

## **On epithelial xerosis of the conjunctiva / by Sydney Stephenson.**

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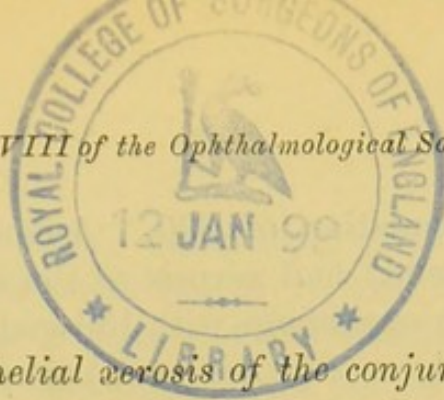
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2.

*On epithelial xerosis of the conjunctiva.*

By SYDNEY STEPHENSON.

THEODOR SAEMISCH appears to have been the first systematic writer to apply the name "epithelial xerosis" to a superficial change of the ocular conjunctiva, limited parts of which become dry and lustreless, and are covered with a foam-like whitish substance. The condition described by him may or may not be associated with definite night-blindness. He drew a distinction between the epithelial form of xerosis and the parenchymatous, in which the mucous membrane is atrophic, and converted, wholly or in part, into scar tissue.

Little has been published in England upon the subject of epithelial xerosis. From this dearth of literature it might be inferred that such cases are few and far between. The affection, however, is one that I have had many opportunities of seeing, and I quote the following figures in support of the view that epithelial xerosis is far from uncommon in this country. The statistics, it should be explained, are drawn from schools (residential and otherwise), the scholars of which belonged for the most part to the lower strata of society.

For our present purpose the various institutions may be conveniently distinguished by letters, thus :

A. A poor law school, which contained upon the occasion of my visit in July, 1896, 235 inmates, of whom 5 (or 2·13 per cent.) were affected.

B. A London union school with 512 inhabitants on July 29th, 1896. Of that number 8 (or 1·56 per cent.) showed epithelial xerosis.

C. A Catholic orphanage contained on August 10th, 1896, 193 lads, of whom 9 (or 4·66 per cent.) showed the condition alluded to.

D. A metropolitan union school having upon August

3rd, 1896, a population of 330. Among these children 4 (or 1·21 per cent.) had xerosis of the conjunctiva.

E. A Catholic orphanage with 150 girls on August 10th, 1896, included 4 (or 2·67 per cent.) who were affected.

F. A Catholic school with a population on August 18th, 1896, of 88 little boys and girls, had 3 (or 3·41 per cent.) affected.

G. An orphanage, the inmates of which on August 25th, 1896, included 446 boys over seven years of age. Among that number 5 cases (or 1·12 per cent.) were discovered.

H. A Liverpool church school had on October 1st, 1891, 649 scholars, of whom 5 (or 0·77 per cent.) had xerotic patches on the conjunctiva.

I. A Wigan church school contained upon September 28th, 1891, a total of 598 children, among whom 4 instances (or 0·67 per cent.) of xerosis were found.

J. A training ship with 472 lads on board. Of that number 11 (or 2·33 per cent.) were on August 15th, 1896, discovered to be suffering from epithelial xerosis.

So far I have spoken of institutions visited upon a single occasion. My list will terminate with the figures obtained from two schools, both of which were inspected more than once.

K. A Roman Catholic orphanage, receiving lads up to the age of about nine years, contained upon August 17th, 1891, a total of 137 children, of whom 13 (or 9·47 per cent.) were affected. I visited the place again upon July 29th, 1896, when I found that of the 133 inmates 9 (or 6·77 per cent.) were the subject of xerosis.

L. A metropolitan poor law school admitting children of both sexes from three to sixteen years of age. The population numbered 800 on September 14th, 1895, when 18 cases of epithelial xerosis (or 2·25 per cent.) were discovered. The school was again inspected by me on June 27th, 1896, upon which occasion 9 instances of xerosis (or 1·16 per cent.) were found among the 779 inmates. Lastly, on August 16th, 1897, the inmates, who then numbered 687, showed 9 cases (or 1·31 per cent.)

It will be perceived, then, that examples of *xerosis conjunctivæ* at particular places ranged from as few as 0.67 to as many as 9.47 per cent. of the population. The figures as a whole may be summed up by saying that of the total number (6209) of children examined, 1.87 per cent. were affected. It will be noticed that my inspections were made during summer and autumn, when sunlight in this country is more powerful than at other seasons of the year.

The changes characteristic of epithelial xerosis are never met with\* except in the so-called interpalpebral zone, a region defined by Fuchs (2) as "that part of the cornea and of the scleral conjunctiva which ordinarily is not covered by the lids." They are specially prone to affect the temporal side of the ocular conjunctiva, possibly because a larger area of the mucous membrane is exposed to the influence of light and air there than elsewhere. They take the form of greasy, glistening, dry-looking patches, which once seen can hardly be mistaken for anything else. If of large size they correspond in outline with the external angle of the open lids, conveying the impression to one's mind that they have been swept into place by the movements of the eye. However, a triangular or oval shape, although characteristic, is by no means invariably met with, particularly if the affected area be small. The size and shape of the patches often differ in the two eyes, supposing the changes to be bilateral, which is not always the case. They are sometimes ridged, doubtless due to successive but unequal excursions of the eyeball outwards or inwards. The spots themselves appear slightly raised, and fluid adheres with difficulty, or not at all, to their surface. They do not stain with fluorescein, although they may be tinted by dropping into the eye a weak solution of methylene blue and some other basic aniline dyes. The xerotic areas, when examined by

\* It should be stated that this description refers to what I have myself seen. I am well aware that Cohn (3) and others have described cases of xerosis which involved the whole extent of the ocular conjunctiva.

the aid of a magnifying glass, give one the impression of being made up of so many minute globules of mercury, often arranged in parallels, joined by cross branches. They may be readily wiped away, as by movements of the lids, when white, rather resistant particles may be found lying free upon the palpebral conjunctiva. The silvery scales are reproduced within twenty-four or thirty-six hours after complete removal, as, for example, by scraping with a small blunt spoon.

The xerotic patches show no loss of local sensibility. When of small dimensions, repeated blinking may render them inconspicuous, but as the tears do not moisten them for more than a few seconds, they soon come into view again. The conjunctiva in their neighbourhood may have a faint yellowish hue, be permeated by dilated vessels, and be thrown into little folds concentric with the edge of the cornea, when the eye is moved outward or inward, as the case may be. Finally, many of the affected eyes, when exposed to light, redden and water easily.

The presence of bacilli in the conjunctival patches has been noted by many observers, amongst whom must be especially mentioned Colomiatti (4), Leber (5), Kuschbert and Niesser (6), and Fraenkel and Franke (7). There is no practical difficulty in demonstrating the existence of these organisms. One need simply remove with a small spatula from an affected conjunctiva some of the frothy material, which is then mixed with a little sterile water or broth, and mounted as an ordinary film preparation. This may be treated with any of the basic aniline dyes, as methylene blue, thionine blue, methyl violet, or fuchsin. The best specimens, however, are to be got by Gram's process, using eosine as a counter-stain. The organisms, which vary greatly both in length and in breadth, often cling in vast numbers to the epithelial cells, and take the form of rod-shaped bodies with rounded ends. They are in many cases somewhat curved upon the flat, so that when two come into close relationship, as not infrequently happens, an S-shaped figure is produced.

I have not been able to demonstrate the existence of a capsule around each microbe, although the fact that they look larger when stained by Gram's method perhaps indicates that such exists. No flagella can be seen when the specimen is treated by Löffler's well-known plan.

If a tube of serum or of agar streaked with human blood be smeared with a sterilised wire previously drawn across one of the conjunctival patches, and be then kept at incubation temperature, innumerable, tiny, greyish-white colonies, of circular form, will be observed, as a rule, *within sixteen hours*. These increase both in size and in number, so that a fairly luxuriant growth will usually be obtained within forty-eight hours. It is rare, however, for individual colonies to exceed 0.5 mm. in diameter. When fully developed, the latter have a characteristic dry, glistening, fatty appearance, which has been commented upon by almost everybody who has written upon the subject. Cover-glass preparations from such a tube show that most of the bacilli are segmented in their entire length, while many have clubbed ends. Their arrangement, one upon another, often recalls that of red blood cells under the microscope. The organisms at this stage, as pointed out by Dr. J. Eyre (8), could scarcely be distinguished by the microscope alone from diphtheria bacilli. These various points are brought out better when the specimen is stained by weak phenyl-fuchsine, and especially with carbol-methylene blue, than by other methods. The bacteria retain the stain in Gram's plan so tenaciously that, even after immersion in absolute alcohol for many minutes, they are still coloured.

The xerosis bacillus will also grow upon ordinary and upon glycerine agar-agar (2 per cent.), and the resulting cultures offer two points of contrast with those on serum or on blood-agar: (1) they develop with less rapidity, and (2) they tend to remain discrete for a much longer time. Upon gelatine, at room temperature, the microbes form small, separate colonies, but this medium has seemed to me much less suitable than those mentioned above. In

broth, however, the bacillus grows well, forming many small, whitish clumps (easily visible to the naked eye), which accumulate at the bottom of the tube. Milk, again, is a favorable medium. Potato, on the contrary, is distinctly inimical to the growth of the xerosis bacillus.

Undoubtedly the readiest way of obtaining growths from the conjunctiva is to inoculate serum or blood-agar in the first instance, and afterwards to transplant the organism to ordinary agar-agar or other favorable medium. In this respect the parasite reminds one of the tubercle bacillus, which will readily develop as a sub-culture upon glycerine agar, a material almost useless for the making of cultures directly from tuberculous foci.

Among my numerous cases of epithelial xerosis I have never yet failed to find the foregoing bacilli, not only in cover-glass preparations, but also in cultures made from the frothy patches.

At the same time it must be borne in mind that these bacteria are common apart from actual xerosis. For example, they may be now and then demonstrated in the normal conjunctival sac, as pointed out by Fraenkel, Uhthoff, and others. Speaking for myself, I am familiar with them under such circumstances, but as I have kept no notes of my examinations, I am not in a position to say in what proportion of cases they occur. Again, they are to be met with in various superficial inflammations of the eye, as catarrhal, phlyctenular, and follicular conjunctivitis, and trachoma, subacute or chronic. Their existence in keratomalacia has been commented upon by several observers, as for instance, Leber (5), Schulz (10), and Denk (11), while I have myself seen them in association with that very serious malady. They are constantly present, too, in the dry, white patches found upon wrinkled conjunctiva of patients with parenchymatous xerosis, such as may follow trachoma.

CASE 1.—Annie S—, æt. 28, contracted trachoma about twenty-two years before she came under my notice.

Upon examination the corneæ were hazy from old pannus and nebulæ. R. V.  $\frac{2}{36}$  and J. 12. L. V.  $\frac{1}{36}$  and J. 16. The near types held at 4 cm. from the eye. Although the tarsi of the upper lids were deformed ("scaphoid"), yet there was no trichiasis. Most of the lashes were lost. The palpebral conjunctiva was markedly contracted, and in places soldered to the ocular conjunctiva by cicatricial bands. A dry, foamy patch was noticed in each palpebral fissure, to the outer side of the cornea, and xerosis bacilli were obtained from these by the usual methods.

