had been blind for twenty years. Both eyelids on each side were everted, and the protrusion of the anterior portion of the eyeballs caused the lids to stand out prominently. The bulging of the right globe was less extensive than that of the left, which was very large. In the former some portion of the cornea was occupied by the white tissue of leucoma, which remained in the normal plane, and the staphylomatous part was dark; but in the left eye the anterior staphyloma involved the whole cornea as well as the ciliary region, and there was an irregular



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distribution of white and dark patches over its area, the lower half, or nearly as much as that, having also a rough and rather deeply ulcerated surface. The tension of both eyeballs was normal.

These eight cases afford illustrations of the diseased processes which eyes undergo when once the leprous paralysis of the orbicularis palpebrarum leaves them unguarded and unprotected; and they suffice to prove that, although with different anatomical results, a common termination of blindness may be reached. From the clinical account of the anterior segment of the eyeballs, the ruin of the internal tissues may be inferred.

#### INFLAMMATION AND ULCERATION OF THE EYELIDS

The frowning and protruding eyebrows of some lepers owe their prominence to the presence of leprous deposits, and from a similar cause the eyelids are sometimes disfigured or distorted. In such circumstances the eyeballs themselves may be

diseased, or they may be quite unaffected. The existence of a leprous tuber, or of a knot of tubers in the skin, which is discoloured and darkened over them, gives the thickened lids a heavy appearance, and impairs their movements; and, if such a nodule ulcerates, as it usually does, although now and then the little tumours disappear by softening and absorption or by suppuration, the resulting cicatrix and loss of tissue leave the lids with irregular edges, destitute of eyelashes, or ectropic, or misshapen in a variety of ways.

Besides the common inflammation or occasional ulceration which occurs in the conjunctiva exposed by ectropion to the irritating influences of the air, other diseased states of the lids were found in the blind lepers. Much havoc is brought about by the ordinary ulcerative processes, to which any superficial part of the body attacked by leprosy is liable; and an extreme example of this is given here.

CASE 9, N. R. W.—A woman, twenty-nine years of age, with *Elephantiasis anaesthetica*. This woman had been blind for a year, and was much mutilated by leprosy. From her cheeks, which were scarred

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and ulcerated, she wiped away the discharge and overflowing tears with a cloth held somehow in hands which were scarcely recognisable as such, being little more than stumps, on which some projecting knobs remained as indications of what had formerly been fingers. Her four eyelids were almost entirely gone, having been consumed away by the slow ulceration which was yet in progress upon the few fragments left. This state of the lids was accompanied by great destruction of the eyes also. They were reduced to about half their normal size; and, in place of the front portion of each globe, there was a prominent fleshy mass, yellowish red in colour, traversed by blood-vessels, irregular on the surface and in outline, shining with moisture, and composed of a collection of leprous tubers. In the right eye ulceration had been present for some time in this tuberculated mass, and the dark blackish *débris* of the destroyed iris was embedded in and easily distinguished about the front of the tumour. In the left eye hardly so much of the anterior portion of the globe was gone, for a part of the upper segment of the cornea could still be made out

though altered in character and quite opaque or leucomatous.

Another condition found among the blind lepers was the union, apparently by an operation, of the upper lid to the lower one along their edges. This was present in four cases, all classed as anaesthetic. It was symmetrical, and involved the inner or nasal portion of the lids to the extent of a third or a half of the whole length of their margins. The precise state of the eyeballs could not in such circumstances be quite determined, owing to the very small part of the interpalpebral fissure which was left, for this opening could of course hardly be increased or diminished either by the will of the patient or the fingers of the observer. From the notes of the cases, however, it will be seen that the blindness was due to leprosy of the front of the eyeball of the flat form of infiltration to be afterwards described. Three cases are given here, and the fourth is recorded as Case 40.

CASE 10, J. A. B.—This woman, sixty-three years of age, with Elephantiasis anaesthetica, had been a leper for forty-five years, during the last

eleven years of which period she had been quite blind. On the right side the nasal third of the opening between the eyelids was closed by their union to one another. The lids themselves were thin, and presented the shining features of skin which has passed through the degeneration of Elephantiasis maculosa; and the line of adhesion between the united portions was quite indistinguishable, unless indicated by a slight depression. Behind the lids the globe was felt moving freely, but it seemed reduced in size, although not softened. Through the narrow chink between the outer free edges of the lids only the scleral region could be seen, and this was covered with inflamed, moist, rough, and spongy conjunctival tissue. On the left side the junction between the edges of the lids involved only a third of their extent, and they were somewhat bulged forward by an anterior staphyloma of the globe.

CASE 11.—In the case of A. T. R., a man, sixty years of age, with Elephantiasis anaesthetica, who had been a leper for twenty years, the union of the lids to one another was similar to that just de-



scribed, and involved the inner third of the interpalpebral fissure on each side. The eyes also were symmetrically affected. In each of them the lower half of the cornea was infiltrated with leprous deposit, whitish yellow in colour, rough with superficial ulceration, and somewhat vascular, while behind the now nebulous upper half an iridectomy had been performed some years previously. In the left eye some slight perception of light was still retained, so that the man could slowly fix upon the position of a light; but I could not determine that even this amount of sight was present in the right eye, although it was claimed by the patient himself.

CASE 12, S. H. H.—A man, seventy years of age, with *Elephantiasis anaesthetica*. The union between the edges of the lids involved the nasal half on each side. The corneae were infiltrated with leprous material, and quite opaque all over; and there was some ulceration on the surface of the left one; while, owing to conjunctival inflammation, there was a considerable amount of discharge from the right eye. With the right eye light was still perceived, but the left was totally blind.

## CORNEA

### INFILTRATION

CORNEAL affections are the most common of the local causes of blindness in leprosy. Their progress is slow and intermittent; and, as they are rarely uncomplicated, the final state of the eyes varies in nearly every instance. The cases can, therefore, be only vaguely classified according to their main features. The early stages are characterised by an accumulation of round cells in the cornea, with a consequent opacity which advances towards the centre from the ciliary border. This may occur either as a somewhat smooth infiltration, or as a more or less prominent tumour rising from the surface; but these varieties do not correspond with cases of *Elephantiasis anaesthetica* and *Elephantiasis tuberculosa* respectively, for both forms of corneal affection occur among the patients classed as an-

aesthetic, and both forms also occur among the patients classed as tubercular.

On examining an eye which has just begun to be thus attacked, a patch of ciliary injection, two or three millimeters in length, is noticed at some part of the anterior margin of the sclerotic, and here the deep vessels with their radiating course are partly hidden by the hyperaemic, overlying, meandering, conjunctival vessels of a brighter hue. The next step is a loss of transparency in the adjacent part of the cornea, and bright light reveals the presence of some vessels spreading into this region from those about the corneo-scleral junction. It is a superficial marginal keratitis, and is commonly symmetrical, both eyes suffering, though it may be in different degrees or at different dates. The outer side of the eye seems to be most frequently the locality from which the disease starts.

