UNIVERSITY OF GLASGOW

THESIS FOR THE DEGREE OF M.D.

A CLINICAL STUDY OF TOBACCO BLINDNESS WITH AN INVESTIGATION INTO ITS RELATION TO CERTAIN SYMPTOMS OTHER THAN OCULAR

By

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P R E F A C E

As an Assistant Ophthalmic Surgeon to the Glasgow Royal Infirmary I have been brought into touch with many cases of tobacco amblyopia. For unlimited scope in the observation of these, and for permission here to make use of them, my thanks are due to Dr. A. Maitland Ramsay.

I am also indebted to Professor Muir for permission to carry on experiments in the pathological department of the University.

H. W. T.

I N T R O D U C T I O N

To Mackenzie[1] is accredited the first scientific reference to tobacco amblyopia, and since his time much has been written on the subject by many authors. The great mass of literature thus accumulated has been reviewed with praiseworthy thoroughness by de Schweinitz,[2] and to him we are indebted not only for a complete history of tobacco amblyopia but for the most outstanding of modern work on the subject of toxic amblyopias generally.

But it has seemed to the writer that while on the one hand progressive refinement of ophthalmic technique has led to the better recognition of the affection, and on the other, time has permitted opportunities of pathological examinations of at least similar conditions, due consideration has not been directed to the general condition of the patient. In short, attention has been directed towards tobacco amblyopia to the undue exclusion of chronic tobacco poisoning.

This thesis is the result of such considerations, and it may be said to be of a two-fold nature. Firstly, it is a clinical exercise involving the observation

during a period of three and a half years of fifty cases of tobacco amblyopia, and of certain other diseases which closely resemble it. Secondly, it contains the result of investigation as to the nature and relationship of certain symptoms of chronic tobacco poisoning, other than ocular.

SYMPTOMATOLOGY

With regard to the symptoms of this affection, it will be convenient to consider first, under the heading of "Clinical History," the accounts given by patients of their condition, and secondly, under the heading of "Clinical Examination," the results of systematic observation.

CLINICAL HISTORY. The story which is common to all cases of tobacco amblyopia is that of a dimness which has gradually come over the sight of both eyes. The difficulty is at first manifested only in connection with near vision, but very soon there is experienced a difficulty in discerning distant objects, and this difficulty is usually described as being due to a mist which has come over everything. The mist is variable in its

intensity. In the mornings it seems to lift a little, but as the forenoon wears on and especially if it be a bright day, it settles down again. Towards the late afternoon when daylight begins to fail, the sight improves, and by dusk, if the case be not far advanced, there may be no appreciable visual defect at all. Many patients do not notice the variation described above as occurring in the earlier part of the day, but there are few who are not conscious of the great benefit which it is to them to work in a dull light, and the correspondingly great disadvantage of bright light, and especially sunlight. As the case progresses, the mist becomes thicker, and the obscuration of vision is then not infrequently described by patients as being similar to what would be caused by putting fine gauze or muslin in front of the eyes. If the disease be so far advanced that there is in the centre of the field of vision, an area of absolute blindness - the absolute dark spot of Fick[3] - this may manifest itself to the patient, as in a case reported by Ramsay[4], in which the patient noticed in walking along the street that at a certain point a lamp would seem to go out, then reappear, when he had walked a few steps further on.

In a few cases, and especially in the earlier stages of the disease, no complaint is made by the patient of anything beyond mere dimness of vision; but in a large

proportion of the well established cases, a disturbance of colour vision has been made evident to them, and that very commonly by a difficulty in distinguishing between gold and silver coins of the same size, or between silver and copper. Almost as common is the story that friends' faces seem all to have changed in colour, so that they have become "pale," "corpse-like," or "like china." These colour symptoms usually follow the onset of the dimness of vision, and in fact may be taken as indicating the presence of a fairly large colour scotoma, but in one case the patient, a shop attendant, noticed for two or three weeks before the dimness of vision was apparent to him, that his customers all seemed very pale, and that the gas light resembled the pale blue of the electric arc lamp. The contrast between the defective central colour vision, and unimpaired peripheral perception was illustrated in an interesting way in the case of another patient who was a dyer to trade. He had no difficulty in recognising and matching colours when dealing with large surfaces, but, in the process of dying some cloths, they were immersed in acid baths, from which they were removed when the small flowers in the pattern had been decolourised to a certain shade of red, and for this he was totally incapacitated. In most instances, by reason presumably of the insidious onset of the dimness of vision, and

the frequency with which it is ascribed to ordinary presbyopia, patients do not seek advice until the visual acuity is very much reduced. Again, the disturbance of colour vision does not usually obtrude itself to any extent on the attention of the patient till the disease is well advanced; but occasionally the nature of the person's employment is such that even the earliest manifestations interfere very seriously with his work. The following is a case in point. W. H., aet. 58, complained of dimness of vision of a month's duration, getting rapidly worse during the two weeks prior to his seeking advice. His occupation consisted in copying pictures, and he described his difficulty as a two-fold one, firstly, with regard to form - a general dimness - and secondly, with regard to colour. He was not conscious of a depreciation of his vision for any one colour, but rather considered that he had become hypersensitive to blue. Thus, when looking at a multicoloured bouquet of flowers, any blue flourishes, be they ever so small, stood out from the rest with a prominence which to him was very distressing. The colouring of a landscape was similarly disturbed, and in the mixing of colours for painting, he "reduced" his blues to a much greater extent than was necessary. His visual acuity was reduced to a half normal, but no actual colour scotoma could be demonstrated, although

red and green seemed lighter in shade when in the central part of the field of vision. He was instructed to test himself at different times of day with small red and green dots, and in this way, it was discovered that in the mornings he had great difficulty in recognising them, but as the afternoon wore on his difficulty was much less, and by dusk he had no difficulty at all. Here then, there was in the central area of the field of vision a condition short of actual blindness to red and green, a mere reduction in the power of perceiving these colours so that the visual relationship between them and blue was disturbed, the latter seeming unduly prominent, whereas it was really the former that were less distinct than normal. In a few cases yellow is the colour which obtrudes itself most on the patient; thus in one case the patient stated that frequently in the mornings, he saw, on looking at his fingers, a yellow edging or fringe round each, a similar yellow edging surrounded other peoples' faces at these times. Another patient who was suffering from a second attack after an interval of two years, complained that everything seemed yellow to him. Simi[5] reports having met with this condition of Xanthopsia.

While there is no group of general symptoms, which is characteristic of tobacco amblyopia, there are often to be found in the clinical histories of these cases,

circumstances occurring immediately prior to the onset of the eye symptoms, which are likely to have had a prejudicial influence on the resistive power of the nervous system as a whole. In a very large proportion of cases there has been a period of mental worry or strain, caused it may be, by financial difficulties, or by the losing of a situation, or, as is not at all uncommon, by the death of a near relative, and it is obvious that under any of these conditions there is likely to be, in addition to the nervous strain, an irregular if not diminished dietary.

Sleeplessness is also a frequent symptom, and not at all uncommon is the history of gastric trouble more or less chronic in duration, and often alcoholic in origin. But, there are certainly some cases in which there is neither any history of mental or nervous strain, nor does the patient seem to suffer in any way apart from his sight. In these cases the consumption of tobacco has usually been very large.

A considerable degree of mental depression is often obvious, and may be ascribed to the patient's sense of helplessness, as may also be the irritability of temper and nervousness so often confessed to. In not a few cases, alcohol has been resorted to as a solace, or a still more excessive use of tobacco indulged in for its "soothing effect." On the other hand, it frequently transpires that the patient has of late reduced his

smoking considerably, because he has found himself much more easily upset and made sick by smoking than formerly; and finally, there are a few patients who have actually noticed a temporary increase in their visual difficulty to follow a smoke, and who have in consequence become more temperate in their use of tobacco.