Furthermore, the organisms may be found in scanty numbers in the whitish, cream-like substance that collects about the lids in some chronic inflammations of the conjunctiva. This observation, for which we are indebted to Schleich (12), I have confirmed in the last twenty cases that have fallen under my immediate notice. Lastly, they may be demonstrated in those curious xerotic changes that now and again follow ulceration of the cornea, mostly in blind or semi-blind eyes. Three of these rather rare cases were described by Hocquard (13) under the name "Plaques épithéliales de la Cornée." Leber (5), moreover, has alluded to them as instances of secondary xerosis—that is to say, a form of xerosis appearing in eyes that have suffered from chronic conjunctivitis or keratitis. In the whitish froth he found numerous short bacilli and cocci, which he was unable to distinguish from the organism of epithelial xerosis. The following is a case in point:

CASE 2.—Robert G—, æt. 6. About four and a half years before coming under notice the child suffered from measles and whooping-cough, followed by inflammation of the left eye. When examined by me (October, 1896) the left cornea showed a large opacity, to the hinder surface of which the somewhat atrophic iris was attached (*leucoma adherens*). Towards the centre of the leucoma lay a slightly raised patch of white colour and satiny



sheen ; it was oval, and measured 2.5 mm. by 2 mm. It could be scraped away almost completely. The eye was neither painful, tender, nor reddened. Perception of light was lacking ; tension was normal. The patient was again seen some ten months later (August, 1897), when no change was found to have taken place in the condition of things. Upon this occasion xerosis bacilli were demonstrated in smear-preparations and in cultivations made from the central white plaque. When examined three months later (November, 1897) the left eye had become convergent to the extent of about  $20^{\circ}$ , while the curious little patch had almost disappeared from the cornea.

Before passing away from the subject, the fact should perhaps be mentioned that Schreiber claims to have found this organism in gangrene, soft sores, and in pus both from gonorrhoea and from an ulcer of the leg (Krienes [14]).

The experimental evidence, as far as it goes, is dead against the pathogenicity of these bacilli, both as regards men and the lower animals. Kuschbert and Neisser, for example, inoculated, but without success, the conjunctiva of dogs and of rabbits. Fraenkel and Franke, again, injected the bacilli into the veins, peritoneal cavity, anterior chamber, and under the conjunctiva of rabbits, guinea-pigs, and mice, but without result ; they introduced the organism into the human conjunctival sac, also with negative effects. Cirincione's (15) investigations, too, lead him to believe that the organisms have no pathogenic power in respect of the conjunctiva. Gallenga (16) found that they gave rise to no disease, unless associated with staphylococci, when grafted into the eyes of rabbits. Piltz (17) and Braunschweig (18) inoculated the human conjunctiva without setting up any local disease.

My own experiments upon the human conjunctiva confirm the statements made by these various writers. They were divided into three classes : first, attempts to set up xerosis in the second eye of a patient with one

eye already affected, morsels of the greasy material from the conjunctiva being used for the purpose; second, attempts to produce xerosis in the eye of a second person, by conveying to it some of the frothy material obtained from another subject; and third, attempts to set up the condition by inoculating healthy conjunctivæ with pure cultures of the xerosis bacilli. Without entering into the details of these experiments, which numbered twelve in all, I may at once say that in no single instance did xerosis result.

It will be perceived, however, that all this is so much negative evidence, upon which it would be scarcely wise to lay undue stress. My results and those of others do not exclude the possibility of xero-bacilli being, after all, the agents directly responsible for the conjunctival changes. Positive results might be obtained were inoculations made upon the conjunctiva of those predisposed to disease by semi-starvation, wasting illnesses, pregnancy, or other factors of the kind, or locally upon damaged corneæ or conjunctivæ.

This suggestion is rendered reasonable by a consideration of certain facts: in the first place (as already stated), the organisms are to be invariably found in the characteristic silvery-grey conjunctival spots. Secondly, it is at all events suggestive that outside the human body they grow best at incubation temperature, and upon serum or agar smeared with human blood, as do some other microbes about the pathogenicity of which there is now no serious conflict of opinion, *e. g.*, pneumococci, gonococci, and the bacilli of acute contagious ophthalmia. Thirdly, the xerotic changes are located precisely at those places upon the mucous membrane where the germs may most readily lodge, supposing that the latter are at all widely distributed in nature, which would seem to be the case. Lastly, the reproduction of the foam-like areas within twenty-four or thirty-six hours after complete removal reminds one of what occurs when the parasites are grown artificially.

Thus far nothing has been said with regard to the connection between epithelial xerosis, on the one hand, and night-blindness, on the other. Hubbenet (19), who was the first to describe the conjunctival changes (1860), appears to have regarded the silvery scales as invariable signs of hemeralopia,\* and most observers are now agreed that the two are frequently associated.

At the same time it is somewhat difficult to say, with any approach to trustworthiness, in what proportion of cases xerosis coincides with night-blindness. The question, indeed, is surrounded by many fallacies. In children under six or seven years of age evidence of hemeralopia must, to a large extent, be based on purely conjectural grounds, and even in older subjects dependence has sometimes to be placed upon mere statements. There is, so far as I am aware, no simple objective test whereby we may at once decide whether hemeralopia is or is not present. Finally, it must be remembered that in some of these cases of xerosis a difficulty in seeing at night exists upon one occasion, and not upon another.

Apart from these considerations, of the 29 instances of night-blindness described by Bitot (20), all are stated to have presented the so-called "hemeralopic spot" upon the conjunctiva. Bitot's statement was soon confirmed by independent investigations carried out by Villemin (21) among the soldiers at Strasburg. Of the 10 cases of xerosis published by Mr. Simeon Snell in the first volume of the 'Ophthalmological Society's Transactions,' all, without exception, suffered from night-blindness. But Mr. Snell's figures are, perhaps, open to the objection that, in hospital practice, medical aid is hardly likely to be sought by parents on behalf of their children unless

\* By hemeralopia I mean a difficulty in seeing well at night. From the researches of Greenhill (22) and of Tweedy (23) it would seem that the use of that word in the sense indicated is not etymologically correct. In the present communication, however, I have thought it better to follow the general practice and to employ hemeralopia and night-blindness as interchangeable expressions.

conjunctival changes are associated with a definite difficulty in seeing at night. Kuschbert and Neisser (6), however, describing an outbreak of hemeralopia that affected more than half the children at a Breslau asylum, state that xerosis existed in every case. Of 33 deaf children with xerotic changes, Adler (24) found 23 suffering from idiopathic hemeralopia. Among the poorly nourished negro infants of South Carolina, Kollock (25) has come across a peculiar form of xerosis. In this disease the ocular conjunctiva is dry, discoloured, and thrown into folds, capped by silvery scales. "The xerotic condition of the conjunctiva," he continues, "is never absent in (*sic*) the negro, and is therefore pathognomonic." Dujardin (26) and Lecœuvre (27) in an outbreak at a Lille orphanage, noted night-blindness in 17 out of the 18 children with conjunctival stigmata.

On the other side, Netter (28) in 6 cases of hemeralopia, came across xerosis thrice only, a fact that led him to brand the latter as a mere epiphenomenon. Walther (29) states that he has never seen epithelial xerosis along with epidemic night-blindness. Chauvel (30), among 35 soldiers suffering from essential hemeralopia, found 4 only with epithelial changes. Hans Krienes (14), among 31 patients affected with essential hemeralopia, had 10 with xerotic patches on the conjunctiva. Truc, Gaudibert, and Rouveyroles (31) have lately examined the eyes of 362 juvenile criminals in a reformatory at Aniane. Of these, 36 had xerosis, complicated in 15 instances with night-blindness. The authors note that most of those affected were in feeble health, small for their age, and addicted to vicious practices.\*

For my own part I have observed that the proportion of those with night-blindness varies according to time and place. For example, as regards the inmates of an institution (L) mentioned earlier in this paper, among the 18 cases of xerosis in 1895, no fewer than 11 (or 61

\* Robert Cane (32), writing in 1840, relates four instances of hemeralopia in young men, due, in his opinion, to onanism.

per cent.) were more or less blind at night, whereas during 1896 and 1897 that complication appeared to be wholly absent.

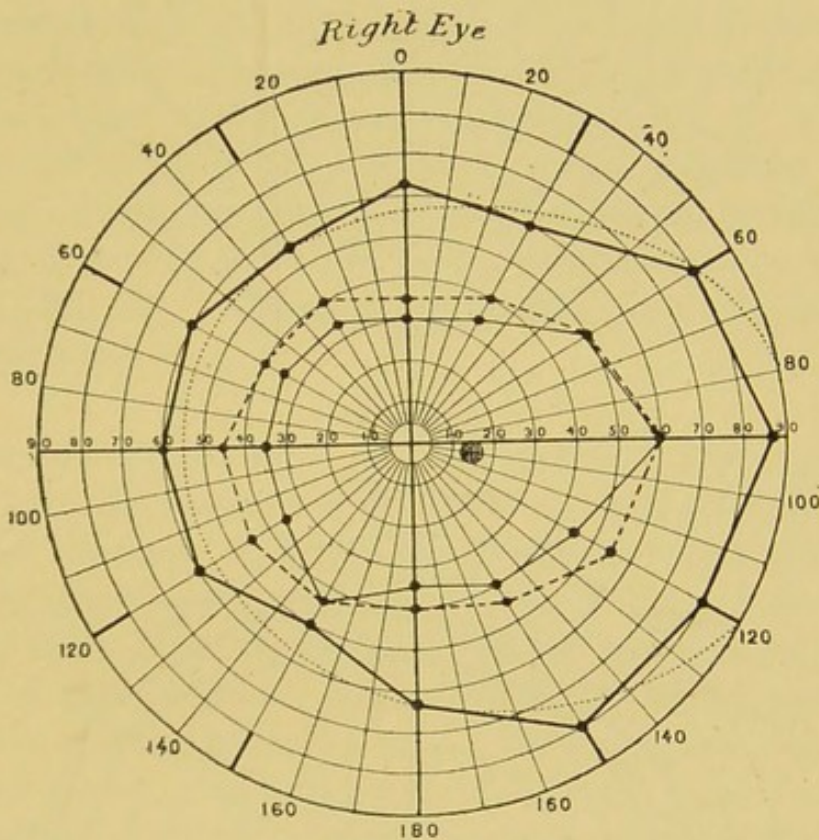
When all is said and done, we must, I think, conclude (with Saemisch and Leber) that xerosis and hemeralopia occur so frequently side by side, that the association between them is likely to be something more than merely accidental. For that matter I shall next adduce facts that tend to show their connection is much closer than generally supposed.

It is commonly taught that epithelial xerosis, in the absence of an associated night-blindness, gives rise to no symptoms beyond the appearances presented by the conjunctiva. This assertion, however, needs modification, inasmuch as I have found changes to exist in the visual fields when taken in ordinary daylight. These alterations are of two kinds, namely, constant and inconstant. The former was found in 12 cases examined during last summer and autumn—that is to say, in every one investigated fully. It consists in a reduction of the red and green fields, as taken with a circular test-object having a diameter of 10 mm. But this is not all, for the field for red is shrunken more than that for green, so that the former lies inside the latter, whereas under normal conditions the reverse should, of course, be the case. In three fourths of the patients this transposition was complete, but in the others the two fields overlapped at one or more spots. The second or inconstant change was demonstrated in 9 cases, and lies in a contraction of the limits of the field for white. As a rule, this was slight in degree, and better marked upon the temporal side of the chart, where it ranged from 5 to 10 degrees. In this connection it should be remarked that in children the field for white is usually larger than it is in grown-up persons. Hence a chart that, judged by the adult standard, may seem normal, may in reality indicate more or less contraction for white, a fact that was clearly brought out by some of my cases.

When the silvery patches have disappeared from the conjunctiva, the visual field will generally be found to have resumed its natural characters, thus indicating that the foregoing changes are not due to mere accident or to inaccuracy of observation. The following may be quoted as typical instances :

CASE 3.—Lucy M—, æt. 10. On August 16th, 1897, a small frothy patch was discovered upon the conjunctiva to the outer side of each cornea. Characteristic bacilli

FIG. 1.