In the flat form this infiltration creeps towards the centre of the cornea, and at the same time spreads round more and more of the margin. The progressive edge invades fresh ground by minute deposits in the anterior layers at many points,

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which then coalesce to form a more dense opacity, into which the new blood-vessels extend. A zone of fine gray dusty dimness is thus the forerunner of the pannus-like yellowish infiltration. Numbers of such cases, which were yet a long way off from blindness, were quite quiescent, and had been so for years; but in others the resting stage had given place to another attack, with the congestion, the vascularity, and the deposition of more foreign material, all showing renewed activity. The history of the lepers blinded in this way was a history of many such intermittent periods with a growing darkness. In the majority of the examples here recorded it was the lower portion of the cornea which was thus destroyed, if any part of that membrane was left transparent; but in several so much of the cornea was involved, that the starting-point could not be determined, and any changes which might be present in the deeper parts of the eye were completely hidden. As a rule, however, this process by itself is not so dangerous to the leper's sight as some others, for most commonly it does not proceed beyond the middle of the cornea,

which remains sufficiently clear for vision, and it is usually further changes inside the globe which render the patient blind.

The microscopical researches of Bull and Hansen<sup>1</sup> have demonstrated that in the early stages there are round cells in the anterior part of the cornea, and that in the late stages this interstitial deposit degenerates into brownish granular material.

The following cases illustrate very well blindness brought about by this insidious corneal disease, and other examples will be found among the patients, the condition of whose eyes is considered in connection with different parts of the subject.

CASE 13, B. O. S.—A woman, thirty years of age, with Elephantiasis tuberculosa. With the right eye this woman could distinguish a large object as something moving, when it was in a good light, as, for instance, between her and the window; with the left eye there was no perception of light at all. The tension of both globes was normal. The right eye afforded an admirable example of

<sup>1</sup> *The Leprous Diseases of the Eye*, by O. B. Bull and G. A. Hansen. Christiania, 1873.



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great opacity induced by leprous deposit without any appreciable elevation of the surface. The disease had spread over almost the whole cornea from the upper and outer margin, a small crescent at the inferior and inner edge being still clear, or comparatively so, as contrasted with the density of the obscuration in the rest of the membrane. This was yellowish white, with a more yellowish aspect in little patches towards the outer part, and rather more light gray patches towards the inner side. A number of thin blood-vessels could be detected in it. The left cornea was mostly transformed into a white leucoma, in which some specks of calcareous deposit were present about the centre; and behind the clearer upper and inner margin the iris was partially wanting, owing to an iridectomy which had been performed some years previously.

CASE 14, B. E. H.—A woman, fifty years of age, with Elephantiasis anaesthetica. In this case both the corneae were rendered opaque by the leprous deposit, which gave some irregularly distributed localities a yellowish white colour, these

places being scattered over the greater part of the cornea, and alternating with areas of leucomatous cicatricial tissue. The surface of each eye was slightly uneven; but no ulceration was present. In the left eye the upper third or so of the cornea was rather less opaque than the rest; and, although nothing of the deeper tissues could be seen through this by an observer, some dim light penetrating it saved the patient from living in absolute darkness. The presence of muco-purulent conjunctivitis gave rise to a considerable quantity of irritating discharge from both eyes.

#### TUBERS

The growth of a tuber standing out from the cornea is one of the most characteristic and disfiguring ways in which leprosy blinds an eye. Where this has begun to form, a patch of hyperaemic conjunctival and episcleral vessels at some part of the corneo-scleral junction accompanies a vascular opacity

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of the neighbouring region of the cornea, and, in addition, a small, circumscribed, elevated, and rounded nodule is situated on the sclerotic and the adjacent corneal edge. The congestion spreads, the opacity advances, and the little tumour slowly increases. The growing border of the tuber is preceded by a superficial infiltration of the cornea in the neighbourhood, the breadth of this varying in different cases and following the outline of the advancing tumour, and having the characters of the leprous opacity already described, where no tuber is present. A rather less densely opaque zone may be found intervening between the edge of the tumour, and this zone of greater opacity. By and bye a considerable portion of the cornea is covered by the growth, which is pale red in colour and of an unevenly rounded outline, with the surface sloping up gradually from the conjunctiva, but steep and sometimes even overhanging at its advancing side. The lower portion of the cornea was found to be the part occupied by the tuber among the blind, when any normal or transparent tissue was still left; but the whole cornea may be covered, and the

tumour become so prominent as to prevent the edges of the eyelids coming together over it, part remaining exposed when the patient attempts to close the eyes. The size of the outgrowth is sometimes so large that the rest of the eyeball, hidden behind it, acts merely as a movable pedicle to the reddish, vascular tumour, which is moist, studded with secondary roundish prominences, and surrounded with spongy inflamed conjunctiva. As usual, this variety of leprous disease is generally symmetrical; but one of the eyes may be in a more advanced stage than the other, and may have undergone great subsequent changes.

CASE 15, J. S.—a man, thirty years of age, with *Elephantiasis anaesthetica*. This man's eyes were very much counterparts of one another. The most prominent part of a yellowish red, shining mass was visible between the eyelids when gently closed; and, when the lids were opened, nothing in the least resembling an eyeball was to be seen. A fragment of the upper part of the sclerotic was all that could be found. Over the whole front of the globe there was a large, outstanding, fleshy growth, the surface

of which was uneven from the presence of smaller secondary excrescences. It was traversed by numerous blood-vessels, between the ramifications of which there were spots of a paler red or more orange tint; and the whole was bathed in tears with a few stringy flakes of a discharge from the surrounding inflamed conjunctiva. The edges of the lids were somewhat raw-looking, and had some crusts of dried secretion on them. When felt through the lids, the growth seemed fairly firm, without being in any way hard to the touch. It occupied the lower part of the ciliary region as well as the whole of the cornea. Sight was completely lost.

CASE 16, L. L. K.—A man, forty years of age, with Elephantiasis tuberculosa. Both of this man's eyes were alike. In each of them sight was abolished by a growth of leprous material in the form of a large tuber, the main portion of which was seated at the inferior border of the cornea. It was rounded in outline, yellowish red in colour, moist and smooth on the surface; and it extended over about two-thirds of the cornea from the lower



part of the ciliary region. From the latter, which had been its point of origin, it rose gradually, until reaching its maximum height, and then sank rapidly towards its upper border, which overlapped the portion of the cornea still remaining. This portion of cornea, however, was not free from dimness, and behind it the iris, or some of its dark blackish tissue, could be distinguished apparently bulged forwards so much, that the anterior chamber was almost obliterated. As far as could be made out through the obscurity, the iris was adherent to the cornea at one or two points. The tension was normal. The lower lid was tilted forwards with a complete ectropion paralyticum, which left the tumour and the eyeball greatly exposed.

Another manner in which leprosy attacks the cornea is by the formation of tuberculated growths in the deeper layers. Here again there is, at first, localised ciliary injection with engorged episcleral and conjunctival vessels, and afterwards infiltration spreading in advance of the main deposit, the latter taking the form of yellowish gray tubers in the cornea behind a layer of more or less normally clear

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and transparent tissue. The precise situation of the deposit as to its depth in the thickness of the cornea is extremely difficult to determine; and when, as sometimes happens in the more advanced stages, it projects backwards into the anterior chamber, the discrimination between a tumour having its origin thus in front and one originating in the periphery of the iris behind is even more difficult still, if not impossible. The disease ultimately leads to obscurity of the entire cornea, which is thickened and uneven, and it may be accompanied by tubers on the surface as well. In the latter case, of course, the cornea is disfigured, as has been described, by a prominent tumour; but otherwise the surface is comparatively moderately raised above its normal plane, and that only where the growth is extensive.