In many cases, as pointed out by Doyne,[6] there is perceptible about the patient a peculiar heavy odour. It is found only where alcohol is used, and indeed occurs in non-smoking chronic "tipplers." It is a valuable guide in any given case of dimness of vision, but is to be regarded as an indication of the habits of the patient rather than a symptom of tobacco amblyopia.

CLINICAL EXAMINATION. The symptoms of tobacco amblyopia are almost exclusively subjective in character, hence, as a general rule no abnormality is discoverable by external examination of the eyes. There have been described by Fontan,[7] Jan and Strumpel,[8] cases in which ocular palsy or paresis in some form occurred, apparently the result of chronic tobacco poisoning; and Landolt[9] mentions the excessive use of tobacco as a cause of palsy; but the coincidence of such a condition with visual deterioration of toxic origin, if ever noticed, is of such rarity as to warrant the exclusion of muscular affections from the symptomatology of tobacco amblyopia.

The pupils are unaffected both as regards size and reflex activity.

The following case is here related as presenting most of the typical symptoms.

W. L. complained of dimness of vision in both eyes least marked in dull light, of nine months duration. For three months prior to the onset of the visual defect he suffered much from nervousness and sleeplessness, the result of excessive drinking. There seemed to be a mist before his eyes, and he had great difficulty in recognising his friends. He also found difficulty in distinguishing between half sovereigns and sixpenny pieces. There was no renal or specific history. He had been a smoker of black tobacco for thirty years, and for twenty years, at the rate of half an ounce per diem.

V.R. = 6/60 and J. 16 V.L. = 6/60 and J.16
Tested with small coloured spots he could detect blue and yellow, but failed with red and green.

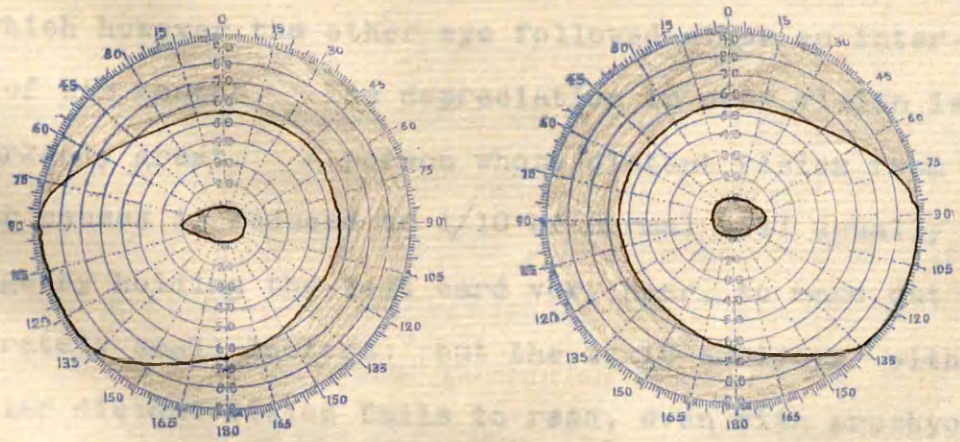


FIGURE 1.
Central Scotoma for
Red and Green

The fields of vision were normal peripherally, but in each eye there was a central scotoma for red and green, the scotoma for each being identical in shape and extent. Ophthalmoscopic examination revealed well marked pallor on the temporal side of each disc, but the fundi were otherwise normal in appearance.

The extent to which the visual acuity is reduced is great, and a survey of a group of well marked cases will usually reveal an average acuity of 1/6 to 1/10 of normal.

As a rule the vision of both eyes may be said to be equally affected, the difference rarely amounting to more than 1/12. Thus, a common result of testing is to find the vision of one eye = 6/60 and the other 6/36 or, the one 6/36 and the other 6/24. Occasionally however asymmetry is manifest, and very rarely the affection may be unilateral. Hutchinson, junr.[10] records such a case in which however the other eye followed after an interval of six months. The depreciation in near vision is remarkably great. A person whose distant vision from other causes is reduced to 1/10 of normal will usually manage by holding the test card very near, to make out moderately small letters; but the toxic amblyope with similar distant vision fails to read, even with presbyopia corrected, anything smaller than J.20 or J.16. This disproportionately great reduction in near vision is common to all defects in the central area of the

field of vision, and hence is of considerable diagnostic value.

The following examples will serve to illustrate the relationship between distant and near visions in different degrees of amblyopia:- V = 6/15 and J8; V = 6/18 and J12; V = 6/36 and J14; V = 6/60 and J18; V = 3/60 and J20.

It will usually be found that when the patient is allowed to look with both eyes together he states that the vision is markedly better than with either eye alone. The improvement thus obtained is not often sufficiently great to permit of his reading a line more in the distant test card, but quite commonly he will read smaller print near at hand. Thus, a patient who with either eye alone read J12, made out J8 when both eyes were used. An explanation of this is found in the eccentric distribution of the scotoma in relation to the central point of the field of vision. In binocular vision the healthy nasal pericentral area of one field overlaps the deficient temporal pericentral area of the other, and consequently the binocular field presents a smaller scotoma than either monocular field.

With regard to the variation in visual acuity in different degrees of illumination, this seems to be more manifest during the earlier stages than later when the vision is very seriously impaired. Thus a patient

who has only 6/18 of normal vision in bright sunlight may later on in the same day manage 6/12 or even 6/9, whereas the patient with 6/60 in bright light, when tested in a dim light will usually say that the large letter is much clearer and blacker then formerly, but it is not often that he will be able to make out any smaller letters. The difficulty in bright light is described by the sufferers as being caused by a dazzling before the eyes, and is specially manifest when bright metals are looked at. The difficulty in distinguishing between gold and silver coins, or between silver and copper, is the commonest manifestation of this phenomenon, but tradesmen who have to deal with bright metals may be peculiarly sensible of it. Thus a plumber complained that when engaged in soldering joints in pipes, he had the greatest difficulty in making out the margin of the solder, owing to the manner in which both pipe and solder glittered. Berry[11] and De Schweinitz[12] both refer to the glittering or dazzling in bright light as being most probably due to hyperaesthesia of the retina.[13] In this connection it is interesting to note results of examination of the light sense. Wallace Hendry[14] in a series of cases of tobacco amblyopia found in all, that the light minimum in the central portion of the field of vision, was normal. As a result of his observations he concludes that all cases in which the light perception

is reduced to 4 or under (the figures represent the number of opaque discs through which light can be seen, 5.24 being normal) are not toxic in origin. The results of the writer's observations undertaken with a Wallace Hendry photometer are essentially similar to the above. Owing, presumably to a difference in illumination (a one candle power electric incandescent lamp was used) the normal L.M. was found to be 3. In every case of supposed tobacco amblyopia in which the L.M. was below 3, there was found unequivocal evidence either of a renal or a nervous lesion. These results afford evidence in favour of retinal hyperaesthesia being the cause of the relatively greater visual embarrassment in bright light, rather than the explanation as mentioned by Fick,[15] that the improved vision in dull light is due to the dilatation of the pupil allowing of the use of more peripheral parts of the retina.