Thick continuous line = field for white —————  
 Thick interrupted line = field for green - - - - -  
 Thin continuous line = field for red —————

were obtained in pure culture from the affected areas. Night-blindness was denied; light minimum (as tested by Förster's photometer) was 2 sq. mm. The patient was able to read J. 1 when the light was turned low. No alteration recognised in the pupils. Colour vision

FIG. 2.

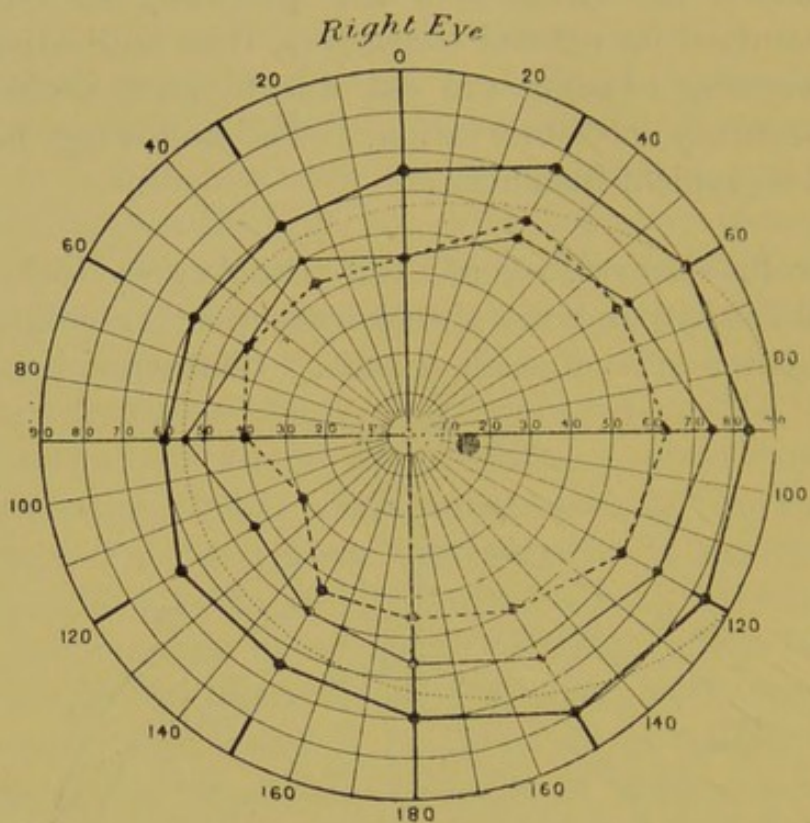
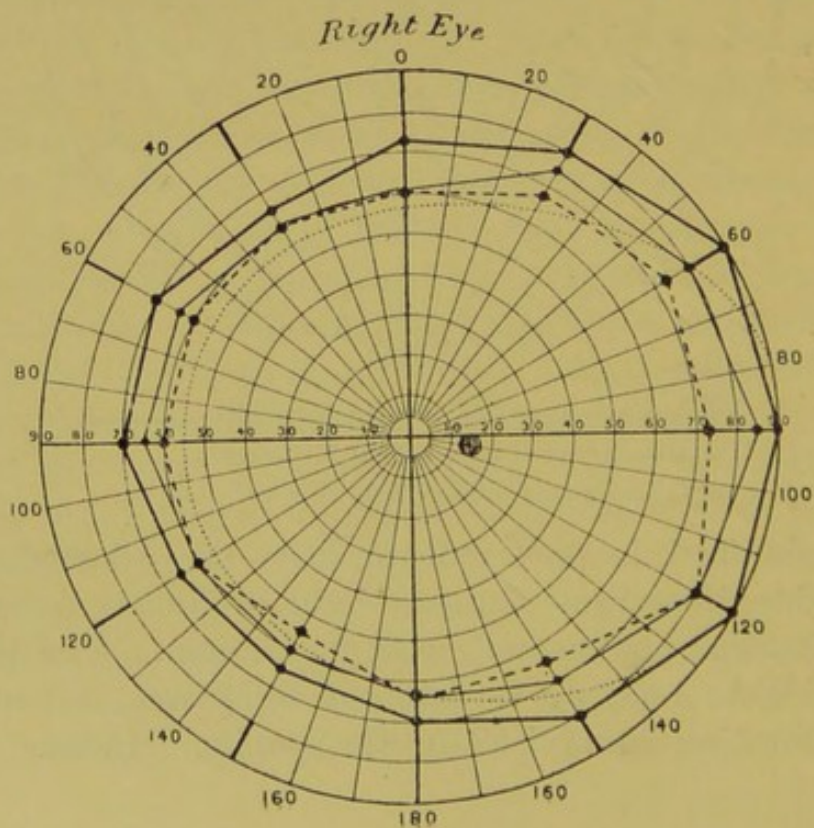


FIG. 3.



normal. The fundus reflexes were thought to be exaggerated. Visual field for white, judged by the ordinary standard, slightly contracted, especially upon its temporal side. The fields for red and for green were markedly small, the former lying at every point within the latter (Fig. 1). Red blood-cells 80 per cent. and hæmoglobin 70 per cent. of the normal.

October 30th.—The xerotic changes have disappeared without treatment, and without at any time being associated with night-blindness. The field for red (Fig. 2) is larger than it was nine weeks ago, and now lies external to that for green, save in one meridian of the chart (right eye). The percentage of hæmoglobin has risen to 75, while red blood-cells now equal 90 per cent. of the normal.

November 18th.—Xerosis has recurred to a slight extent as regards the left eye. The fields for white, red, and green are larger than they were nineteen days ago, and the red field now lies wholly external to that for green (Fig. 3). Hæmoglobin 80 per cent. and red cells 116 per cent.

CASE 4.—James G—, æt. 12, suffered from epithelial xerosis in the summer of 1895 and again in 1896, but upon neither occasion was it associated with night-blindness. His right ear used to discharge; he is subject to eczema of the scalp; and he has suffered from peripheral ulcerations of each cornea. His cervical glands are somewhat swollen, and the lad looks pale. Upon August 16th, 1897, he was found to have a patch of xerosis upon the outer side of each eye, the change being especially well marked upon the right side. The affected spots contained numerous xerosis bacilli, which were cultivated by the usual methods. Light minimum 4 sq. mm.; read J. 1 when the light was turned down. Colour vision normal. Pupils showed no change. Ophthalmoscopic reflexes appeared to be exaggerated. The field for white (according to the general idea) not contracted; those for red and green, however, shrunken and more or less trans-



FIG. 4.

*Left Eye*

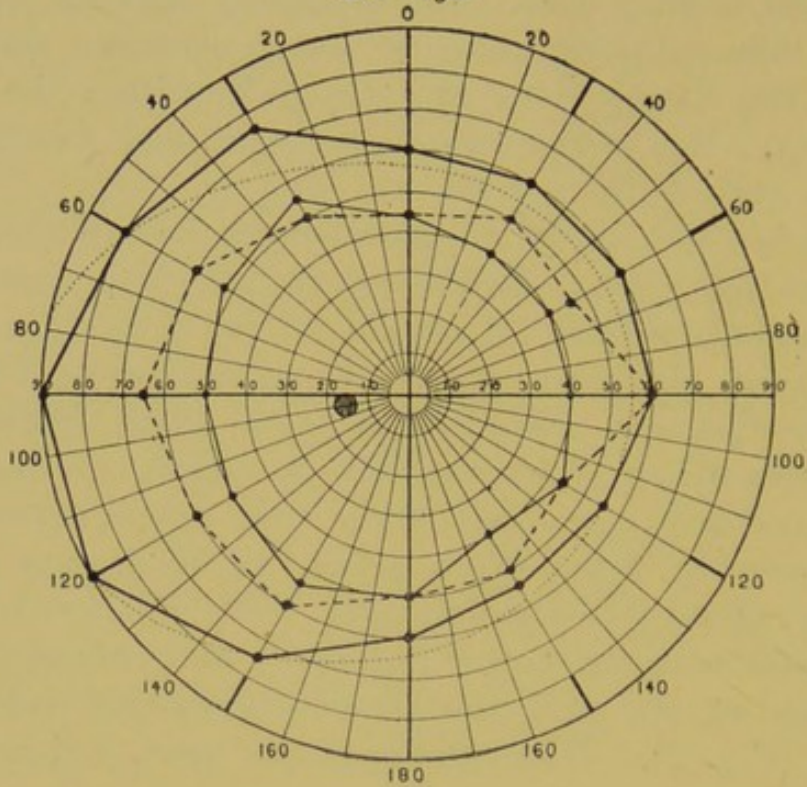
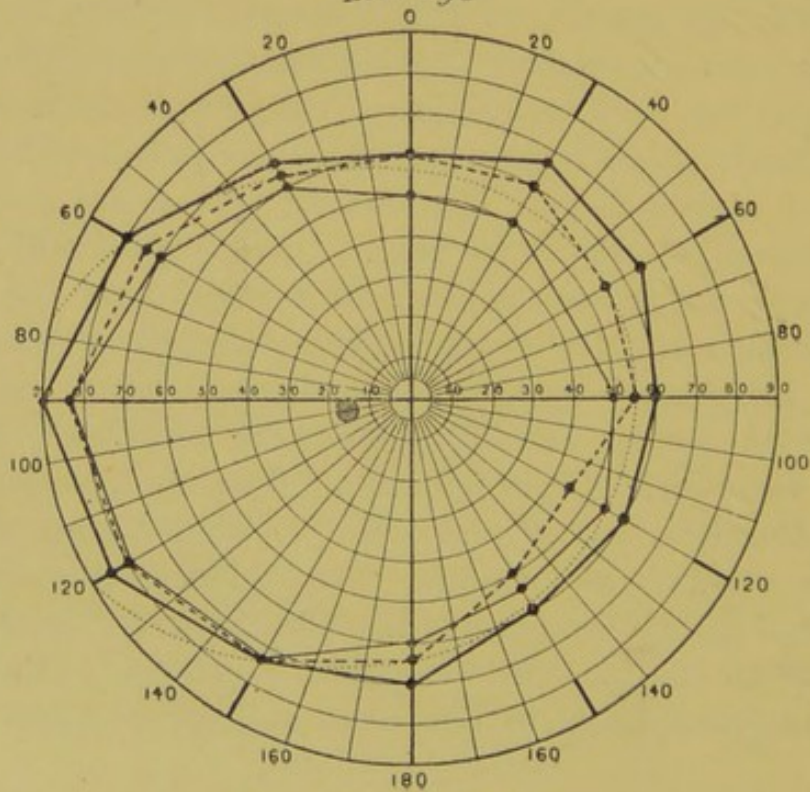


FIG. 5.