According to the histological observations of Bull and Hansen,<sup>1</sup> the round cells of the superficial tubers penetrate into the cornea from the episcleral tissue either under the anterior epithelium, or somewhat further back about the middle layers of the

<sup>1</sup> *Loc. cit.*

cornea; and the overlying conjunctival margin or limbus conjunctivae may be infiltrated with similar cells. The deep tubers, on the other hand, start from the neighbourhood of Schlemm's canal, and permeate inwards in front of the membrane of Descemet, while the spaces and meshes of the ligamentum pectinatum at the angle of the anterior chamber are always crowded with the round cells. The growths are supplied with a moderate number of vessels resembling capillaries. A peculiarity of leprous tubers is the retrogressive metamorphosis, which, in common with similar tubers in other parts of the body, they undergo to a greater or less extent into granular material. The degenerated elements occur as brownish yellow bodies of all sorts and sizes, from small rounded particles to large masses with nodulated outlines, lying in the midst of collections of round cells, and larger cells with several nuclei. Some of the corneal corpuscles have been seen with a similar degeneration. There is sometimes a thick liquid present with the metamorphosed elements; old shrunken tubers are dry. The Bacilli leprae have been observed in all the

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cells, which have invaded the cornea from its border, and also lying isolated between the corneal layers.<sup>1</sup>

### ULCERATION

In most of the eyes destroyed by corneal diseases the infiltrations and growths were undergoing, or had undergone, further changes. Ulceration was frequent, even to the length of perforation, which occurs in the cornea not only where there is leprous material, but also at places free from this. There were numerous examples of leucoma, either total or partial as leucoma adherens; and anterior staphyloma presented itself in its usual diversity of forms; while some shrinking of eyeballs or reduction of them to mere stumps had resulted in various degrees.

Instances where leprous infiltration had gone on to ulceration have been already quoted, and examples of large tuberculated growths covering the

<sup>1</sup> Neisser. *Virchow's Archiv*, vol. 84, 1881.

front of the eyeball and passing on to ulceration were afforded by the three following cases.

CASE 17, S. H. H.—A man, forty-three years of age, with Elephantiasis tuberculosa. The most striking appearance about this man's eyes was due to the amount of the conjunctiva exposed by symmetrical ectropion paralyticum of the lower lids. The swollen, inflamed, and uneven conjunctiva was bathed with a muco-purulent discharge; and the conjunctivitis was not confined to the lids, for the ocular conjunctiva was also inflamed, and formed a red spongy frame to the unsightly growths which covered the front of the cornea. No cornea as such could be detected, and in its place there was a mass of pale, pinkish yellow, fleshy, nodulated, leprous material, with some blood-vessels running over it. A very large proportion of its surface was roughened and eaten into by several areas of ulceration, from which a dirty yellow discharge was being thrown off. There was neither vision nor pain; but some smarting and considerable irritation were experienced from the troublesome discharge. The condition of the two eyes was so similar



that the description of the one applies to the other also.

CASE 18, O. K.—A man, thirty years of age, with *Elephantiasis anaesthetica*. This man's face was disfigured by the destruction of the nose, which was entirely wanting. In its place there was a large opening surrounded by indented and uneven borders. Extensive ectropion of the lower lids added to his miserable appearance, which was rendered still worse by the ravages which leprosy had made in his eyes. . Large, fleshy, yellowish red tubers covered the former situation of the cornea; and, in the midst of this, deep ulceration here and there was in progress, producing ragged depressions, yielding a grayish yellow discharge. The condition of the right eye corresponded closely with that of the left; and the discharge and lachrymation distressed the patient much.

CASE 19, E. T.—A woman, thirty years of age, with *Elephantiasis anaesthetica*. In each eye a large prominent leprous tuber covered the lower two-thirds or so of the cornea and also the surrounding sclerotic for a short distance; and the

surface of the growth was ulcerating. Through the upper part of the cornea, beyond the dim zone of infiltration which preceded the advancing border of the tuber, a small portion of the periphery of the iris could be seen; and with each eye there was some distinct perception of light on the part of the patient. There was no complaint of pain, and no spasmodic photophobia was present; but the woman preferred not to sit facing the light.

Ulceration leading to perforation in a cornea invaded by leprous tubers was exemplified in Case 9, where there was prolapse and disintegration of the iris; and another instance may be given here.

CASE 20, N. A. M.—A man, thirty years of age, with *Elephantiasis anaesthetica*. In the right eye the outer portion of the cornea was occupied by a cluster of tubers, the growth not reaching to the centre of the cornea, though the preceding opacity extended beyond this; and in the midst of the tumour a deep ulcer had penetrated backwards, permitting a large prolapse of the iris, the remains of the outer part of which were mingled with the ulcerating tissue, while the rest of the iris was

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drawn as a curtain behind the clearer part of the cornea. The tension was normal, but sight was abolished. In the left eye a different state of matters was present. Here a prominent, reddish yellow, rounded tuber was situated on the internal ciliary region, and covered the inner third or rather more of the cornea. In the outer and upper segment of the cornea a perforation had occurred, followed by local prolapse of the iris. This had healed, and the infiltration had disappeared, leaving a leucoma adherens of the usual kind in its place. The remainder of the cornea was by no means clear; but through it, though hazy, the remains of the iris could be distinguished towards the leucoma without any indication of a pupil. On this side also tension was normal, but sight was gone.

#### LEUCOMA

A later stage is reached when the perforation and prolapse have healed, and the eye is quiescent but

blinded by leucomatous opacity of the cornea or opacity darkened by the adhesion of the atrophied iris.

In the following case the production of such a condition was in progress on the left and completed on the right side.

CASE 21, J. J. R.—A man, fifty-one years of age, with Elephantiasis tuberculosa. This patient was greatly mutilated. Several fingers were gone; the skin of the face was considerably scarred by ulcers; and the larynx was so seriously involved that tracheotomy had been required. In the left eye the lower half of the cornea was occupied by a somewhat crescentic area of leprous infiltration, corresponding in its distribution with the border of the cornea. This had ulcerated, and the cornea had been perforated, with the result that there were very extensive anterior adhesions of the iris. No pupil could be detected; but the central region of the cornea was too opaque to permit exact observation. The position of that portion of the iris, which could be seen through the clearer upper part of the cornea, showed that the anterior chamber was

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exceedingly shallow or obliterated; but the iris, stretched across here from the superior margin towards the synechia anterior below, seemed to be separated from the posterior surface of the cornea by a small interval. In the right eye the leprous deposit was all gone; but the lower half of the cornea was completely opaque, partly white and glistening as in simple leucoma, and partly dark bluish gray from the incorporation of the remains of the iris with the posterior aspect of the leucomatous cornea. The upper part of the cornea was nebulous, and nothing could be observed of the iris with exactness. The tension was normal in both eyes.

CASE 22, J. B. J.—A man, thirty-nine years of age, with Elephantiasis anaesthetica. This man's face could scarcely be called a face. The mouth was drawn awry, and the lips were distorted, making his voice, which was shrill from the leprous invasion of the larynx, still more indistinct. The nose was largely wanting, its former situation showing merely the sunken nasal bones in the upper part and beneath them an irregular hole, surrounded by



nodules and prominences representing the parts of the cartilages and skin which had not been consumed. There were neither eyebrows nor eyelashes; and the entire skin of the face was shining and marred with scattered and confused bands of cicatricial tissue, most of it being blanched, but having here and there a patch of brownish staining interspersed over the ghastly and shrivelled surface. Each of the totally blind eyes was like its fellow. Leprous infiltration of the lower part of the cornea had been followed by perforating ulceration, ending in synechia anterior; and the remaining part of the cornea, above this large white area of leucoma adherens, was almost black from the mixture of the adherent and atrophied iris with its degenerated and wasted tissue. The tension was normal.