We have seen in our typical case an oval shaped central scotoma for red and green, i.e., an area in which red and green are not recognised, extending less than 10° to the nasal and 20° to the temporal sides of the central point of the field of vision. Such an extensive central visual defect is only to be found in advanced and well marked cases. In the earlier stages, and during recovery, there are present scotomata so limited in area, that they are not detected by means of the

ordinary 10 m.m. test object at the usual perimeter distance. It is necessary then to have some form of "Scotometer," by which not only may any primary colour be shown, but in which the area of colour shown may be varied from 10 m.m. to 1 m.m. in diameter. Such an instrument is easily devised. When used always at the same distance from the eye, say 12", it affords a means of comparative measurement of small scotomata. Its more frequent use, however, is in the routine examination of eyes to detect the mere presence of colour defects. The method of procedure is to present to one eye, at a time, each of the colours white, blue, red, and green, through a 10 m.m. aperture. Failure to recognise red and green suggests a central scotoma for these colours. If the defect be only central then on moving the scotometer rapidly from side to side so that accurate constant fixation is impossible, rays from the coloured area will fall on peripheral parts of the retina, and the patient will be conscious of "glimpses" of red or green as the case may be. Confirmation may be obtained by directing the patient to fix the eye on a finger of the observer's one hand, while with the other the scotometer is held close to, but not quite in the patient's line of vision. It will be found that in such a position, red and green are readily recognised but as soon as the scotometer is brought right into the

line of vision the colours disappear. It will sometimes be found, however, that while red and green are promptly recognised even when in the direct line of vision, they are described as being "less distinct" or "darker in shade" than when perceived by peripheral parts of the retina. Reduction of the size of the scotometer aperture will usually reveal in such cases the presence of a small scotoma. When the preliminary examination of a case yields evidence indicative of a central visual defect, it cannot be said that there is no central colour scotoma present, unless each colour has been recognised through an aperture of 2 m.m. or at most 3 m.m. diameter, at a distance of 12" from the eye. The results of examination may be conveniently registered by the use of initial letters, thus:-

S (scotometer) R:- r = 4, g = 3, b = 2, w = 2,
L:- r = 5, g = 3, b = 2, w = 2,

r, g, b, and w meaning red, green, blue and white respectively, and the numbers indicating the smallest aperture through which each colour is recognised.

In making such examinations, one cannot but be struck with the marked tendency which there is in some cases to variation in results. This seems to depend on "fatigue" of the central area of the retina. Thus in one case, if to the rested eye red or green was presented through a 2 m.m. aperture it was recognised, but only

for a moment, after which the colour disappeared. If now the eye was closed for a few seconds, then opened again the colour was recognised for a short time to disappear as before. If instead of resting the eye, the area of colour exposed was gradually enlarged, each added fringe of colour was recognised immediately on its appearing, but only for a fraction of a second, so that the area of blindness for red and green could be gradually extended till it assumed the shape and dimensions of the typical central scotoma. Beyond the border of this scotoma red and green were constantly recognised. Then, if a rest of a few minutes was allowed, red or green was promptly recognised again for a moment, though only 2 m.m. in area.

In another case a similar fatigue phenomenon was manifest, but red and green were never recognised in area less than 10 m.m. diameter. In these two cases the difference between the vision of the rested and the tired eye was extreme, but in a large proportion of cases of tobacco amblyopia there will be found on careful observation minor variations in the size of the colour scotomata, which may be demonstrated to bear a definite relationship to the condition of the eye as regards fatigue. It is probable that this goes far in explaining why the scotoma for any colour in the right eye, rarely comes out identical in shape and size

to that for the same colour, in the left eye: it also accounts for the zone of hesitancy which frequently surrounds a scotoma. The central scotoma, then, may be of minute size, in which case its extent is approximately gauged by means of the scotometer, or it may be so extensive that the colour in question is not recognised even when the largest aperture (10 m.m.) is used. In such a case we proceed to map out the scotoma by means of the perimeter, using 10 m.m. test objects, and the result will be - if the case be typical - an oval shaped area blind to red and green alike, whose long axis is horizontal and which extends less than 10^{o} to the nasal side of the fixation point, and about 20^{o} to the temporal side.

A survey of the charts of our cases, however, reveals what a degree of variation there may be in the characters of the scotomata both as regards form and the extent of the scotoma for each colour involved. Firstly, with regard to form, we recognise a kind of scale of scotomata. Beginning with those which are so small as to be difficult of demonstration, we pass on to those which are obvious, but which can only be measured by means of the scotometer. Then we come to those which can be indicated on the perimeter chart.