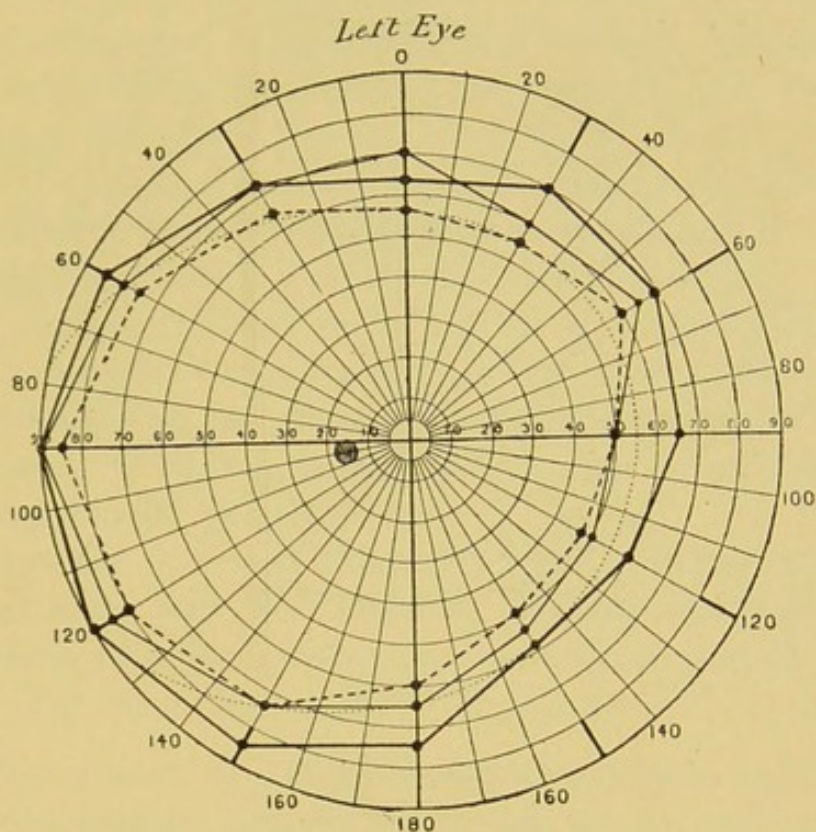
*Left Eye*



posed (Fig. 4). Hæmoglobin 55 per cent. and red blood-cells 98 per cent. of the normal. No treatment adopted.

November 2nd.—The xerotic areas have disappeared. Fields for red and for green have become larger (Fig. 5),

FIG. 6.



although the first-named still lies abnormally within the second, except in lower nasal quadrant of the chart (left eye). Hæmoglobin 70 per cent.

15th.—The conjunctival patches have not recurred ; the fields for white, red, and green now occupy their natural places (Fig. 6). Hæmoglobin 75 per cent.

The next case is quoted for the purpose of showing that conjunctival changes may persist notwithstanding the fact that the fields have become normal.

CASE 5.—Ernest R—, æt. 10, a somewhat delicate lad, had suffered during the summer of 1895 from triangular xerosis, in which organisms were demonstrated. Some

FIG. 7.

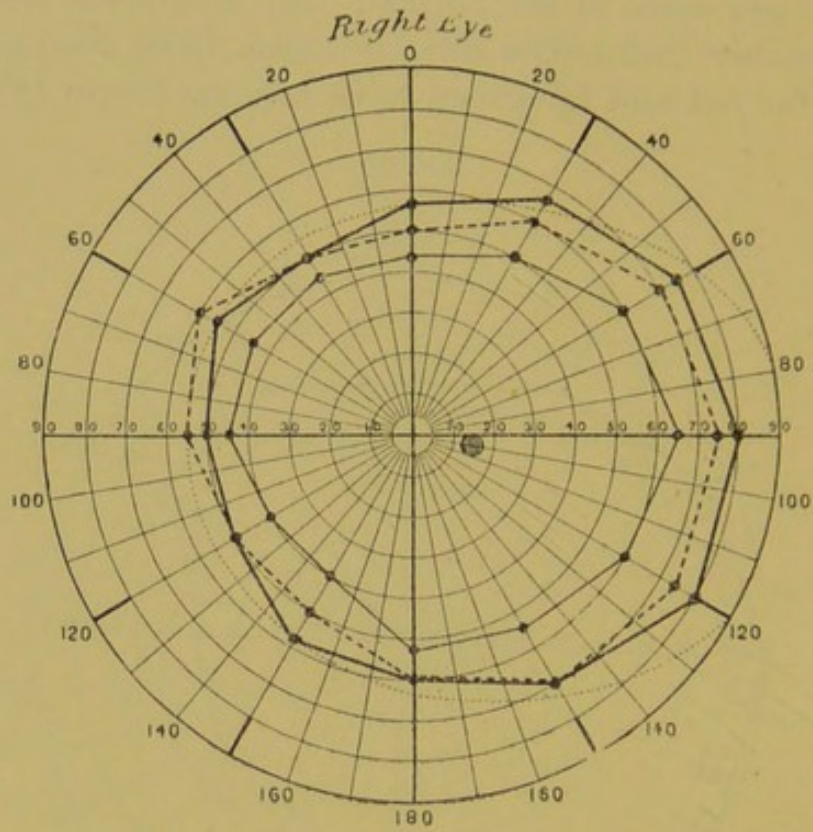
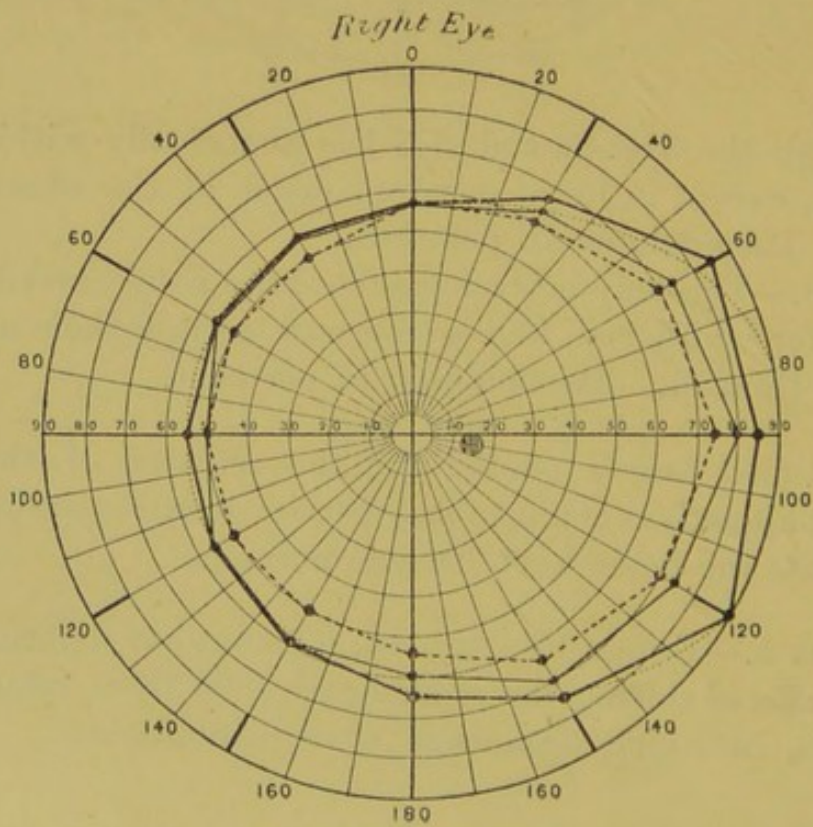


FIG. 8.



degree of night-blindness was present at that time. The conjunctival changes persisted for about four months. The condition recurred in the summer of 1896, but upon that occasion hemeralopia was absent.

August 16th, 1897.—A small patch of epithelial xerosis was found upon the conjunctiva in the external commissure of each eye. Night-blindness denied. Although the child was able to decipher in a dull light J. 1, yet the light minimum, as tested by the photometer, was 11 sq. mm. Fields for white, green, and red all rather small; the field for red lay wholly within that for green (Fig. 7). Colour sense feeble, probably as a congenital condition. Pupils equal, active, and not unduly dilated. Ophthalmoscopic reflexes certainly exaggerated. Hæmoglobin 65 per cent. and red cells 80 per cent. No treatment adopted.

October 30th.—A trace of xerosis is still present. Hæmoglobin 65 per cent.

November 15th.—The conjunctival patches, although insignificant, still in evidence. Fields for white, red, and green of natural extent, and arranged in their proper order (Fig. 8). Hæmoglobin 70 per cent.

When xerosis is complicated with definite night-blindness, the field for white and for colours is concentrically contracted to an extent that has appeared to me to bear a distinct relation to the grade of the hemeralopia. The curious transposition of the red and green fields, however, is also present. Neither ring scotomata nor zonular defects were observed in any of my patients. In other words, the changes, although more marked, are similar in kind to those found in simple xerosis, that is, uncomplicated with hemeralopia. The following is a good example:

CASE 6.—Harriet H—, æt. 10. On August 9th, 1897, a tiny white patch of xerosis was noted upon the conjunctiva in each external commissure. The child stated that every night for about two weeks she had stumbled over things, such as steps or her bed. She was certainly

FIG. 9.

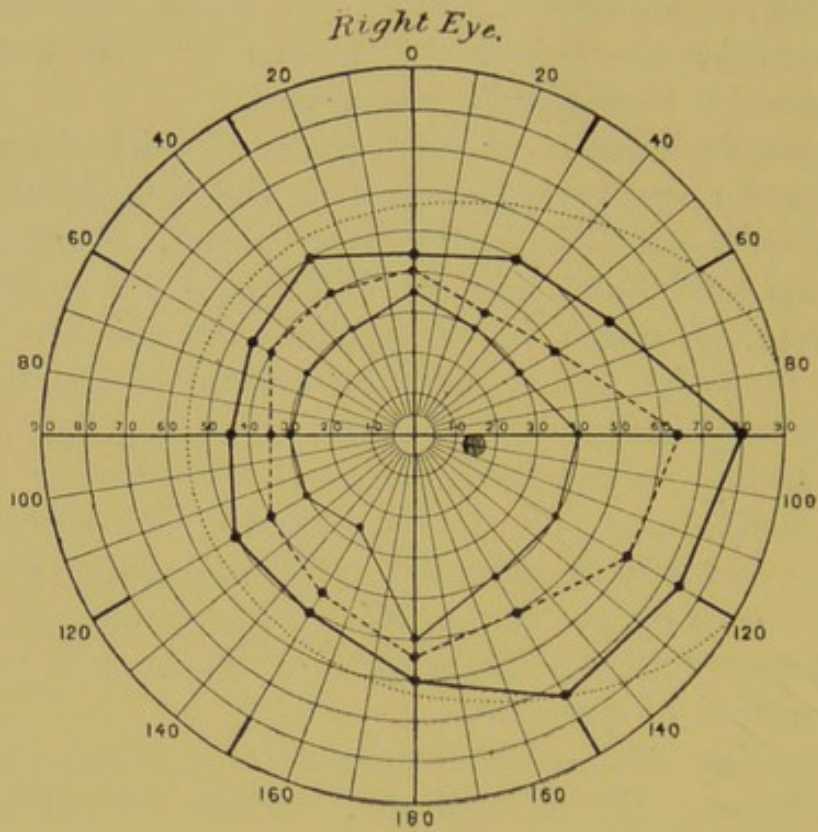
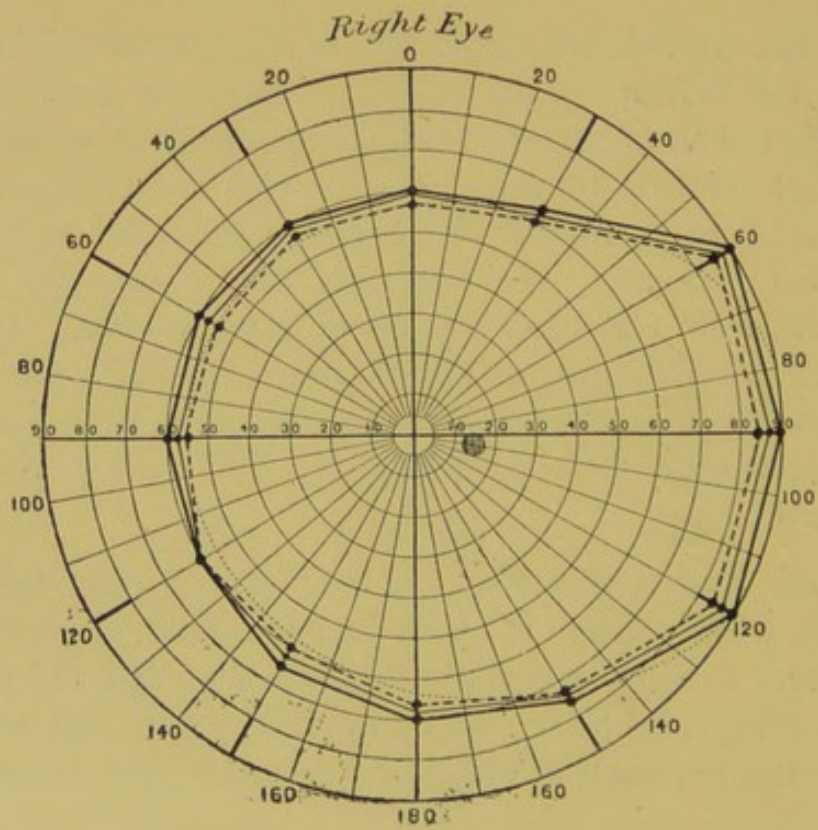