#### ANTERIOR STAPHYLOMA

Staphyloma anterior develops comparatively frequently in eyes where the cornea has undergone

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widespread degeneration from leprosy. There were, among the forty-one blind persons, thirteen eyes with this corneal bulging. In three patients the defect was bilateral, involving both eyes; while in seven others it was unilateral, one right eye and six left eyes being affected. This was the proportion among thirty patients with both eyes blinded by disease of the cornea, in twenty-eight of whom the corneal affection was primary, and in two of whom it was secondary to leprous ectropion. Very diverse forms were, as was to be expected, present; and one or two cases will give the best idea of these, which corresponded with the protean staphylomata exhibited by persons who are not lepers. Reference may be made to Cases 7 and 8, and to others recorded further on in illustration of different conditions.

CASE 23, M. M. B.—A woman, fifty years of age, with Elephantiasis anaesthetica. The anterior portion of each of this woman's eyeballs was very prominent, forming a large total staphyloma of the cornea, and involving also the corneo-scleral region all round. The bulging was nearly uniform every-

where, and was without secondary prominences. Most of the surface was very dark in colour; but there were areas of whiter tissue, especially about the places where blood-vessels of some size passed towards and beyond the centre of the protrusion. The tension of the right eye was increased above the normal (+ 1), and in the left eye it was decreased (— 1) as much below the normal. There was no perception of light.

CASE 24, O. P.—A man, sixty-five years of age, with Elephantiasis anaesthetica. This man's right eye had a large, smooth, total staphyloma of the cornea, most of which was white, with some darker patches scattered about the leucomatous tissue. The left eye, on the other hand, though it had passed through the same leprous destruction of the cornea, had no such bulging, the normal contour of the eyeball being retained; and the lower half of its cornea, which, as in a number of the other instances quoted, had been the seat of leprous deposit, was densely opaque with a white shining leucoma, while the upper half was nearly black from the incorporation of some tissue of the iris

behind the dim and atrophied anterior layers. The tension of both eyes was normal; but sight was abolished.

CASE 25, K. P.—A woman, fifty-seven years of age, with Elephantiasis anaesthetica. The condition of the eyes here was very similar to that of the case just given. On the right side the cornea, which was not protruding, was converted into an opaque leucoma throughout, most dense in the inferior portion, this being whiter than the upper one, which was rather gray. There were spots of dark bluish tint from fragments of the tissue of the iris shining through. The tension was normal. The left eye presented a total staphyloma of the cornea, the inferior part of which was white and the upper dark. The surface was fairly even, and the tension was increased ( $T + 1$ ). There was no vision with either eye.

#### SOFTENING OF EYEBALL

Leprous deposits and growths in the cornea may remain for a long time with little alteration, and

then disappear slowly by degeneration and gradual absorption, or by ulceration; but softening and shrinking of the eyeball are apt to ensue. Among the blind persons, several examples of this reduction in tension and size of the globe were found, some in actual progress, others with the process at an end. This implies, of course, atrophic changes in the internal structures, which may be the result of a general panophthalmitis, or of a more localised inflammation or degeneration; but the mischief seems to have its origin in the cornea, and to spread thence.

The following cases show the conditions noted, where the eyes were softened apart from any apparent or great shrinking.

CASE 26, A. L.—A woman, twenty-nine years of age, with Elephantiasis anaesthetica. Leprous infiltration had invaded the whole cornea in each of this woman's eyes, and had then been absorbed; and the completely blinded eyeballs were left with a white opaque membrane, resembling the sclerotic, in place of the cornea. The anterior surface of this total leucoma was somewhat flattened, forming a



segment of a larger sphere than the rest of the globe, instead of a smaller one as in the normal eye. The eyeballs were thus slightly shrunken; and, while the tension of the right was  $-1$ , that of the left was reduced to  $-2$ .

CASE 27, L. L. B.—A man, sixty-seven years of age, with *Elephantiasis anaesthetica*. Both of this man's eyes were softened without shrinking, the tension of the right being  $-2$ , and that of the left  $-1$ ; but anatomically the two globes were dissimilar. In the right eye, a deposit of leprous material had involved the entire cornea, and then disappeared, leaving that membrane transformed into a white opaque tissue with blood-vessels, some of which were of large size, passing among its layers from the ciliary region. The eyelids were normal. The lower part of the left eye on the contrary was exposed by rather extensive ectropion of the under lid, and the inferior half of the cornea, in which there had been leprous deposit, was more opaque than the upper part, the former being very dense and whitish-yellow, while the latter was nebulous and gray. Through this part the iris

could be seen to be attached to the cornea by synechia anterior about the small remains of the pupil. The whole ciliary region was congested. Sight was gone on both sides.

CASE 28, G. K. S.—A woman, sixty-five years of age, with *Elephantiasis anaesthetica*. The right eye showed softening of the eyeball along with the presence of a tuber on the cornea. A large, prominent, tuberculated, leprous mass was growing from the lower ciliary region over a third or so of the cornea; and the portion of the cornea above the upper margin of the tumour was largely ulcerated, only a comparatively small part about the superior border being left unaffected in this way. Behind this last part the remains of the iris could be distinguished as a dark membrane. The tension was reduced to — 2, and the eye was totally blind. There was some ectropion of the lower lid; but it was of moderate degree. The left eyelids were in their proper position so far as was compatible with the presence of a large total corneal staphyloma, the under part of which was the most prominent. The lower ciliary region was included in the

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bulging, and here the tissue was very dark in colour; but the upper and less protruding portion was much whiter. The tension of this eye was normal, and some perception of light was claimed by the patient, the actual possession of which, however remained doubtful.

#### SHRINKING OF EYEBALL

Quite a number of eyeballs—sixteen in all—were shrunken. The shrinking varied from a very limited amount to the extreme degree of reduction to a minute stump; and in most instances it was consecutive to leprous destruction of the cornea, with subsequent alterations in the inner structures of the globe, as has been illustrated by cases already given. When it is remembered that leprous corneal diseases are almost invariably symmetrical, the ultimate fate of a less ruined eye with active disease seemed pitifully foreshadowed by the state of its fellow with a mere rudiment of its original

formation remaining. The presence of a quiescent stump is, however, doubtless preferable to the possession of a sightless eyeball, ulcerating, irritable, and productive of discomfort or distress, when the malady is one which persists irresistibly.

Various corneal processes may end in shrinking. Infiltration may be absorbed slowly, and, as this proceeds, the globe may soften and shrink without any further external indication of the internal changes; a tuber may run a similar course; ulceration may lead to perforation, allowing prolapse of the iris with subsequent atrophic changes and shrinking in place of bulging; a large perforation may permit a large loss of the contents of the globe, and all that is left may shrivel into a small stump.

Excluding Cases 5 and 6, as shrinking from secondary processes, and also Case 41, where the shrinking was due to injury in childhood, there were thirteen shrunken eyes. In two instances the shrinking was bilateral; in the others it was unilateral, and, of these, six were right eyes and three were left eyes. A series of cases follows herewith, and the rest will be found elsewhere.