EXAMPLES OF SCOTOMATA

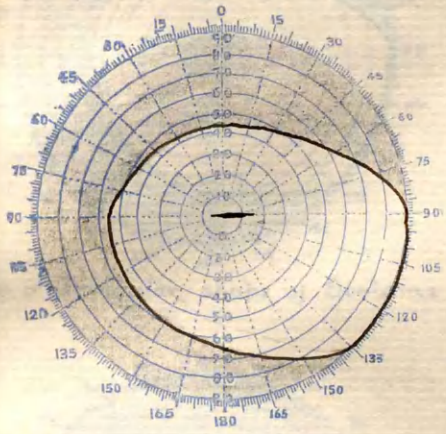


FIG. 2. Scotoma confined to line joining the Central and Blind Spots

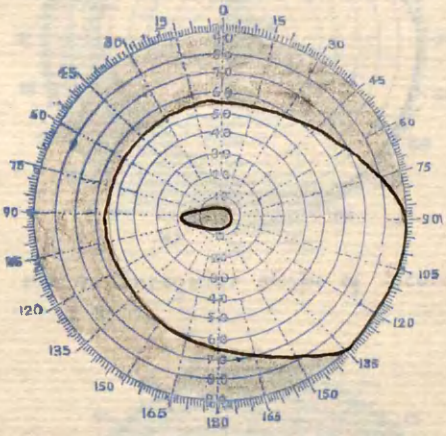


FIG. 3. Scotoma approaching typical size

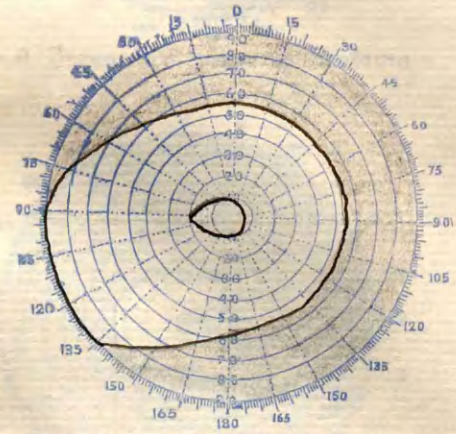


FIG. 4 Typical Scotoma

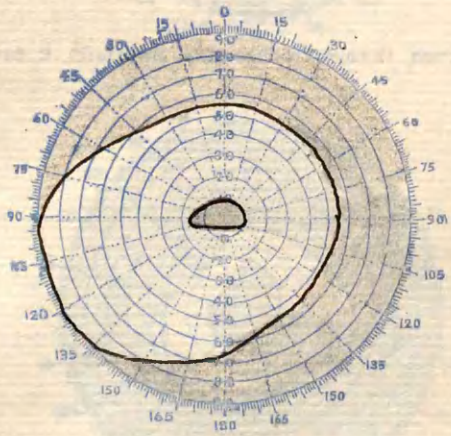


FIG. 5. Irregular shape of Scotoma

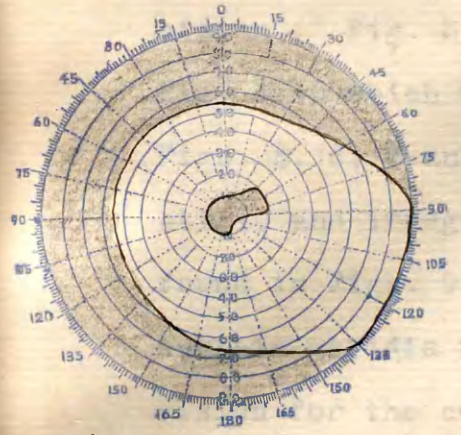


FIG. 6 Irregular shape of Scotoma

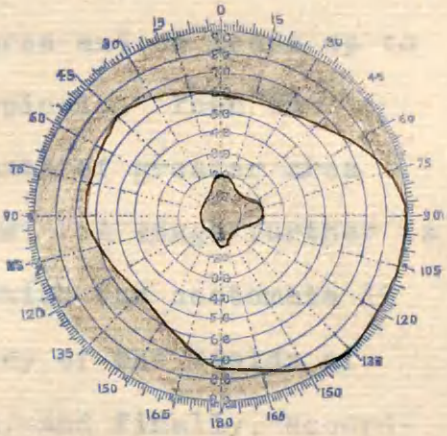


FIG. 7 Irregular shape of Scotoma

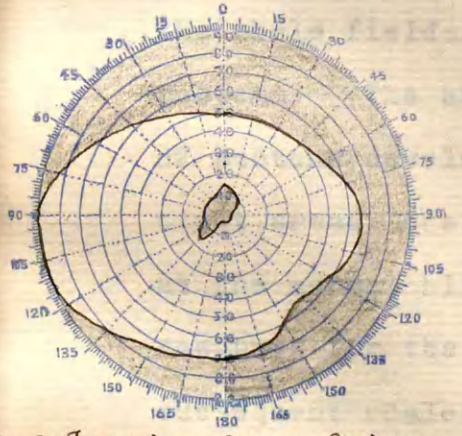


FIG. 8 Irregular shape of Scotoma

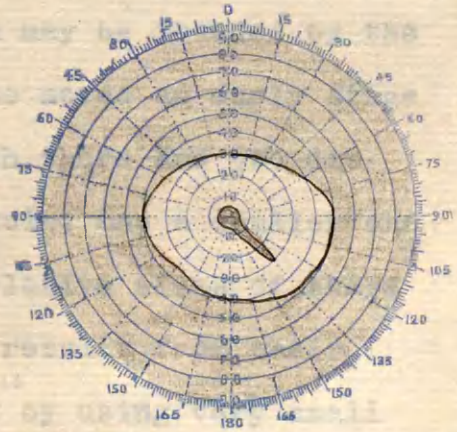


FIG. 9. Scotoma extending towards periphery.

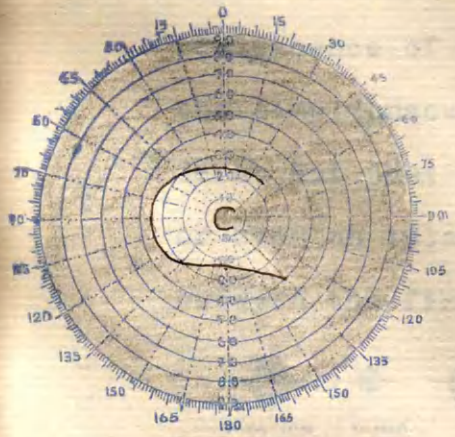


FIG. 10 Scotoma has reached the periphery, i.e. has "broken through"

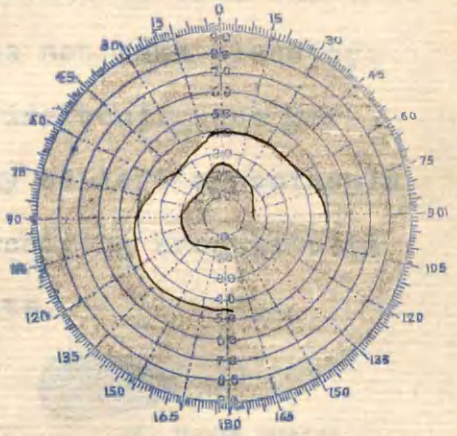
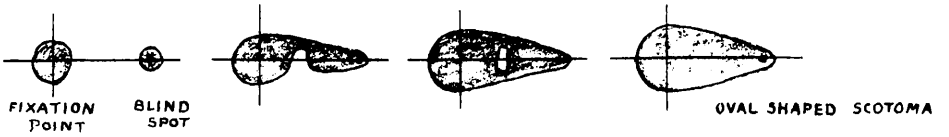


FIG. 11 Another example of breaking through.

In Fig. 2 the scotoma exists only along the line joining the central and blind spots of the field of vision. Fig. 3 shows a larger area and so leads up to Fig. 4, in which the scotoma is typical. Then in Figs. 5, 6, 7 and 8 we see scotomata of greater area still, and irregularity of outline. A stage further is found in Figs. 9, 10 and 11, in which the scotomata in certain meridia reach the periphery of the fields of vision for the colour in question, and finally, according to De Schweinitz, there are occasional cases in which the whole fields for red and green may be invaded by the scotoma. The same author has also noted an early stage of scotoma development during which there are two distinct areae, one at the fixation point and a smaller one at the normal blind spot. The relative sizes of these accounts for the oval shape which results from their subsequent coalescence. Wilbrand[16] by using very small test objects (2 - 5 m.m.) has demonstrated that the coalescence of these two areae does not take place by the simultaneous fusion of the entire contiguous borders, but that for a time there may be left a peninsula or even an island of red green perceiving area situate between the fixation and blind spots.



Secondly, with regard to the different sizes of the

scotomata for different colours in the same case, due allowance must be made not only for the influence of "fatigue" but also for the part played by the intelligence of the patient in tests which require on his part varying degrees of acuteness of observation. Red as a distinct colour is familiar to, and is unhesitatingly named by, persons of very low intellectual power and with little or no training in colour observation. Green, on the other hand, however readily it may be "matched" by all persons who are not colour blind, is when seen alone often "called" blue or at most "greenish blue." Hence at the outset of a test, it is necessary to find out in how far the patient is capable of correctly "naming" what he "recognises," otherwise the result as far as green is concerned may be entirely fallacious. It is noteworthy how easily blue is recognised and how unhesitatingly it is named by even the most advanced cases of tobacco amblyopia, and we have already seen the importance of this in considering the history of the symptoms as related by the patient.

To what extent then does the study of our cases justify us in saying that the scotoma for red may differ in size from that for green? It may be seen that in the majority of the cases, the scotomata for red and green are not identical in size, but, in view of what has been said concerning sources of fallacy, it is well

to disregard differences of a few m.m., and when this is done we are left with the following cases:-

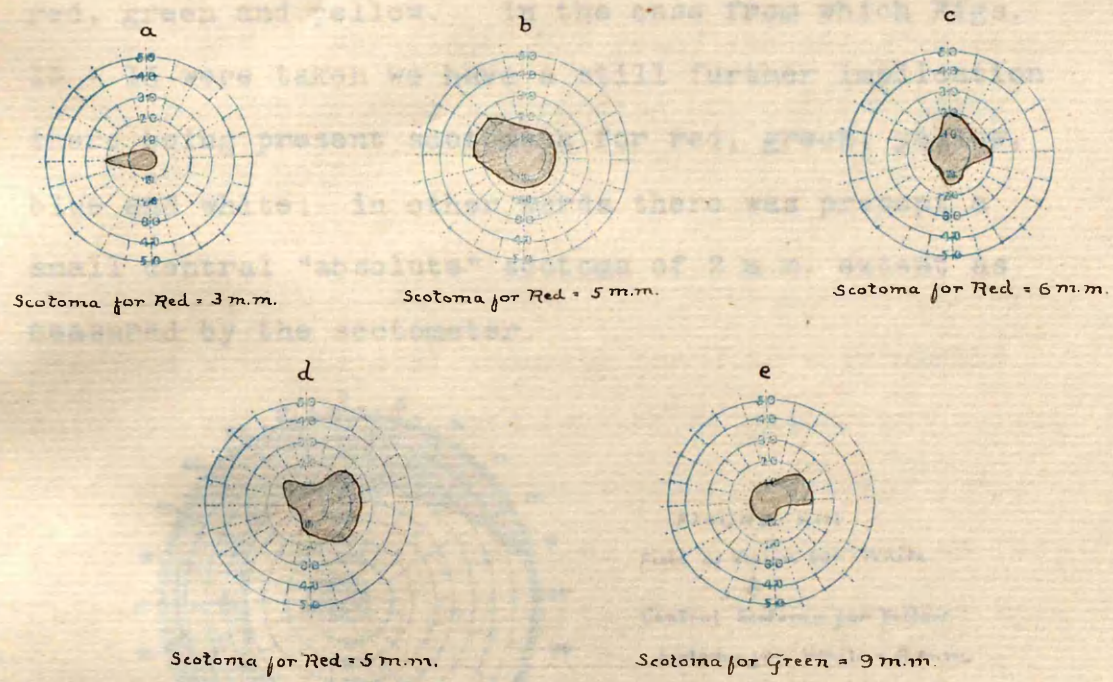


FIGURE XII

a.b.c.&d are scotomata for Green. e. is a scotoma for Red.