FIG. 10.



unable to get about well in a darkened room, where she could not recognise a mantel-board (of large size) until close to it. Her complexion was ruddy, and she appeared to be well nourished. Upon examination, R. V.  $\frac{6}{6}$  v letters; L. V.  $\frac{6}{6}$  vi letters, but good illumination needed. Light minimum 10 sq. mm. No alteration detected in the pupils. The fundi, examined without a mydriatic, showed a slightly curved reflex, roughly corresponding with the inner half of the optic disc, and lying about 2.5 mm. from that structure; the retinal reflexes, as a whole, exaggerated. No confusion as regards blues; colour sense normal. Field of vision, as taken in daylight, contracted for white, red, and green, so that the area for red fell wholly within that for green (Fig. 9). Red blood-cells 98 per cent. and hæmoglobin 70 per cent.

August 27th.—Xerosis (.25 mm.) now present upon the outer side of the left eye only. Fields as noted. Able to read "diamond" type in a dull light; light minimum 1.5 sq. mm. The patient states that she now sees well at night.

September 7th.—The xerotic patch has disappeared.

October 15th.—Neither xerosis nor hemeralopia is present. Child in excellent health. R. V.  $\frac{6}{5}$  vi letters; L. V.  $\frac{6}{5}$  vi letters. Fields normal, both as regards white and colours (Fig. 10). Hæmoglobin 85 per cent.

The next case is of some little interest, since it both shows the singular fluctuations that may be met with in idiopathic night-blindness, and illustrates aptly the perimetric changes associated with that condition.

CASE 7.—John E—, æt. 15, had been an inmate of the Ophthalmic School at Hanwell since September 25th, 1896, whither he had been sent suffering from inflammation of the conjunctiva and "strumous" ulceration of each cornea. The lad, although small for his age, appeared to be well nourished. He was affected, however, with chronic *otitis media*, as shown by a purulent discharge from the

FIG. 11.

*Left Eye*

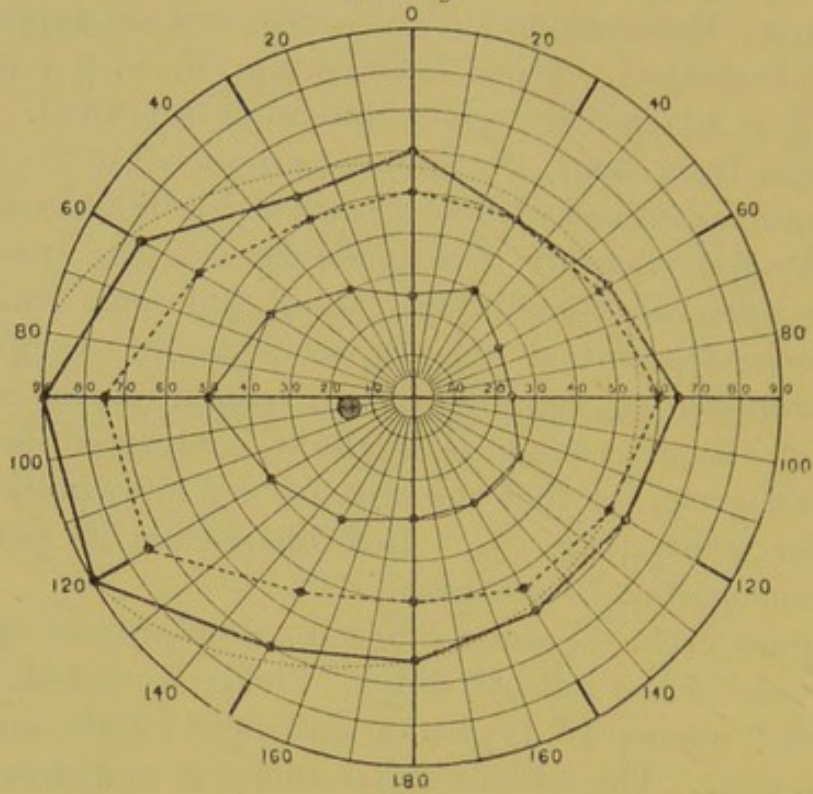
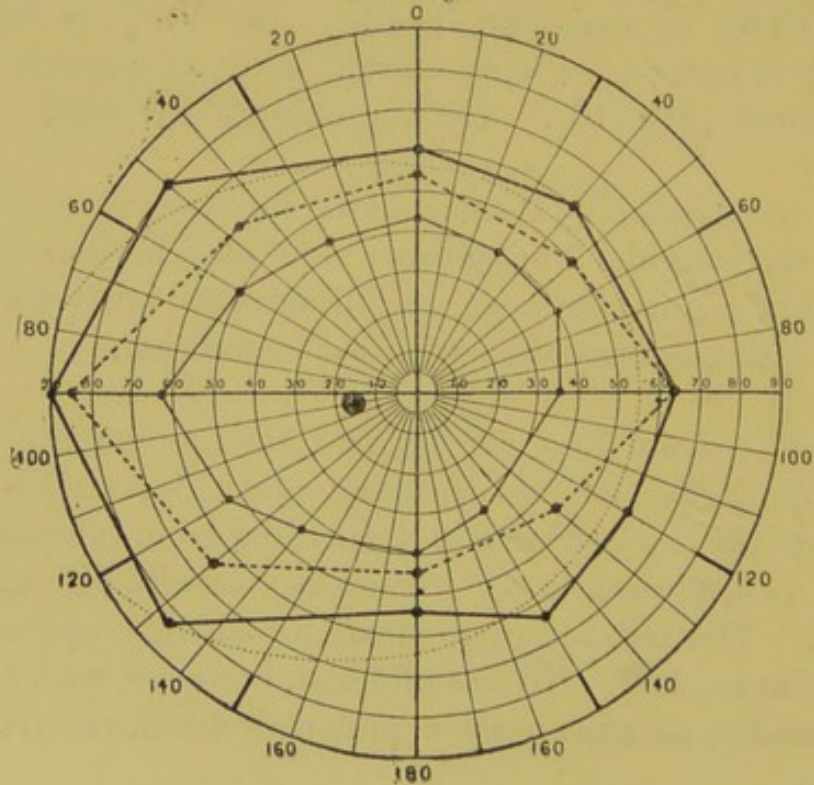


FIG. 12.

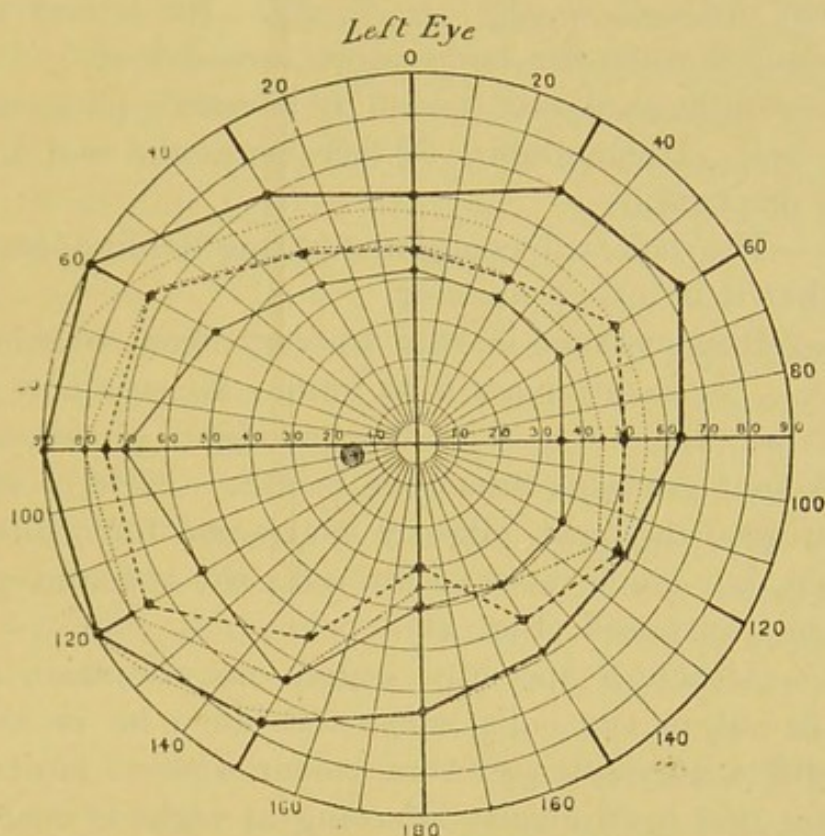
*Left Eye*



ears, perforated drums, and some deafness. Sight upon admission: R. E.  $\frac{2}{60}$  and J. 16; L. E.  $\frac{6}{36}$  and J. 1.

July 1st, 1897.—The patient states that whilst in his ward on the evening of June 28th 'a mist came right

FIG. 13.



Thin interrupted line = field for blue.

over his eyes' and lasted until he fell asleep. Next morning he could see clearly, but the same evening he knocked into one of the lamp-posts fixed in the boys' yard, and had to be led into his dormitory. He volunteers the statement that when living at home he experienced a similar difficulty in seeing at night, lasting from about August to December in two successive years (1895 and 1896). His diet at that time seems to have been made up chiefly of tea and bread and butter; he had meat, so he says, on Sundays only. Upon examination a patch of epithelial xerosis was found in the conjunctiva upon the outer side of each cornea, the change being more marked in



the right than in the left eye. R. V.  $\frac{6}{24}$  and J. 2; L. V.  $\frac{6}{18}$  and J. 1. No colour defect. Some degree of night-blindness was certainly present, as in a dull light vision sank inordinately. Fundi difficult to explore on account of the nebulæ that exist, but so far as could be made out there were no material alterations.

August 3rd.—R. V.  $\frac{6}{36}$ ; L. V.  $\frac{6}{24}$ . No letters could be recognised when the lamps were turned low.

13th.—Light minimum (tested by Förster's photometer) 13 sq. mm. Hæmoglobin 60 per cent. and red blood-cells 90 per cent.

23rd.—The lad still complains of night-blindness, but states that it is less in amount.

27th.—Hemeralopia is said to vary from evening to evening. Light minimum 6 sq. mm. Xerosis now more marked on the outer side of the right cornea. The affected spot contains numerous bacilli. Field of vision, taken in good daylight, slightly contracted for white and for green, but much more so for red; the red and green fields are transposed (Fig. 11).

30th.—Although specially tested, no alteration could be made out in the lad's sense for blue; he is able to select different shades of that colour without hesitation. He states that his difficulty in seeing at night is becoming less.

September 10th.—The patient says that for the first time he was able to see quite well last night. Hæmoglobin 75 per cent.