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CASE 29, M. M. N.—A woman, seventy-one years of age, with *Elephantiasis anaesthetica*. This woman had been blind for twenty-five years, and her eyes had been in their present condition for the larger part of that time. The right was of normal size and tension, but was rendered useless by the total opacity of the cornea. It had been the seat of the usual slowly spreading infiltration, which had gradually shut off all entrance of light, and then undergone retrogressive metamorphosis and partial absorption, leaving a cicatricial membrane in place of the cornea. This membrane was dirty yellow in various areas from the presence of some degenerated leprous elements. A similar process had obscured the cornea of the left eye; but disease of the deeper structures had ended in softening of the globe, which was reduced to about half its proper size, and showed the common four shallow furrows in the sclerotic, running backwards from the ciliary region, and corresponding in position with the insertion of the recti muscles.

CASE 30, O. O. H.—A man, sixty-nine years of age, with *Elephantiasis anaesthetica*. In this man's



eyes a very similar result of the same process was found as in the last patient. He had been blind for twenty-two years, the disease having advanced by that time to a degree of opacity of the cornea, which abolished vision. Both eyes lay somewhat far back in the orbits; and, while the right one, the tension of which was normal, had a dense leucoma of the whole cornea with a slightly more prominent part towards the inferior border which was dark in colour, the left globe was considerably shrunken and very soft. Its cornea was also entirely leucomatous.

CASE 31, K. O. S.—A woman, sixty-eight years of age, with *Elephantiasis tuberculosa*. This woman had been blind for thirty years. The right eyeball was reduced to a firm stump, appearing about a third of the size of the normal globe; and it had deep antero-posterior furrows above and below and on either side. No cornea as such was visible, vascular cicatricial tissue occupying the former situation of that membrane. The left eye had an anterior staphyloma of the whole cornea and the adjacent part of the sclerotic. Degenerated re-

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mains of the infiltrated leprous material were present in some quantity in the opaque cornea, especially in its lower portions, as a yellowish and rather dirty-looking substance near the surface. The tension of this eye was normal.

CASE 32, J. R. A.—A man, thirty years of age, with Elephantiasis tuberculosa. This man had been blind for four years, and was a most distressing object to look at. His face was scarred and stained in some parts, and much disfigured with tubers and ulcers in others. His hands were mutilated by the disease to such an extent as to be little more than irregular stumps with prominent knobs representing some few fragments of the fingers. Very pronounced ectropion of the lower lids left a large conjunctival surface exposed, and this was acutely inflamed, bright red, spongy, swollen, uneven, and yielding a copious mucopurulent discharge, mingled with many tears. Of the right eye nothing could be seen; but a minute nodule—all that was left of it—could be felt at the back of the orbit, hidden by the inflamed conjunctiva. The front of the left eyeball was

quite irrecongnisable as such. In its place there was a rough ulcerating mass which was composed of a number of tuberculated leprous deposits, yellowish red in colour, uneven in outline, partially eaten away by ulceration, and covered with a stringy discharge. With this on its front the eyeball seemed a moving mass of fleshy tubers rather paler than the surrounding tissues, which were swollen and reddened by conjunctivitis. The eversion of the lid on the right side is worthy of note in the absence of the globe, and its position may be compared with that of the lids in Case 6, with a similar almost complete absence of the eyeball. The right eye had been affected with a tuberos growth in the cornea leading to such great destruction with ulceration, that the eyeball had given way, emptied itself, and shrunk to a very small stump.

CASE 33, M. H. H.—A woman, fifty-two years of age, with *Elephantiasis tuberculosa et anaesthetica*. This woman had been blind for two years, and the right eye afforded a typical example of a large tuberos growth attacking the cornea, for a

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prominent, vascular, yellowish, tuberculated tumour occupied the lower part of the cornea. It sloped upwards from the point of origin at the ciliary margin, and extended downwards for a short distance over the sclerotic. Its upper and advancing border was steep and rounded, hiding a narrow zone of dim cornea beneath it, this zone being succeeded by another one of infiltration, still more opaque, further away from the tuber. The upper part of the cornea was clear; but the iris was adherent to it in several places. The left eyeball was reduced to about half its normal size, with an opaque and shrivelled cornea. It was soft, and had four deep antero-posterior furrows on the upper, the under, and the lateral aspects respectively. There was moderate ectropion of the lower lid.

CASE 34, K. B.—A woman, fifty years of age, with Elephantiasis tuberculosa. Here there was ectropion of the lower lids, which exposed a large part of the conjunctival surface. On the left side the inferior portion of the eyeball, including about a third of the cornea, was uncovered; but the right eyeball was too much reduced in bulk to be visible

It was only a stump, perhaps about a third of the normal size, with an irregular patch of dim gray tissue representing the former position of the cornea. The ocular conjunctiva, however, was of interest, for it was studded with leprous tubercles, small, hemispherical, yellowish red prominences, rising above the general level of the hyperaemic and inflamed conjunctiva. The palpebral conjunctiva had a number of these little tumours embedded in it also, making its surface more rough and uneven than the muco-purulent conjunctivitis alone would have rendered it. The left conjunctiva had no such leprous deposit, although it was markedly inflamed; but the eyeball showed extensive ulceration of the under portion of the cornea, which was covered with, and somewhat prominent from the presence of, a collection of leprous tubercles, while the upper part was quite opaque and bulged forwards as a partial staphyloma corneae.



## HARDENING OF EYEBALL

Leprous affections of the cornea may end in hardening of the eyeball. Among the forty-one blind people, there were four eyes which were harder than normal, and these all occurred in different individuals. Three were staphylomatous, and the other was of proper size, but it had synechia anterior and obliteration of the anterior chamber. There was, of course, adhesion of the iris to the posterior surface of the cornea in the former cases also, along with partial blending of the two and bulging forwards of the combined and altered membranes; but increased tension was found in only three of the total number of thirteen staphylomatous eyes. Cases 23 and 25 may be recalled, and the other example is as follows.

CASE 35, J. R. H.—A woman, seventy-eight years of age, with Elephantiasis tuberculosa. The right eye of this woman was reduced to a stump, rather irregular in outline with the contracted remains of the cornea in front as a gray spot, only

distinguished from the sclerotic by its darker hue. The eyeball was soft, its tension being  $-1$ . The anterior portion of the left eye, on the contrary, was bulged forwards as a total staphyloma of the cornea, dark bluish-black in most of its extent with white cicatricial areas here and there ; and the tension of the globe was  $+2$ .

Pathological processes of a similar nature, but without any staphylomatous bulging, had occurred in

CASE 36, A. O. L.—a woman, forty-five years of age, with *Elephantiasis tuberculosa et anaesthetica*. The right eye was atrophied but not soft, and from the opaque and distorted cornea four shallow furrows, corresponding with the position of the recti muscles, passed backwards. Ectropion of the lower lid exposed much of the palpebral conjunctiva and also part of the eyeball. In the left eye the inferior half of the cornea was invaded by an infiltration with the usual leprous characters, and this was ulcerated in several places. The cornea had been perforated ; and, although its upper half was clear, even this portion was useless, for against its posterior surface the iris was closely applied, and

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the pupil was obliterated in the synechia anterior, which had arisen at the inferior part of the cornea. The tension of the eyeball was + 1.