In these the differences are very considerable, and it may be here stated that in each case the results were confirmed by repeated observations. It will be noticed that in only one case (the last) was the scotoma for green the smaller of the two, and this case was otherwise remarkable in that there was present a "fatigue scotoma" for white.

So far we have considered only red and green, and it is true that in most cases of tobacco amblyopia it is only these two colours which are demonstrably affected,

but in rare instances we do get other colours affected. In one case there was a central oval shaped scotoma for red, green and yellow. In the case from which Figs. 13 - 16 were taken we have a still further implication there being present scotomata for red, green, yellow, blue and white; in other words there was present a small central "absolute" scotoma of 2 m.m. extent as measured by the scotometer.

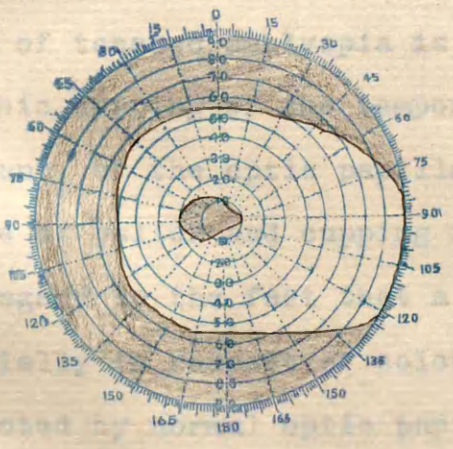
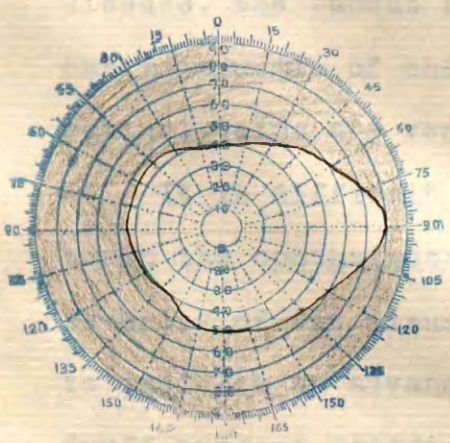


FIGURE XIII
Field of Vision for White
&
Central Scotoma for Yellow
Scotoma for White = 6 m.m.

FIG. XIV

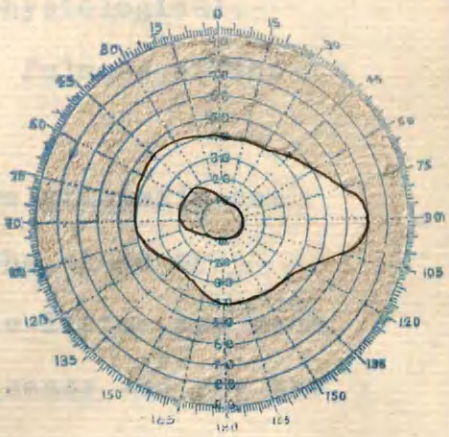


Field of Vision for Blue
Scotoma = 2 m.m.

FIG. XV

Field of Vision and
Central Scotoma
for Green.

FIG. XVI



Field of Vision and Central
Scotoma for Red.

Groenouw[17] refers to the occasional occurrence of "small islands of absolute defect" within the colour scotoma, and de Schweinitz has found the colour scotoma taking a circular form surrounding but not involving the fixation point.

OPHTHALMOSCOPIC EXAMINATION. The ophthalmoscopic appearance which is most commonly found in well marked cases of tobacco amblyopia is that of pallor and slight atrophic cupping of the temporal half, or lower temporal quadrant, of the optic papilla. But, inasmuch as the degree of pallor and cupping is very variable, and having regard to the fact that a similar appearance - especially in respect of colour - is not infrequently presented by normal optic papillae, such evidence must be held as of little diagnostic value, however important it may be pathologically. In the earlier stages of the disease, the fundus appearance may be physiological, but hyperaemia of the disc and distinct fulness of the retinal veins are very often manifest.

It is difficult to establish any relationship between the ophthalmoscopic picture and the stage or severity of the visual symptoms, for the latter may seem to indicate an advanced stage of the disease and yet the fundi present practically normal appearances or at most those of slight hyperaemia. Similarly, though not so

frequently, the disc appearance may suggest a prolonged history, yet the symptoms be found to be slight in degree and short of duration.

Goldzieher states that there is always to be found a zone of indistinct and irregular pigmentation on the temporal margin of the disc. The writer has been unable to confirm this observation.

PATHOLOGY

As there is yet no record of the histological examination of the eyes of a person who has died while suffering from tobacco amblyopia pure and simple the pathological anatomy can only be surmised, or deduced from analogy, and, as may consequently be expected, it has been the subject of much controversy.

Under the heading of "toxic amblyopias" there are described visual disturbances which are caused by certain substances acting as poisons, and in a proportion of these, the deterioration in sight is manifest as a central colour and form scotoma, i.e., the condition is that of central amblyopia.

Now, there have been recorded by Samelsohn,[18] Nettleship and Edmunds,[19] Vossius,[20] Bunge[21] and Uhthoff,[22] necropsies of cases in which central amblyopia had been present, and in all of these there was found an interstitial inflammation involving the papillo macular bundle of the optic nerve.

From this evidence most authorities conclude that those poisons which cause central amblyopia do so by setting up such an inflammation of the optic nerve, an axial, or retrobulbar neuritis.

Prominent among those who reject this conclusion is Berry,[23] who holds that inasmuch as none of the cases examined were pure toxic amblyopes, they do not prove retrobulbar neurites to be the pathology of toxic amblyopia.

Johann Deyl[24] again talks of acute and chronic retrobulbar neuritis, and subdivides the chronic form into retrobulbar neuritis proper and intoxication amblyopia. As examples of the former he mentions the central amblyopia which occurs in lead, and sulphonal poisoning, and in diabetes, and seems to confine the term toxic amblyopia to that caused by tobacco and alcohol. De Schweinitz on the other hand includes under the heading of toxic amblyopia all cases in which a poison has been introduced from without, and differentiates them from those of non-toxic retrobulbar neuritis. Mention may

here be made of two theories to the effect that the site of the lesion in toxic amblyopia is in the brain cortex,[25] and retina,[26] respectively. The former theory seems incompatible with the invariably bilateral distribution of the affection, and the latter sets at naught the results of Foester's experiments which proved the phenomenon of increased visual acuity in dull light to be due to disease of the light conducting fibres.

It is proposed in this thesis to consider tobacco amblyopia in relation to central amblyopia from other causes, so it will be well here to enumerate these, excluding those due to obvious structural changes in the macular region.