30th.—Xerosis still present. Says that until last night he has been free from trouble, but that then he "came over dizzy and could not see." Hæmoglobin 80 per cent.

October 6th.—Xerosis persists. Pupils remain small, even when the argand lamp is turned pretty low. R. V.  $\frac{6}{18}$ ; L. V.  $\frac{6}{12}$ . He is able to read J. 1 with full illumination, but not otherwise. States that his sight has been dull at night since the last note was made. Hæmoglobin 80 per cent.

20th.—A tiny patch ( $\frac{1}{8}$  mm.) of xerosis is still to be

seen upon the outer side of the right eye. R. V.  $\frac{6}{12}$ ; L. V.  $\frac{6}{12}$ . Field for white remains a little shrunken; red and green fields are transposed (Fig. 12). Hæmoglobin 80 per cent., and red blood-cells 94 per cent. States that he noticed some night-blindness on the evening of October 16th, when "everything looked misty."

November 8th.—Xerosis has disappeared.

12th.—Neither hemeralopia nor xerosis is present. Light minimum 4 sq. mm. Field for white normal (Fig. 13); that for red now excèeds that for green at two points (in the chart belonging to the left eye). Hæmoglobin 80 per cent. and red cells 99 per cent.

In simple xerosis, then, and in xerosis associated with night-blindness, the field of vision shows changes that are essentially similar.

A word may next be added with regard to ophthalmoscopic appearances. In examining the fundi of my patients, all of whom were children, many peculiarities were met with; but as none of these, with the exceptions noted below, were common to all or to a majority of the cases, they may safely be put on one side. Without wishing to seem in the least dogmatic on so difficult a subject, however, I may say I have convinced myself that in xerosis (with or without definite hemeralopia) the retinal reflexes are exaggerated, while, in addition, a semicircular jagged reflex is often to be seen close to the inner side of the optic disc. These points are easier to appreciate when the examination is made under weak illumination with an undilated pupil.

From the state of the fields and of the fundi, I conclude that xerosis and hemeralopia are closely connected; in fact, I would personally go so far as to claim that every eye suffering from epithelial xerosis is in a state of incipient night-blindness, with some, though perhaps slight, signs of *torpor retinæ*.

By Adamuck (33) and others it has been claimed that idiopathic hemeralopia is due to a miasmatic cause

akin to malaria. The theory usually accepted, however, assumes them to be the outcome of two factors: (1) lowered nutrition, such as may be brought about by a scarcity of animal or vegetable food or by actual disease, and (2) dazzling of the eyes by sun, snow, electric light, or furnace-glow.

The general truth of this latter explanation is attested by a large body of evidence. Thus, the two affections are met with in people likely to be imperfectly nourished, as, for example, the inmates of poor-class schools, reformatories, orphanages, convict transports, prisons, and ships. They are extremely common, again, among orthodox members of the Greek Church during the great Lenten fast, which lasts for seven weeks, and during which the use of animal food is strictly forbidden. On the other hand, they seldom fall under notice in June, August, and December, as the fasts proper to those months are not so rigidly kept. The popular Russian remedy is beef liver, which for some reason or other is not prohibited, and the patients soon recover when that is taken, or when the religious observances come to an end. Moreover they are prone to occur in certain maladies of a weakening kind, especially scurvy, hepatic affections, malaria, and pellagra. As to scurvy, night-blindness was regarded as one of its symptoms by Sir Gilbert Blane (34) so long ago as 1785, a view endorsed since his time by many writers, *e. g.* Rees (35), Nicholls (36), &c. Numerous examples of hemeralopia dependent on scurvy in soldiers and sailors employed in the Crimean war will be found in the second volume of the 'Ophthalmic Hospital Reports.' Vaucelle (37) has related a striking instance. It appears that during a cruise in the Pacific (1876-8), eight months after leaving France, fresh meat became scarce on board, while there was a complete absence of green vegetables. Under these circumstances, eight of the crew developed hemeralopia. That symptom soon yielded to cod-liver oil, but recurred upon several occasions when meat was scanty for long

together. Three of Vaucelle's patients suffered from definite scurvy. Parinaud (38) and Leber (5) have each described a case where night-blindness and xerosis were seen in a chronic hepatic affection associated with jaundice.\* With regard to malaria, Sulzer (39) states that in Java night-blindness is not infrequently a symptom of the cachexia induced by that disease, an observation confirmed by Forster and by Knies (40). Zimmermann (41) saw four children of one family, living in a low and insanitary situation, attacked by hemeralopia and intermittent fever. It was only after they had moved to healthier quarters that the night-blindness recovered. Hemeralopia is a characteristic sign of that curious Italian affection pellagra, which (according to Lombroso) is due to the consumption of unsound maize. Pregnancy, too, predisposes to its development, as in a remarkable case related by Weinstein (42). A woman, twenty-nine years of age, developed hemeralopia in three out of four successive pregnancies. The ailment, which was of paroxysmal type, commenced with gestation, and from the fourth month onward was complete, so that the sufferer is said to have been unable to distinguish anything from sunset to sunrise; the eyes were examined by Welz, but with negative results. During an epidemic of night-blindness described by Fleury and Flechier (43), it was found that pregnant women were affected more than other people. Kubli (44), among 19 women with hemeralopia, ascertained that 6 were pregnant. Facts reported by Uthoff (45) go to show that alcoholism may be also a factor. Among 1500 lunatics he discovered 17 instances of xerosis, 3 of night-blindness, and 7 in which the two conditions were associated. Almost all his cases were in chronic alcoholics. Achenbach (50) has published a confirmatory case. In short, whenever the general health is

\* The connection between hemeralopia and jaundice has been remarked by many authors, as Scarpa (46), Bampfield (47), Cane (32), Weinstein (42), Frerichs (48), and Cornillon (49). But, so far as I know, xerosis has been mentioned only by Parinaud and Leber.

lowered, there would appear to be a predisposition towards night-blindness.

Nevertheless an exciting cause, dazzling, seems to be almost essential. Hemeralopia was formerly common in sailors exposed to the glare of a tropical sun, particularly when fresh meat and vegetables were scarce. Baillie (51), surgeon to H.M.S. Ajax, had an opportunity of investigating fifteen cases that occurred whilst his vessel lay off Algiers. He found the affection to be confined to men who did duty upon the gangways, poop, and other exposed parts of the ship. According to Sir Thomas Longmore (52), it is still frequently seen among soldiers who have passed from a northern latitude to a tropical station. Among the civil population night-blindness mainly affects those whose occupation exposes them to the causes of dazzling, as, for example, agricultural labourers, mountaineers, quarrymen, and ice hewers. Michel (53), among 47 people with hemeralopia in the Rebdorf workhouse, ascertained that 87·23 per cent. of the sufferers broke stones upon the road, as against 12·77 per cent. who were employed indoors. In this country, at all events, sunlight is the common agent. Mr. Adams Frost (54) has related two excellent instances where hemeralopia followed prolonged exposure to sunlight. His first patient had been engaged for some weeks in painting, during very bright spring weather, the *façades* of white houses. This man had, in all, no less than six attacks in as many years. Mr. Frost's second patient had been painting lamp-posts a stone colour for six weeks in bright weather, and the night-blindness was in his case associated with pain and lacrymation. Krienes (14) mentions the case of a man who, by way of a joke, looked for a long time at the sun, and in consequence developed a marked night-blindness. From my own observations among children I know that the condition in question is practically never met with save in spring and summer, although cases that have commenced at those seasons of the year may, of course, last through the

autumn well into the winter months. The glare of stone-flagged yards and whitewashed walls, together with the fact that the inmates of poor-law schools run about without any protection to the eyes in the shape of hats or caps, has appeared to me to be the immediate or exciting cause in most of my cases. The latter I have always found to be more frequent in a bright than in a dull spring.

Sunlight, however, is by no means essential, for it has been shown that exposure of the eyes to the dazzling light reflected from tracts of snow, as in the steppes of Siberia, causes night-blindness, attended, it may be, with a form of painful conjunctivitis. Thus during the war between France and Sardinia (1793), several regiments were forced to encamp on Mont Cenis and Little Bernard. Whole companies developed night-blindness, which was attributed, with every show of reason, to snow-dazzling (Weinstein). Reich (55) investigated several cases of this kind amongst labourers engaged in removing snow from roads in the Caucasus. During the recent voyage of the "Fram," Nansen, in his 'Farthest North,' alludes to a few cases of the kind. Much the same sort of thing has been known to follow exposure to the light of an electric arc lamp or welding apparatus, although there the conjunctival irritation, as a rule, was so intense as to mask the other signs, as in cases recorded by Nodier (56), Rockliffe (57), Emrys-Jones (58), Hewetson (59), &c. &c. Lastly, Evetzki (60) has found xerosis conjunctivæ to be frequent among glass-workers exposed to the heat and glare of the powerful furnaces employed in that industry. Of seventy men examined by him, thirteen showed xerotic patches, but without hemeralopia. According to Krienes (14), night-blindness was in former times extraordinarily frequent in the zinc workers of Upper Silesia, although now the affection is seldom seen, because the eyes are protected by glasses and the social condition of the men is better.

The notion was once widely prevalent that night-

blindness might be induced by sleeping with the face exposed to the rays of the moon. The existence of this "moon-blindness," as it was called, appears to me to rest upon slender evidence. The older observations may be dismissed without hesitation, inasmuch as they were made before the ophthalmoscope was invented. Hildige (61) and Robinson (62) seem to be the only English writers who in comparatively recent times have alluded to it. The former states that while in South America he came across several cases of this kind, but he fails to give any critical account of the disease. The latter merely repeats the statement proffered by a sailor to account for his night-blindness, namely, that he had been sleeping on the deck at night, and thought the moon must have shone on him as he slept.

One is almost bound to assume that of the two factors concerned in the production of hemeralopia, lowered nutrition is the more important. Otherwise it would be difficult to explain why, amid a body of people exposed to the same dazzling influences, a few alone should be affected. Thus Bampfield (47) laid stress upon the fact that while the lascars employed on the East India company's ships were exceedingly liable to the ailment, the officers nearly always escaped. This observation has been often confirmed since 1814, when Bampfield made his classical communication to the Medical and Chirurgical Society of London. The same sort of thing has been found to be true as regards soldiers. For example, Baizeau (63), out of upwards of 300 cases of epidemic night-blindness, met with the ailment twice only in officers. Poullain (64), again, treated 110 cases among soldiers without a single officer or sub-officer being affected. It would appear, therefore, as though officers, whether at sea or on shore, generally escaped the disease, an immunity doubtless connected with the better diet enjoyed by that class.

It would seem, however, that lowered nutrition, in the absence of dazzling, is not enough in itself to set up the

disease. If that were not the case we should expect to find it in this country all the year round, instead of in the spring and summer months only.

Most of the children with epithelial xerosis who have fallen under my notice appeared to enjoy good health. They were usually well-nourished, while not a few had bright and ruddy cheeks. At first, therefore, I was inclined to endorse the remarks of some other observers, especially Bitot (20), who noted as a curious circumstance in the Bordeaux epidemic that the ailment affected those in rude health, and spared for the most part the numerous scrofulous and rachitic inmates sheltered by the asylum. A somewhat similar conclusion was reached by Cohn (3), from the investigation of six cases of triangular xerosis in patients whose ages ranged from four to forty-three years. Although they were in needy circumstances, yet they showed no disturbance of the general health.