### XEROSIS

Xerosis of the cornea, it may be noticed, was present in three of the cases of which notes have been given, in connection with ectropion uncomplicated by leprosy disease in the eyes. The other four similar cases of ectropion did not exhibit this condition; nor was it shown in any of the nine instances, in which ectropion was only part of the whole process, leprosy with its infiltrations or tubers having attacked the eyeballs themselves.

## CONJUNCTIVA

LEPERS' eyes often have a weak, bleary, blood-shot appearance from hyperaemia of the conjunctiva. The inflammatory condition of the conjunctiva, when exposed by ectropion, calls for no further remark after what has been said under that heading ; nor has the xerosis of the ocular conjunctiva, which may arise in such patients, anything peculiar. Instances of the former were found in the cases referred to, and an example of the latter is mentioned in the notes of Case 4. Even ulceration of the conjunctiva may occur in such circumstances, as was seen in the same case and in the one preceding it, without, however, presenting any special characters. A circumscribed congestion at the limbus conjunctivae precedes the formation of leprous deposits in the cornea, and this hyperaemia spreads, as the interstitial infiltration of, or nodular deposit

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in, that membrane increases in size, until ultimately the whole cornea may be surrounded by this marginal injection; but more usually a further stage is reached, and the conjunctiva becomes itself inflamed, yielding a muco-purulent discharge from its swollen surface. As a corneal tuber enlarges, the conjunctiva in its immediate neighbourhood generally remains free from direct implication; but, when the tumour is growing rapidly, or when it is very large, and has extended over the corneo-scleral junction, the conjunctiva at this spot is apt to be involved in the infiltration. The formation of tubers in the conjunctiva was observed once among the forty-one blind patients, and is noted in the case (Case 34) which was one of Elephantiasis tuberculosa. The small nodules resembled such growths in other mucous membranes, being rounded in outline, moderately prominent, and sometimes paler than the adjacent hyperaemic tissue. Destructive ulceration of the palpebral conjunctiva, when the eyelids are affected in this way, was shown in a most striking degree in Case 9.



## SCLEROTIC

THERE is occasionally a local bulging of the ciliary region in the neighbourhood of a tuber in the iris ; and, when anterior staphyloma, which is comparatively common where the cornea has been attacked by leprosy, is extensive, the front portion of the sclerotic about the corneo-scleral junction is often stretched and atrophied. A yellowish discoloration of the sclerotic is not unfrequently observed in eyes affected with leprosy, and this sallow colour seems to be due to hyperaemia of the blood-vessels with staining of the tissues, accompanying the growth of tubers in the cornea or the iris. Another appearance which has been observed is a somewhat transparent, oedematous condition over the anterior part of the sclerotic. A dark bluish or slaty discoloration near the cornea is not uncommon, and may be caused by thinning of the tunic.

## IRIS AND CILIARY BODY

AN attack of iritis is of frequent occurrence in the clinical history of a leper. In eyes blinded by leprosy the iris is commonly involved in the pathological process; but, besides this, inflammation of the iris, with its various sequelae, may itself lead to blindness. Iritis shows itself both in patients with the tuberculated and in those with the smooth variety of the disease, and similar local changes are found in these classes of cases indiscriminately. Its chronic forms do not seem to damage the eyesight much; but acute attacks, which have a tendency to be recurrent, generally leave opacities floating in the vitreous humour; and, the affection being usually bilateral, these are, as a rule, observed in both eyes, if present at all. This implication of the vitreous humour and the softening of the eyeball, which is apt to follow ultimately, indicate that such attacks

are rather of the nature of irido-cyclitis or irido-choroiditis, although no atrophied nor pigmented spots have been noticed on the choroid, when the fundus was examined with the ophthalmoscope. Microscopical examination confirms this view, for Bull and Hansen<sup>1</sup> found that the infiltration with round cells involved not only the ligamentum pectinatum and the iris, in which they were specially numerous behind the sphincter pupillae, but also the ciliary body, including the ciliary muscle, the ciliary processes on the inside, and the continuation of the lamina suprachoroidea on the outside, and extending backwards as far as the ora serrata. Inflammatory conditions outside the ciliary region were, they noticed, always accompanied by infiltration of the ciliary body, that is to say cyclitis was present when there was episcleritis. Round cells were, further, discovered in the ciliary nerves, and in such quantities that the medullary sheaths of the nerve fibres and sometimes even the axis cylinders were atrophied. In pronounced cases blood-vessels were found in the ligamentum pect-

<sup>1</sup> *Loc. cit.*

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inatum and projecting thence behind the membrane of Descemet of the cornea. Leprous deposits in this region, as with those elsewhere, may undergo retrogressive metamorphosis, and the degenerated material may remain for years.

The iritis may be secondary to ulceration of the cornea; and examples of this have been already given, both where the primary lesion was ectropion paralyticum followed by the affection of the cornea, and also where the primary lesion was some form of leprous deposit in the cornea. In many cases there was adhesion of the iris to the cornea not accompanied by bulging. In some of these the cornea was the seat of leprous infiltration or tubers; in others there was partial leucoma; and in others the cornea was entirely opaque and discoloured with the *débris* of the iris. The softened and atrophied stumps must be remembered as additional illustrations of destructive processes occurring in the iris, along with the other tissues of the globe. In the eyeballs with anterior staphyloma, of course, the iris was implicated, that condition having as one of its features the adhesion of the iris to the posterior

surface of the cornea, with atrophy to a more or less marked degree, or sometimes almost total destruction and incorporation of the remaining pigment or other elements with the cicatricial tissue of the altered cornea. Prolapse of the iris through an opening in the midst of an ulcerated tuberculous mass in the cornea has also been described on a former page.

Iritis by itself, arising from leprosy, is apparently most common in the tuberculated variety of the disease; but the formation of tubers in the iris is rare as compared with their frequent presence in the cornea; and, when they do occur, they are often accompanied by tubers in the latter membrane as well. They are somewhat gray in colour, and may be of such a size as to fill the anterior chamber. They start at the periphery of the iris, and there is always some iritis at the same time. Now and then, along with the iritis, there is a condition of the cornea, recalling keratitis punctata, with a fine dotting of several layers; and, according to Bull and Hansen, the minute opaque spots may continue unchanged for a long time, and they have been seen to become surrounded with a haze



and then to disappear, leaving the cornea once more clear.

The following notes afford evidence of leprous iritis causing blindness by blocking the pupil.

CASE 37, I. H. H.—A woman, thirty years of age, with Elephantiasis anaesthetica. The conditions were almost the same in each eye. The upper part of the cornea to the extent of about one third of its area was hazy with infiltration, without this having reached such a degree as to render it quite opaque. The pupil, which was very small, was completely filled with a dense inflammatory membrane; and this occlusion of the pupil was accompanied by a slight bulging forwards of the iris all round it. The tension of the eyeball was below the normal, being — 1; and vision was entirely abolished.

A greater degree of destruction had occurred in

CASE 38, H. O. H.—a man, forty-one years of age, with Elephantiasis tuberculosa. He had been quite blind for two years, and both eyes were softened. In the right eye the tension was — 1, and in the left it was — 2; but there was no apparent shrinking in either. The lower half of the

right cornea was infiltrated with leprous deposit, and behind the upper clear part a good view of the iris could be obtained. The latter structure was completely disorganised, and transformed into a dark, discoloured, atrophied, irregular membrane, with patches of cicatricial tissue about it; and no trace of a pupil could be detected. The left cornea was infiltrated in the same way in its lower and outer third, and behind the upper clear portion an iridectomy had been performed upwards; but this was of no use to the patient, for inflammatory membranes occupied the opening, and with the remains of the iris they formed a complete veil, hiding everything.