I Non-toxic Retrobulbar Neuritis. This usually follows a chill and is often associated with the rheumatic diathysis. It may be unilateral. The scotoma tends to the circular rather than the oval shape and may involve not only red and green, but blue and white also, and indeed is sometimes absolute. The fields of vision for all colours are liable to peripheral contraction.

II Central Amblyopia occurring as a complication of diabetes mellitus. Clinically this form is indistinguishable from tobacco amblyopia.

III Central Amblyopia in Lead Poisoning. This is uncommon and is usually preceded by general saturnine symptoms.

IV Central Amblyopia in Carbon Disulphide Poisoning. This also is usually preceded by general symptoms of poisoning. The scotoma is irregular and may be absolute.

V Central Amblyopia in Iodoform Poisoning. This can only be differentiated from tobacco amblyopia by consideration of the history.

VI Central Amblyopia associated with spinal cord disease, also known as progressive scotomatous atrophy.[27] In its early stage it is identical with the tobacco form but soon atrophic symptoms are manifested at the peripheries of the fields of vision and blindness rapidly ensues.

VII Stationary Scotomatous Optic Atrophy. Occurs usually between the ages of twenty and twenty-five, and is sometimes hereditary. A central scotoma appears which is at first relative but soon becomes absolute and there the disease remains stationary, the peripheral parts of the fields of vision remaining normal.

With regard to the last two conditions, progressive and stationary scotomatous atrophy, they are clearly differentiated clinically from the others, and their inevitably atrophic course warrants us in regarding them as essentially different, the pathological process being probably a primary atrophy.

That central amblyopia may occur as a complication in diabetes has long been recognised,[28] but owing to the fact that in most of the cases reported the patients were smokers, the amblyopia was regarded as toxic in origin, and the diabetic condition looked upon as a predisposing cause rendering the patient more vulnerable to the action of tobacco.

Recent evidence, however, particularly that of Schmidt-Rimpler,[29] is in the direction of proving that it

is the diabetes which is the cause and that the indulgence in tobacco is accidental and not causal.[30]

Nettleship and Edmunds,[31] Edmunds and Lawford,[32] Fraser and Bruce,[33] and Schmidt-Rimpler have all published the results of pathological examinations and shown the lesion in diabetic central amblyopia to be a central axial neuritis. Nor is it matter for surprise that optic neuritis should occasionally manifest itself as a feature of diabetes when it is remembered that symmetrical neuralgias of the inferior dental[34] and great sciatic nerves[35] have been noted, neuralgias, moreover, which did not yield to ordinary remedies but improved only when the glycosuria diminished. More recent observations have revealed the not infrequent accompaniment of peripheral neurites and diabetes, and as an example there may be quoted a case described by J. W. Findlay[36] in which there was found parenchymatous and interstitial neuritis involving the vagus, sympathetic, and anterior crural nerves.

Let us turn now to tobacco amblyopia. We have already noted its frequent association with sleeplessness and dyspepsia, or as Berry[37] puts it, the patient has frequently suffered from something which has acted as a drain on the system.

Now, bearing in mind that the same clinical picture of central amblyopia is common to diabetes - in which a

derangement of body metabolism is evident, - to lead poisoning - the diversity of whose manifestations points to a systemic poisoning, - and to tobacco amblyopia, the query suggests itself, are there to be found in tobacco poisoning any objective indications of functional abnormality apart from those connected with sight? Are we to be content with the simple truth that central amblyopia may be caused by the prolonged habitual use of tobacco, as it may be by diabetes or lead poisoning, or can we adduce any evidence to show that the toxic effect of tobacco is probably primarily a more general one and the influence on the optic nerve secondary?

Bouchard[38] has shown the importance of determining physiologically rather than chemically the nature of the body excreta, and he has demonstrated how by the physiological estimation of the toxicity of the urine an estimate can be made of the toxicity of the blood. Thus he has shown that the urine of an albuminuric patient is normally toxic, but that in uraemia the urine is non-toxic, that is to say, in uraemia the poisons which are normally excreted by the kidneys are held up in the circulation, hence the uraemic symptoms.

Now in chronic tobacco poisoning is it not possible that by investigation of the urine, we may find some significant disturbance of the emunctory action of the kidneys?

With this end in view the writer undertook a series of experiments, and, in order that the description of each experiment may be as brief as possible, a few remarks, applicable to all, may here be made.

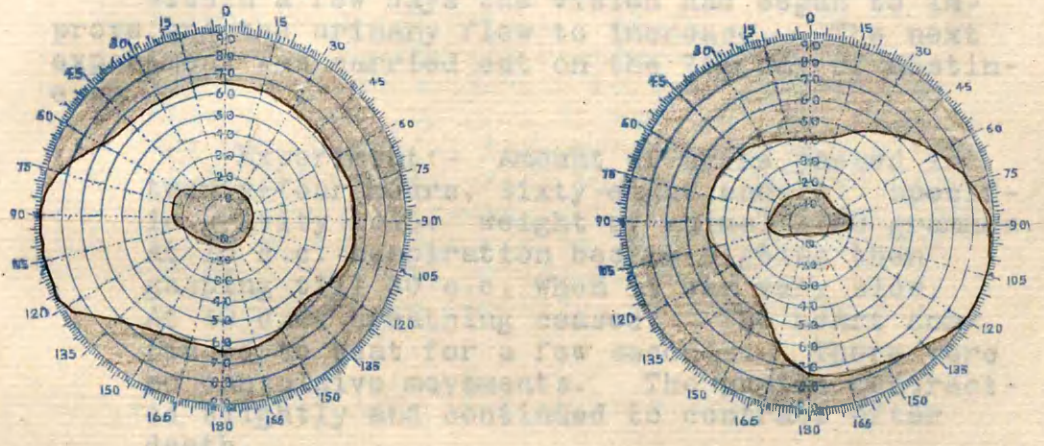
The urine used was always from a twenty-four hours' collection, and before use it was neutralised by bicarbonate of soda, then filtered. This neutralisation was done to secure uniformity of results for comparison, but, as Bouchard has shown, the reaction of urine does not materially affect its toxicity. The filtered urine was placed in a burette connected by rubber tubing with a large sized hypodermic needle. This needle was introduced into the large vein on the back of a rabbit's ear, and the urine allowed to flow in. Note was made of the amount of fluid required to cause death, and, the weight of the animal having been previously ascertained, the fatal dose per kilogramme of animal calculated.

Bouchard's statement may here be quoted that distilled water may be intravenously injected into rabbits up to 90 c.c. per kilo. of animal, with impunity, and that it requires 122 c.c. per kilo. to cause death.

The first case chosen for investigation was one of pure tobacco amblyopia of a considerable duration.

CASE I R. R., aet. fifty, draper, was admitted to hospital, May, 8th, 1900, with a history of dimness of vision most marked in bright light, of fourteen months' duration. At the time of onset

he was smoking an ounce of thick black tobacco per day and had done so for about twenty-five years. Suspecting this to be the cause of his visual trouble he reduced his consumption to two ounces per week. A slight improvement ensued and lasted for a month or two, when he became involved in financial difficulties, got badly out of sorts, and his sight steadily deteriorated. He had been a total abstainer from alcohol all his life with the exception of a period of three months some years before.



Central Scotoma for Green

$V^{R.\frac{3}{60}+J19}_{L.\frac{3}{60}+J19}$ $S^{R.P.S}_{L.P.S}$

FIG. 17

Ophthalmoscopic examination revealed a typical temporal pallor of both discs. One day was allowed to elapse after admission and then the urine for the second twenty-four hours was collected.

Experiment:- Amount of urine passed in twenty-four hours, fifty-six ounces: specific gravity 1010: weight of animal 1530 grammes.