A closer examination of my cases, however, brought to light two important facts: first, that a majority showed signs of past or present "scrofula" or tubercle, as evidenced by internal otorrhœa,\* hypertrophied tonsils, peripheral vascular opacities of the cornea, relapsing pustular eruptions about the face and ears, swollen upper lips, catarrh of the nasal mucous membrane, enlarged cervical glands, and synovitis of the larger joints, named in their order of frequency. Secondly, an investigation of the blood showed in every instance (fifteen) a marked deficiency in hæmoglobin, the average of which was only 65 per cent. of the normal. The estimation was made by means of Gowers' hæmoglobinometer, which is probably as useful for the purpose as the more complicated instrument of Fleischl. When xerosis had disappeared the proportion of hæmoglobin was found to have risen, but never to the normal limit. This latter observation naturally led me to inquire whether it was possible that the percentage of hæmoglobin was always below par in

\* I find that Kuschbert ('Deutsche med. Woch.,' No. 21, 1884) makes the observation that purulent otorrhœa is not uncommon in xerosis.



children. Failing to find any reference to the matter in the works that deal specially with the subject, I thought it advisable to examine the blood in a number of presumably healthy children. With the assistance of Mr. G. C. Burton, resident medical officer to the North-Eastern Hospital, I investigated the point in 164 children whose ages ranged from a few months to fourteen years. The figures thus obtained have been embodied in an Appendix to this communication. It will suffice to state here that we found the percentage of hæmoglobin in every instance to fall below 100; that it varied in individual cases from 65 per cent. to 95 per cent., and averaged 76·62 per cent.; that it was slightly greater in males than in females; and that it appeared to bear no definite relationship to age.

One fact was brought out clearly by the investigation, namely, that the percentage of hæmoglobin was lower in children with than without xerosis. For example, amongst the former (as already stated) it stood at 65, whereas among the latter it was 76·62.

In my xerosis cases the red blood-cells ranged from 70 per cent. to 134 per cent., and averaged 88 per cent. of the normal, which is, perhaps, no more than might be expected in children.

From all this it follows that in xerosis the so-called "colour-index"—that is to say, the relationship between red corpuscles, on the one hand, and hæmoglobin, on the other—is generally reduced, or, in other words, a condition akin to chlorosis exists.

With these facts before us it were easy (though possibly not very profitable) to theorise. We might assume, with Parinaud and Treitel (65), that hemeralopia depended on molecular changes in the retinal pigmented epithelium, which is known to secrete the retinal purple, and that this was brought about by an impoverishment of the blood circulating in the vessels of the underlying choroid. The xerosis might be explained by supposing that degeneration had taken place in the superficial layers of the conjunctiva, whereby settlement of the characteristic

bacilli was favoured. In this view both night-blindness and xerosis would be attributable to a common cause, namely, impaired nutrition, while the former would be proximately due to dazzling and the latter to the rod-shaped bacteria.

The treatment of xerosis is a comparatively simple affair, although as the affection tends to come to an end of itself, some caution is needed in drawing inferences as to the effect of the drugs employed.

The reduction in hæmoglobin which has been shown to exist points to the necessity of administering some preparation of iron, especially the well-known Bland's pill.\* Whatever the particular preparation, it should be given in liberal and increasing doses. Iron sometimes exercises an almost specific influence upon xerosis, as shown by the case of Harriet H— (No. 6) mentioned earlier in this paper, whose symptoms yielded after eleven days' treatment by Bland's pill. That such a speedy result is unusual, the following, taken from a number of more or less similar histories, will testify.

CASE 8.—Thomas K—, æt. 11, a "strumous" subject, with a running ear, chronic vascular opacities of the cornea, ulcerated gums, and a tendency to tonsillitis, had suffered from epithelial xerosis upon former occasions.

August 16th, 1897.—A faint patch of xerosis was found upon the outer side of the left eye. Hemeralopia was absent; light minimum 4 sq. mm.; he read J. 1 when the lamp was turned low. Colour sense normal; pupils showed no alteration; fundus reflexes thought to be exaggerated. Red and green fields, as usual, shrunken and transposed, while the field for white was contracted about 10 degrees upon its outer side (Fig. 14). Hæmoglobin 75 per cent. and red blood-cells 126 per cent. After the condition had persisted for about four weeks (Septem-

\* An improved formula, ascribed to Dr. Stephen Mackenzie, combines 2½ grains of sulphate of iron with 1½ grains of carbonate of potash and 1 grain of sugar.

FIG. 14.

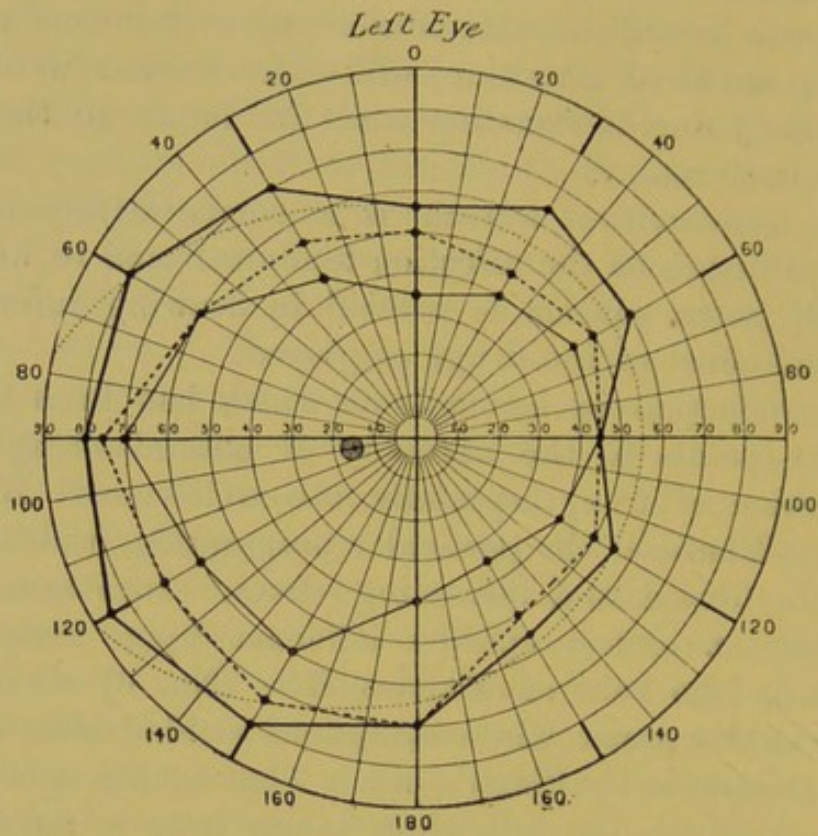
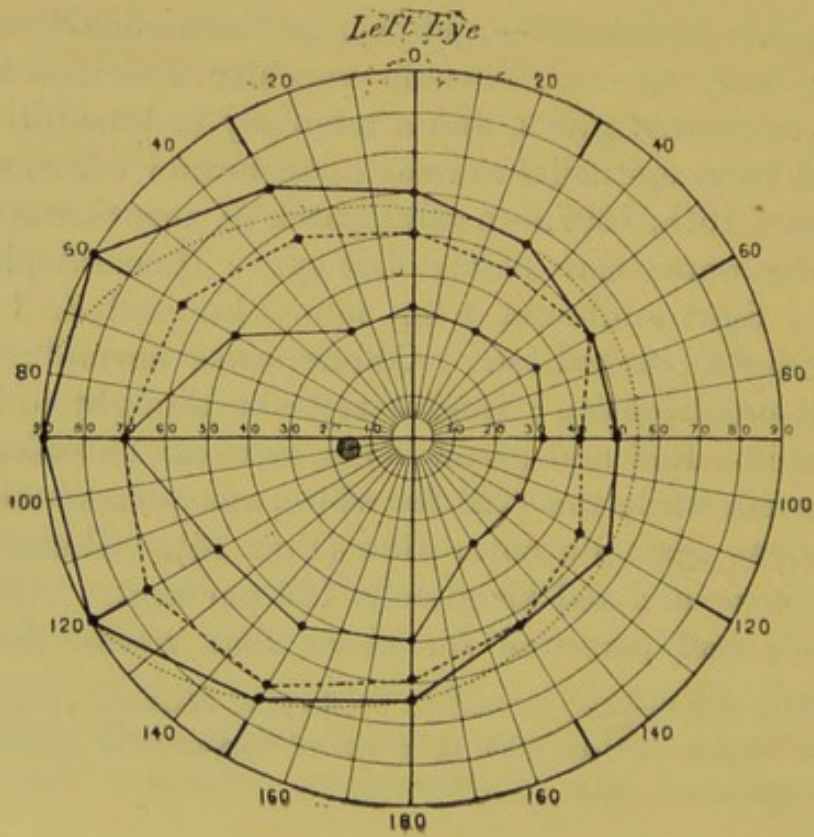
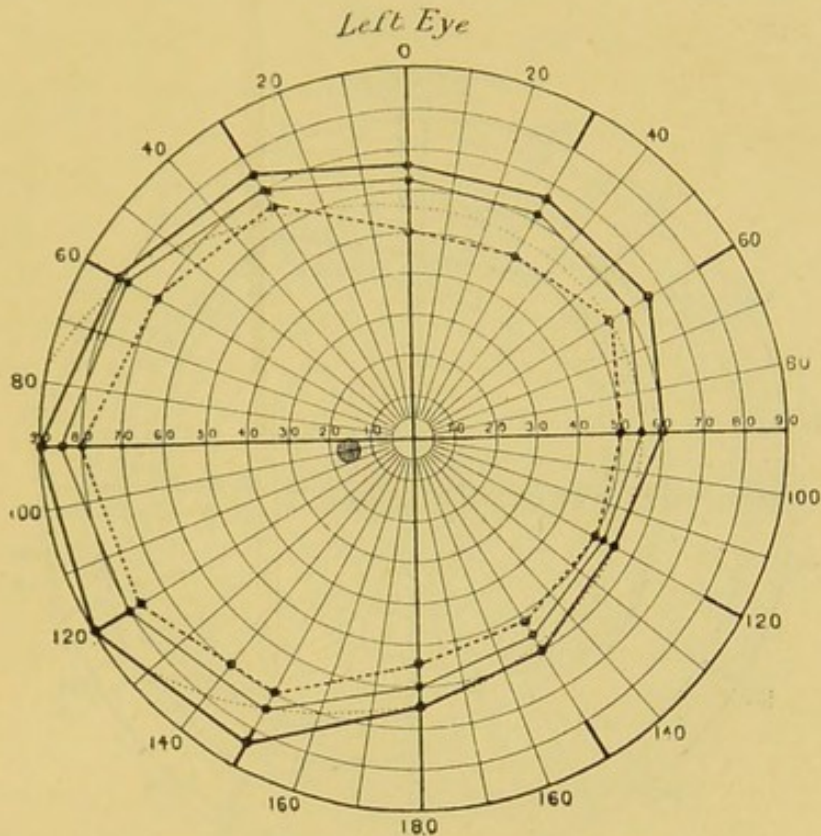


FIG. 15.



ber 19th), the patient was placed on six Blaud's pills a day. At that time a conjunctival patch was present on each eye; hæmoglobin was 76 per cent.

FIG. 16.