Immobility of the pupil, the precise nature or cause of which could not be determined, was present in three blind persons. The patients were all the subjects of well-marked Elephantiasis anaesthetica or smooth leprosy, without, however, any paralysis of the eyelids; and in each of them there was infiltration of the cornea extending from below upwards. The most probable explanation, perhaps, was the presence of atrophy of the optic nerve; but

the history threw no light on the matter ; nor, owing to the anatomical conditions, was it possible to examine the fundus of the eye. Bull and Hansen found, on post-mortem examination of some eyes, leprous invasion of the retina, which indicated that that membrane was first attacked in the peripheral portions, the disease extending backwards, and forming white spots with degenerated elements in the different layers ; and, after attacks of iridocyclitis or irido-choroiditis, the same observers often saw “a light grayish obscuration of the parts of the retina which surround the optic disc, with a relative tenuity of the retinal arteries.”<sup>1</sup> But these observations do not explain the affection just mentioned, with no great destruction of the eyes, and yet with total loss of vision and absence of any dilatation or contraction of the pupil in shade and light.

CASE 39, R. R. B.—A man, twenty-six years of age, with Elephantiasis anaesthetica. The right eye had a densely opaque infiltration of more than the lower half of the cornea with some thickening of this membrane ; and, on looking obliquely through

<sup>1</sup> *Loc. cit.*

the clear upper part of the cornea, the pupil seemed quite normal. The eye was utterly blind, however, and the pupil did not react to light and shade in any way. The tension was normal. Owing to the presence of the corneal opacity opposite the pupil, and the haziness of the zone immediately above this, it was impossible to examine the deeper structures. The state of the left eye gave no clue to the proper explanation, for the entire cornea on that side was transformed into a leucoma, its white shining cicatricial tissue having a number of blood-vessels, some of considerable size, traversing it. The tension of this eye was normal also.

CASE 40, E. A. B.—A woman, forty-nine years of age, with Elephantiasis anaesthetica. Union of the eyelids to one another existed on both sides, the inner third of each upper lid being united with the corresponding portion of the edge of the lower lid, as described in other instances already given. The right eyeball was partially atrophied and reduced in size, the remains of the cornea being quite opaque with yellowish spots here and there, indicating the presence of degenerated materials of former leprous

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deposit. In the left eye the lower portion of the cornea was deeply infiltrated, the opacity extending beyond the centre, and having along its border a hazy zone, which hid the pupil from direct view. When examined through the upper clear portion of the cornea, the iris appeared all right; but the pupil, which was of moderate size, did not move under any stimulus of light and shade. The tension was normal, and vision was all gone.

CASE 41, A. O. H.—A woman, sixty-four years of age, with *Elephantiasis anaesthetica*. The right eye was of normal size and tension; but there was no sight. The cornea was infiltrated with leprous material, extending from the inferior border upwards beyond the centre, and covering the pupil, when viewed from the front. When examined from above, however, the pupil, which was not dilated, was found to be quite motionless under alternations of light and shade, although the iris seemed unaltered in structure. The left eye had been injured and blinded when the patient was a child, nine years of age, by being cut with a stone. It was, at the time of examination, an atrophied stump with



the four familiar furrows running backwards above and below and on either side from the margin of the gray membrane, which occupied the position of the cornea.

The Norwegian observers Danielssen and Boeck<sup>1</sup> describe a blinding affection of the iris in tubercular leprosy, of which I did not see any example. After the white of the eye has acquired a sallow colour, and a little greenish yellow elevation has appeared on the sclerotic with conjunctival injection, the growth, instead of invading the cornea, seems to stop; but the patient complains of deep-seated periodic pains in the eyes, with fugitive pains in the neighbourhood and obscuration of vision. Six months or more afterwards the pains become more persistent, vision decreases, and the pupil appears retracted and irregular in this or that direction. With the aid of a lens, threads of exudation are seen passing from the uvea to the capsule of the lens or from side to side of the pupil, and soon some exudation can be discovered in the middle of the

<sup>1</sup> *Traité de la Spédalskhed*, by D. C. Danielssen and W. Boeck, Paris, 1848.

pupil. At some place here a yellowish white spot appears, and invades some part of the iris, and at last advances into the anterior chamber, where it may attain the size of a pea. The tubercle then ceases to grow, though the pains may continue; but it rarely softens and occasions a hypopion with destruction of the eye. Such is its chronic course; and the unfortunate patient, after living a great many years, at last passes into a cachectic state, exhaustion and diarrhoea ultimately ending his sad days.

## CONCLUSION

THE processes in leprosy, which lead to blindness, are commonly symmetrical. Thus the history of the one eye is usually prophetic regarding the other, which has suffered less; and the state of this second eye affords a retrospect of what occurred in the first. The disease of the eyeball is largely ciliary in origin. Infiltration of the cornea starts from the tissues at the corneo-scleral junction, and spreads from the periphery forwards towards the centre in the superficial layers; tubers may do the same. Tubers arise in the deeper parts of the corneo-scleral junction, and destroy the posterior layers of the cornea, into which they extend; the anterior chamber may be invaded from the angle between the cornea and the iris; the iris is attacked from its periphery, and the ciliary body is often involved; and from this region also the disease

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passes to the neighbouring portion of the choroid and the ora serrata of the retina. Slow and intermittent in its progress, it is disastrous in its results. An eye once seriously involved may be looked upon as doomed. There is no tendency to recovery, and thus the arrival of blindness is prevented only by the more speedy approach of death. The perception of light may linger long; it is almost sure to be ultimately quenched. Of the forty-one patients, whose eyes have been described in the previous pages, eight claimed the power of distinguishing between light and darkness; but in only five of them was even this certainly present. One of these had tubers on the corneae with ulceration, and both eyes retained this amount of vision; of the others the corneae were destroyed by leprous infiltration, and in each case one eye was totally blind.

Recalling at times many other affections of the eyes, leprosy has at other times manifestations which are peculiar to itself. For instance, corneal affections are the most frequent local diseases, which blind the eye of a leper; and these may be such as are seen in non-leprous patients, or they may be

quite characteristic of leprosy. Paralytic ectropion is not confined to this disease, although no other complaint yields so many victims of this distressing paralysis; and the blinding hazards which ectropion implies are familiarly known to those who have never seen a leper, but who have seen many eyes exposed to the risks of irritating and noxious influences from the want of the natural covering. On the other hand, the invasion of the cornea by leprosy, whether in the flat variety of infiltration or in the form of tubers varying in their degree of prominence, is essentially characteristic of the disease with its special appearances, its intermittent advances, its augmenting disturbances, and its final hopeless destructiveness. All of these, with the resulting conditions of softening, shrinking, bulging, and hardening, have been passed in brief review. The inclusion of the internal structures of the eyeball is frequent, and the share which these take in determining the ultimate state of the blind eye prevents any rigid classification of the individual cases, which have, therefore, been used in a somewhat disordered manner to illustrate rather various clinical facts of interest.



## SUMMARY OF CASES

CASE 1, J. K. F.—Female, age sixty-four, anaesthetic. Right eye; ectropion, pannus, xerosis, corneal ulcer, conjunctivitis. Left eye same as right.