The injection was practically without incident, till 170 c.c. had been introduced when slight muscular jerks were noticed. At 252 c.c. a violent convulsion ensued terminating in death. The pupil varied only very slightly and the conjunctival reflex remained active till the last.

Fatal dose per kilogramme of animal 168 c.c.

The patient now stopped smoking absolutely and

began to take the following diuretic alkaline mixture:-

℞

Potassi Citratis ℥v
Potassi Acetatis gr. cLx
Caffeinae Citratis gr. xLviii
Glycerini Purissimi ℥iii
Aquae Destillatae ad ℥viii

Sig:- A tablespoonful in water three times a day

Within a few days the vision had begun to improve and the urinary flow to increase. The next experiment was carried out on the 7th day of abstinence.

Experiment:- Amount of urine passed in twenty-four hours, sixty-eight ounces: specific gravity 1015: weight of animal 1700 grammes. At 10 c.c. respiration became sighing then gasping till 30 c.c. when it was very slow. At 40 c.c. breathing ceased. The heart continued to beat for a few seconds. There were no convulsive movements. The pupils contracted slightly and continued to contract after death.

Fatal dose per kilo. of animal 23.5 c.c.

The urinary output continued to increase and on the 13th day measured ninety-two ounces for the twenty-four hours and was slightly alkaline. On the 15th day the character of the urine was unchanged, but was only in amount thirty-seven ounces.

Experiment:- Amount of urine in twenty-four hours, thirty-seven ounces: specific gravity 1020: weight of animal 1900 grammes. As soon as injection was commenced the pupil began to contract, and continued so till death when it measured about 3 m.m. in diameter. The animal remained quiet till 15 c.c. when there suddenly supervened a tetanic spasm of the whole body, its inception being accompanied by a loud scream indicating spasm of the respiratory muscles. Respiration was not re-established and for a few seconds the whole body was involved in a rapid muscular tremor which passed off gradually and was last seen in the orbiculares palpebrarum.

Fatal dose per kilo. of animal 7.9 c.c.

The patient's vision was now 6/36 and the scotoma measured only 3 m.m. The diuretic mixture was stopped, and he was sent to the convalescent home. After he had been two weeks there, during which his vision had further improved to 6/18, and his urinary flow from being very copious had gradually subsided to normal, a twenty-four hours specimen was collected.

Experiment:- Amount of urine in twenty-four hours, fifty-two ounces: specific gravity 1018: weight of animal 2350 grammes. Animal remained quiet. At 70 c.c. pupil contracted slightly and remained stationary. Breathing had meanwhile become somewhat laboured. At 120 c.c. it was slow and gasping, and after that it became progressively slower till just before death when it numbered only 12 a minute. Death occurred at 185 c.c. during a violent convulsion which had been preceded by a short period of coma.

Fatal dose per kilo. of animal 74 c.c.

Now, while it is true that we have Bouchard's results from which to fix the normal toxicity of urine, it was deemed advisable to perform check experiments in which the circumstances were as nearly as possible identical both as regards technique and the conditions under which the patient was placed.

A healthy young man, a moderate smoker, was chosen who was recovering from a traumatic affection of one eye. He had been confined to bed for about a week during which time he had a nightly pill containing calomel gr. ii. and opium gr. i. He was still kept in bed and his urine collected. Except for the administration of the calomel and opium, his circumstances were the same as those of the toxic case before treatment was begun.

Experiment while he was still taking the calomel and opium but before he had commenced taking the alkaline mixture:-

Amount of urine in twenty-four hours, forty ounces: specific gravity 1028: weight of animal 1350 grammes. Injection without incident till 44 c.c. when there occurred a violent convulsion with vomiting, swelling of the eyeballs, and myosis. The convulsion passed off, the pupils dilated, and the animal died at 55 c.c.

Fatal dose per kilo. of animal 40.7 c.c.

Experiment after calomel and opium had been stopped and when he had taken the alkaline mixture for four days:-

Urine passed in twenty-four hours, forty-five ounces: specific gravity 1023: weight of animal 1700 grammes. At 63 c.c. there developed a violent general convulsion with opisthotonus, from which animal did not recover. Pupils were contracted and eyeballs swollen.

Fatal dose per kilo. of animal 42.9 c.c.

Experiment after fourteen days' administration of the alkaline mixture and after being three days out of bed:-

Amount of urine in twenty-four hours, forty ounces: specific gravity 1025: weight of animal 1450 grammes. At 46 c.c. convulsive jerks began and these recurred regularly every few seconds till 70 c.c. when a general convulsion, with contracted pupils, brought about death.

Fatal dose per kilo. of animal 48.27 c.c.

During fourteen days then the toxicity of the urine varied from 40.7 c.c. per kilo. of animal to 48.27 c.c. It is possible that the calomel and opium may have been responsible for the greater initial toxicity, but this influence could not last more than a day or two. We are then left with the important fact that coincident with the administration of the alkaline mixture the

toxicity fell, showing that as a direct source of poison in the urine it may be disregarded.

Bouchard described an experiment with a twenty-four hours' specimen of normal urine in which he found the toxicity to be 46.94 c.c. per kilo. and he refers to the toxicity of normal urine as varying between 30 and 60 c.c. with an average of 45 c.c. per kilo. of animal.

Now, in the light of these normal standards let us look at the results got from the toxic amblyope.

First, we take his urine while he is still smoking and before treatment is begun. We find its toxicity to be 168 c.c. per kilo. That is to say, it has no more effect than distilled water would have. The amount of urine passed in the twenty-four hours was only fifty-six ounces so we cannot refer this innocuousness to mere dilution. We are led to the conclusion that this apparently healthy man's kidneys are not removing certain poisonous substances which experiments have shown they do remove normally. The patient stops his smoking and begins to take a diuretic mixture. In a day or so his urine begins to increase in amount. On the 7th day of this treatment we again test the urine. There are now required only 23.5 c.c. per kilo. of animal to produce death, and yet the amount of urine passed in the twenty-four hours was sixty-eight ounces, compared with fifty-six in the first experiment. There is evidently going

on a very active discharge of poisonous material.

Eight days later we find the toxicity as high as 7.9 c.c. Up till now diuresis has been free so that patient has had to rise frequently at nights, but on this particular day, probably for some dietetic reason, the urinary output measures only thirty-seven ounces. Even allowing for this degree of concentration the toxicity is much greater than normal.

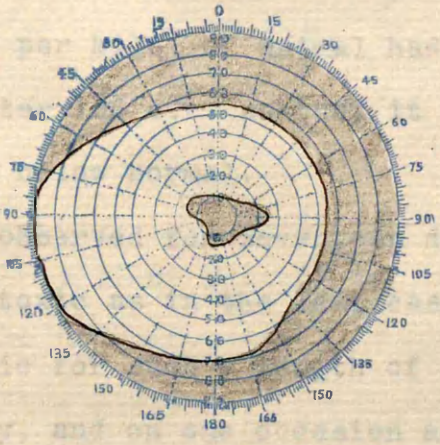
During these fifteen days patient was not subjected to the influence of tobacco, he was taking medicine which our experiments have shown to be innocuous as eliminated by the kidneys, his kidneys were ridding the circulation of a large amount of poisonous material and meanwhile his visual condition improved markedly. The medicine is now stopped, and he is sent to the convalescent home, where he still maintains his abstinence. While there he notices his urine gradually returns to a normal amount. At the end of twenty-four days his urine measures fifty-two ounces in the twenty-four hours, and its toxicity is now 74 c.c. per kilo. of animal, rather less than normal. He feels much benefited and his vision is 6/18.

It should be stated that the urine was repeatedly subjected to the ordinary tests for albumen and sugar, but neither abnormality was ever found present.