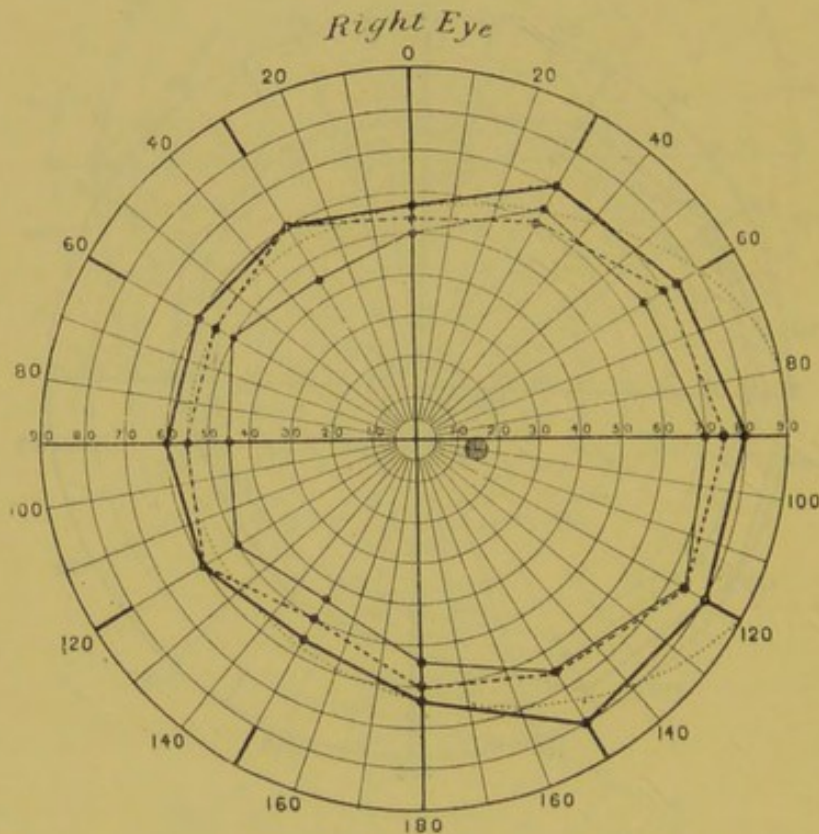
October 23rd.—The xerotic areas were smaller. Ten pills a day were ordered.

29th.—The right eye was free from change, while three tiny white speckles only remained upon the outer side of the left. The latter had disappeared by November 10th, that is to say, after upwards of seven weeks' treatment. Figs. 15 and 16 show the state of the visual fields on November 14th and 24th respectively.

CASE 9.—Frank D—, æt. 12, formerly suffered from a purulent discharge from each ear, and was subject every spring to xerosis conjunctivæ. On August 16th, 1897, his condition was as under:—A large, triangular, ridged

patch of xerosis was present in the conjunctiva upon the outer side of each cornea. Hemeralopia was denied; light minimum 4 sq. mm. Read J. 1 with light turned low. The lad was able to get about in a darkened room without

FIG. 17.

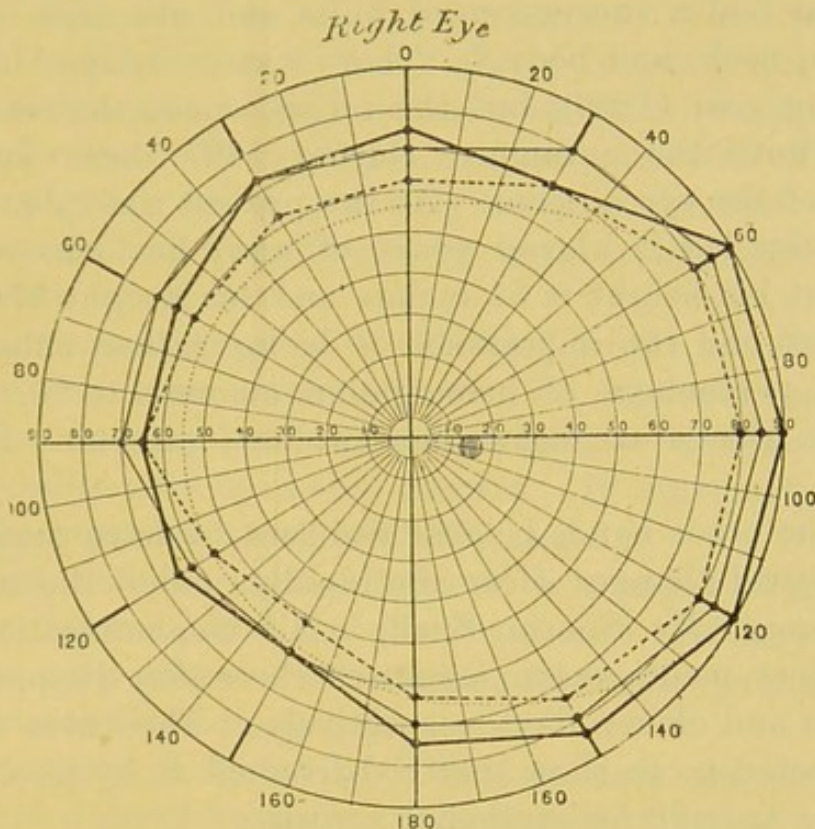


difficulty. Colour vision normal; pupils unchanged; fundus reflexes exaggerated. Fields for white, red, and green all rather reduced (Fig. 17), the red lying internal to the green except at one spot in the superior temporal quadrant of the chart (R. E.). Hæmoglobin 60 per cent., red blood-cells 83 per cent.; white corpuscles normal. On September 1st, six Blaud's pills were directed to be taken daily. Four days later the conjunctival patches were distinctly smaller. On October 23rd, ten pills a day. On October 29th, the xerotic areas were thinner and much less conspicuous; hæmoglobin 75 per cent. Fig. 18 represents the visual field on November 24th, 1897. The conjunctival

changes finally disappeared after rather more than three months' treatment (December 3rd, 1897).

It will thus be evident that although iron may in particular cases cure xerosis quickly, yet two or three months' treatment is in most instances necessary.

FIG. 18.



As pointed out by almost every writer on the subject, cod-liver oil is of service in epithelial xerosis. It probably acts by improving the quality of the blood. Its long-continued administration, as shown by the next case, certainly tends to prevent relapses of xerosis in those subject to the condition.

CASE 10.—Herbert C—, æt. 6, first came under my notice on December 8th, 1892. He was then thin, pale, and gave me the impression of being half-starved; he suffered from internal otorrhœa. A patch of epithelial xerosis was present on the left eye. Upon April 15th,

1893, the conjunctival condition recurred, and persisted for at least four months. In the spring of 1894, and again in the summer of 1895, xerosis was noted. In July of the last-named year the lad was ordered one teaspoonful of cod-liver oil twice a day, a dose shortly afterwards increased to two teaspoonfuls. The xerotic patches had disappeared by October 21st, 1895. The boy at about this time had a succession of boils and abscesses about his face, neck, and body.\* There was no relapse in the following year (1896), but the oil was nevertheless continued until the autumn. During 1897 there was no return of the eye ailment. At the present time (January, 1898) the lad is eleven years of age; he looks rather thin, but his height is 51 inches and his weight 67½ lbs. He gives one the impression of being rather chlorotic, yet the percentage of hæmoglobin amounts to 90. His cervical glands are somewhat swollen; otorrhœa is not present.

On the other hand, I never recollect to have seen the conjunctival changes clear up rapidly under the use of oil, although Mr. Simeon Snell, in his communication on the subject, mentions two instances where they disappeared in seven and eleven days respectively. The cases to be next quoted go to show that cod-liver oil is by no means always a specific for epithelial xerosis.

CASE 11.—Arthur H—, æt. 6. On June 9th, 1893, xerosis was noted. On July 27th the child was placed upon three drachms of oil a day. Nine weeks later an xerotic patch was still to be seen upon the right eye, and this did not disappear until the oil had been administered for three months in all.

CASE 12.—William H—, æt. 12. On September 12th, 1893, a small patch of xerosis was found in the usual place, namely, in the temporal part of each palpebral

\* Hippocrates noted the fact that a spontaneous cure of night-blindness sometimes followed an eruption of boils about the face or head.

fissure. The xerotic changes were not to be seen on December 12th, or three months and two days after treatment was commenced.

CASE 13.—Albert W—, æt. 9. Xerosis noted on July 10th, 1895, and six drachms of oil ordered to be taken daily. As the patches were still present on August 29th the dose of oil was increased to one ounce a day. On September 25th a trace of xerosis (from which the characteristic bacilli were cultivated) still remained in the right eye. Hemeralopia was not present. The lad was red-green blind, probably as a congenital defect. The xerosis had disappeared by October 1st, after about ten weeks' medication.

Numerous other cases of this kind might be cited, but enough has been said to show that however valuable cod-liver oil may be in selected cases, it assuredly does not speedily cure epithelial xerosis. It must not, therefore, be regarded as an infallible remedy.

When definite night-blindness is present along with xerosis, I have found the citrate of iron and strychnine to be a very efficacious medicine, commencing with five-grain doses three times a day.

Pilocarpine is stated by Kühne to have the power in cats and dogs of hastening regeneration of retinal purple, and on that account has been used hypodermically in night-blindness. Kuschbert and Meklenburg report favourably with regard to its action.

From time to time many other agents have been recommended, as, for example, blisters (Bampffield, Bailie), quinine (Sehotschepotjew), eserine (Martin, Fontan), salicylate of soda (Saltini, Manfredi), phosphorus (Dumas), arsenic (Wecker, Landolt), antipyrine (Grandclément), &c. &c.

I have no experience of treating night-blindness by incarcerating sufferers in a darkened room, as advised by Wharton (66), Netter (67), and some other authorities. Nobody can be astonished, however, that patients declare



themselves freed from hemeralopia after a longer or shorter confinement in places of the sort. It would, indeed, be wonderful did that symptom long survive means of so rigorous and penal a kind.

Lastly, it may be added that special attention should be paid to surroundings, diet, and to any constitutional diathesis that may happen to exist. I would insist upon the importance of curing any chronic suppuration, as *otitis media*, that may, with fair probability, be supposed to exercise a bad influence upon the general health.

The conclusions that may be fairly drawn from this paper are, I think, as follows :

1. Epithelial xerosis is not an uncommon affection among poor children in this country.

2. It is exceedingly prone to recur, perhaps for many years, in one and the same subject.

3. It does not entail any serious or permanent mischief, either as regards the eye itself or the body generally.

4. Although it may not be associated with definite night-blindness, still it is always accompanied by signs of *torpor retinæ*.

5. It generally co-exists with a contraction of the visual field for white and colours, and always, so far as my investigations extend, with a transposition of the red and green fields.

6. It coincides with an increase of the retinal reflexes normally present in the eyes of most young subjects.

7. It is probably always associated with a reduction of hæmoglobin, accompanied in some instances by a deficiency in the red blood-cells.

8. It is remotely due to a defect of nutrition, such as may come about under the influence of tubercle, scurvy, hepatic affections, pellagra, deficiency of animal food, or bad surroundings. The dazzling of sunlight in spring and summer is its immediate cause, so that the xerosis bacilli are enabled to effect a lodgment upon the conjunc-

tiva, where they give rise to the peculiar silvery scales characteristic of the disease.

9. Its tendency to spontaneous cure may be hastened by remedies, of which the most important is iron.

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## APPENDIX.

*Estimation of hæmoglobin in 164 healthy children.*

(Tested by means of Gower’s hæmoglobinometer.)

Age.		Males.		Females.
1 year	...	83·5	...	75·0
2 years	...	73·3	...	—
3	„	70·0	...	73·0
4	„	73·3	...	75·0
5	„	73·8	...	76·3
6	„	74·0	...	76·4
7	„	74·0	...	73·7
8	„	79·0	...	75·0
9	„	77·7	...	75·2
10	„	78·3	...	82·4
11	„	76·3	...	72·0
12	„	91·0	...	80·4
13	„	81·8	...	78·4
14	„	77·0	...	73·0

Number of children examined 164 { Males, 88.  
(ages 2 months to 14 years) { Females, 76.

Average hæmoglobin = 76·62 per cent., *i. e.* males 77·35 per cent.  
and females 75·83 per cent.

(January 27th, 1898.)