CASE 2, J. N. H.—Female, age seventy, tuberculated. Right eye; ectropion; cornea with atrophy, xerosis, and calcareous deposit; iris incorporated with cornea; conjunctivitis. Left eye same as right.

CASE 3, L. A.—Female, age forty-five, anaesthetic. Right eye; ectropion, leucoma, pannus, ulceration of cornea and conjunctiva. Left eye same as right.

CASE 4, J. M. H.—Male, age thirty, anaesthetic. Right eye; ectropion, leucoma, conjunctiva with xerosis and ulceration, iris incorporated with cornea. Left eye same as right.

CASE 5, E. P. W.—Female, age sixty-five, tuber-

culated. Right eye; ectropion, eyeball shrunken and soft. Left eye; ectropion, leucoma, synechia anterior.

CASE 6, K. J.—Female, age forty, anaesthetic. Right eye; ectropion, pannus, xerosis, corneal ulcer. Left eye; ectropion, eyeball as small stump.

CASE 7, J. A. O.—Male, age forty, anaesthetic. Right eye; ectropion, leucoma, staphyloma anterior. Left eye same as right.

CASE 8, G. H. H.—Male, age fifty, anaesthetic and tuberculated. Right eye; ectropion, leucoma, staphyloma anterior. Left eye, ectropion, leucoma, staphyloma anterior, corneal ulcer.

CASE 9, N. R. W.—Female, age twenty-nine, anaesthetic. Right eye; eyelids destroyed by ulceration; corneal tubers, ulcerated; prolapse of iris; partial atrophy of eyeball. Left eye; eyelids destroyed by ulceration, leucoma, corneal tubers.

CASE 10, J. A. B.—Female, age sixty-three anaesthetic. Right eye; eyelids partially united, eyeball apparently partially shrunken, conjunctivitis. Left eye; eyelids partially united, staphyloma anterior.

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CASE 11, A. T. R.—Male, age sixty, anaesthetic. Right eye; eyelids partially united; infiltration of lower part of cornea, ulceration; iridectomy. Left eye same as right, but with perception of light.

CASE 12, S. H. H.—Male, age seventy, anaesthetic. Right eye; eyelids partially united, infiltration of entire cornea, perception of light, conjunctivitis. Left eye; eyelids partially united, infiltration of entire cornea, ulcerated.

CASE 13, B. O. S.—Female, age thirty, tuberculated. Right eye; infiltration of cornea, perception of light. Left eye; leucoma, calcareous deposit in cornea, iridectomy.

CASE 14, B. E. H.—Female, age fifty, anaesthetic. Right eye; infiltration of cornea, leucoma, conjunctivitis. Left eye same as right, but with perception of light.

CASE 15, J. S.—Male, age thirty, anaesthetic. Right eye; corneal tuber, conjunctivitis. Left eye same as right.

CASE 16, L. L. K.—Male, age forty, tuberculated. Right eye; ectropion, corneal tuber. Left eye same as right.

CASE 17, S. H. H.—Male, age forty-three, tuberculated. Right eye; ectropion; corneal tubers, ulcerated; conjunctivitis. Left eye same as right.

CASE 18, O. K.—Male, age thirty, anaesthetic. Right eye; ectropion; corneal tubers, ulcerated. Left eye same as right.

CASE 19, E. T.—Female, age thirty, anaesthetic. Right eye; corneal tuber ulcerated, perception of light. Left eye same as right.

CASE 20, N. A. M.—Male, age thirty, anaesthetic. Right eye; corneal tubers ulcerated, prolapse of iris. Left eye; corneal tuber, leucoma adherens.

CASE 21, J. J. R.—Male, age fifty-one, tuberculated. Right eye; leucoma, iris incorporated with cornea. Left eye; infiltration of cornea, leucoma adherens.

CASE 22, J. B. J.—Male, age thirty-nine, anaesthetic. Right eye; leucoma adherens, incorporation of iris with cornea. Left eye same as right.

CASE 23, M. M. B.—Female, age fifty, anaesthetic. Right eye; staphyloma anterior, tension + 1. Left eye; staphyloma anterior, tension — 1.

CASE 24, O. P.—Male, age sixty-five, anaesthetic.

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Right eye; staphyloma anterior. Left eye; leucoma, iris incorporated with cornea.

CASE 25, K. P.—Female, age fifty-seven, anaesthetic. Right eye; leucoma. Left eye; staphyloma anterior, tension + 1.

CASE 26, A. L.—Female, age twenty-nine, anaesthetic. Right eye; leucoma, partial atrophy of eyeball, tension — 1. Left eye same as right, tension — 2.

CASE 27, L. L. B.—Male, age sixty-seven, anaesthetic. Right eye; leucoma, tension — 2. Left eye; ectropion, leucoma, synechia anterior, tension — 1.

CASE 28, G. K. S.—Female, age sixty-five, anaesthetic. Right eye; ectropion, corneal tuber, corneal ulcer, tension — 2. Left eye; staphyloma anterior.

CASE 29, M. M. N.—Female, age seventy-one, anaesthetic. Right eye; leucoma. Left eye; leucoma, eyeball atrophied.

CASE 30, O. O. H.—Male, age sixty-nine, anaesthetic. Right eye; leucoma. Left eye; leucoma, eyeball atrophied and soft.



CASE 31, K. O. S.—Female, age sixty-eight, tuberculated. Right eye; eyeball as stump. Left eye; staphyloma anterior.

CASE 32, J. R. A.—Male, age thirty, tuberculated. Right eye; ectropion, eyeball as stump, conjunctivitis. Left eye; ectropion, corneal tubers ulcerated, conjunctivitis.

CASE 33, M. H. H.—Female, age fifty-two, tuberculated and anaesthetic. Right eye; corneal tuber, synechia anterior. Left eye; ectropion, eyeball atrophied and soft.

CASE 34, K. B.—Female, age fifty, tuberculated. Right eye; ectropion, eyeball atrophied, conjunctival tubers. Left eye; ectropion, staphyloma anterior, corneal tubers ulcerated, conjunctivitis.

CASE 35, J. R. H.—Female, age seventy-eight, tuberculated. Right eye; eyeball as stump, tension - 1. Left eye; staphyloma anterior, tension + 2.

CASE 36, A. O. L.—Female, age forty-five, tuberculated and anaesthetic. Right eye; ectropion, eyeball atrophied. Left eye; infiltration of cornea ulcerated, synechia anterior, tension + 1.

CASE 37, I. H. H.—Female, age thirty, anaes-

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thetic. Right eye; infiltration of upper part of cornea, pupil occluded with membrane, tension — 1. Left eye same as right.

CASE 38, H. O. H.—Male, age forty-one, tuberculated. Right eye; infiltration of lower part of cornea, iris much destroyed, tension — 1. Left eye; infiltration of cornea, iris with iridectomy and inflammatory membrane, tension — 2.

CASE 39, R. R. B.—Male, age twenty-six, anaesthetic. Right eye; infiltration of lower part of cornea, iris motionless. Left eye; leucoma.

CASE 40, E. A. B.—Female, age forty-nine, anaesthetic. Right eye; eyelids partially united, eyeball atrophied. Left eye; eyelids partially united, infiltration of lower part of cornea, iris motionless.

CASE 41, A. O. H.—Female, age sixty-four, anaesthetic. Right eye; infiltration of lower part of cornea, iris motionless. Left eye; eyeball atrophied after injury.



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