Such results were ample warrant for further inves-

tigation on the same lines.

CASE II T. V., a puddler, aet. forty-six,, was admitted September 25th, 1900, with a history of dimness of vision of about seven months' duration. He had been a heavy smoker since boyhood, averaging for some years a consumption of one ounce of black tobacco per day. About six years ago he found that smoking at this rate made him frequently sick, so he reduced his average to a half ounce per day. His indulgence in alcohol had been habitually free.



Central Scotoma for Green

$V^{R} = \frac{3}{60} \times J_{20}$ $S^{R.}\ T=5$
$V^{L} = \frac{3}{60} \times J_{20}$ $S^{L.}\ T=5$

FIG. 18

Central colour vision was markedly subject to fatigue variation. In each eye there was a constant scotoma for red and green of at least 5 m.m. diameter, capable of great extension. In the left eye the scotoma for green, as shown in the chart, was constant.

Ophthalmoscopic appearances practically normal except for slight general pallor.

In this case again the urine was tested before treatment was begun, and its toxicity was found to be 83 c.c. per kilo. of animal, decidedly below normal.

After seven days' treatment, during which the urinary flow was distinctly increasing, another experiment was performed. The toxicity was 48.5 c.c. per kilo., showing that the kidneys were now excreting toxins at a

normal rate.

On the 16th and 17th days of treatment tests were attempted, but on each occasion the injection needle was dislodged by a convulsive jerk of the animal, before death was produced, and an unfortunate lack of material prevented further investigation. In the former experiment, however, 45.6 c.c. per kilo. of animal had been injected, and in the latter 106 c.c. so that it was certain the toxicity was below normal.

In this case then, observed for seventeen days, the urine neither became so toxic as in the last case, nor did it remain highly toxic for such a length of time. It was examined regularly, and on one occasion a very faint haze of albumen was found, but as there was no other evidence of organic renal disease this was regarded as functional in origin.

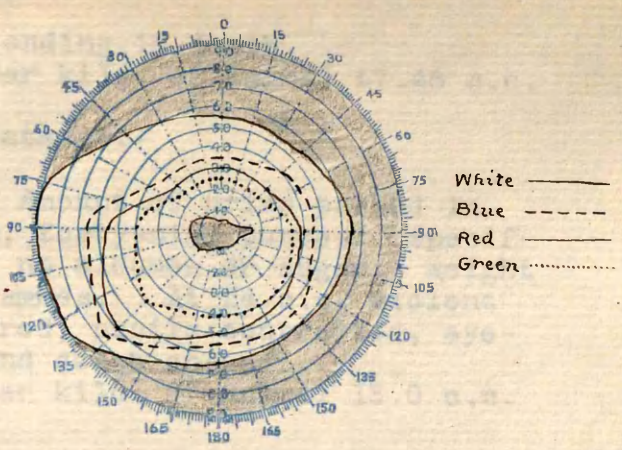
The vision meanwhile improved from 3/60 and J16 to 6/36 and J10, and the scotoma measured only 2 m.m.

Cases I and II were both of considerable duration, and an opportunity was now sought of observing a case of shorter duration and which therefore might be considered not to have attained its maximum severity.

CASE III C. B., weigher, aet. 48, was admitted November 15th, 1901, having noticed a dimness rapidly coming over his sight for a month prior to admission. He had smoked regularly since the age of twenty-six, and his average was five ounces of

"Golden Bar" per week. Indulgence in alcohol had been regular and free.

Ophthalmoscopically both discs were found to present well marked pallor and shelving of the temporal quadrants.



Central Scotoma for Red & Green

$V \begin{matrix} R = \text{‰} \\ L = \text{‰} \end{matrix}$ c Sph. +2 D $\begin{matrix} = J12 \\ = J12 \end{matrix}$

FIG. 19

This case had been an outdoor patient for a few days before admission; he had reduced his smoking and had been taking the alkaline mixture. On admission he stopped smoking entirely.

On the 8th day of treatment:-

Experiment: Amount of urine passed in twenty-four hours, forty ounces: specific gravity 1028: no albumen or sugar: weight of animal 2557 grammes. At 18 c.c. breathing became rapid and noisy. At 40 c.c. there was a sudden convulsive movement followed by four others at intervals of a few seconds each. Breathing ceased immediately after the last. Pupils remained of average size, but eyeballs swelled.

Fatal dose per kilo. of animal 15.64 c.c.

After eleven days treatment:-

Experiment: Amount of urine passed in twenty-four hours, fifty-three ounces: specific gravity 1020: no albumen or sugar: weight of animal 2557 grammes. Injection without incident except for slight oscillation in respiratory rate and contraction of the pupils, till 147 c.c. when violent convulsive

movements ensued ending in death.
Fatal dose per kilo. of animal 57.48 c.c.

On the 16th day of treatment:-

Experiment: Amount of urine passed in twenty-four hours, forty-nine ounces: specific gravity 1022: no albumen or sugar: weight of animal 1850 grammes. At 24 c.c. violent convulsions occurred, pupils contracted, eyeballs distended and death ensued.
Fatal dose per kilo. of animal 13.0 c.c.

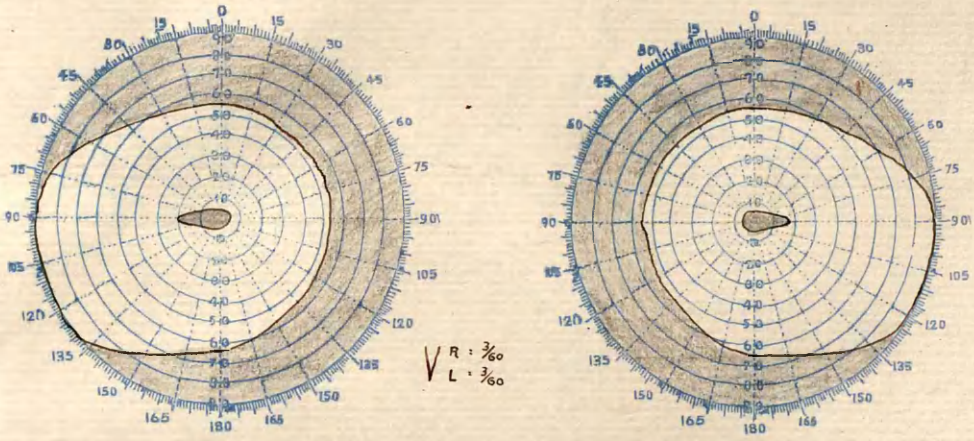
In this case again we find under treatment a very highly toxic urine coincident with marked visual improvement. At the time of the last experiment vision had risen to 6/12 and J4, and the scotoma extended only 10^{o} to the temporal side of the fixation point. In two months' time from the beginning of treatment, vision was in all respects normal.

It may fairly be claimed that these experiments go to show that when the toxic amblyope stops smoking his kidneys at once become very active in the removal of toxic substances from the circulation. Further, the initial experiments in cases I and II indicate that while he continues smoking the normal purification of the blood by the kidneys is not fully carried out. In the case of the moderate smoker who had no symptoms of poisoning the toxicity of the urine was normal. Hence we are led to think that when a smoker becomes the subject of amblyopia his kidneys have become inadequate, and that when he stops smoking the kidneys become very active and the amblyopia gradually disappears, and last-

ly, after a period of this unusual renal activity, the toxicity of the urine falls again. But while there would seem to be little doubt as to an interrelationship between amblyopia and renal inadequacy in chronic tobacco poisoning, it becomes a more speculative matter when we attempt to adjudge as to cause and effect. Have we anything of the nature of an analogy to offer? Reference has already been made to Bouchard's experiments in connection with albuminuria and uraèmia. He found the albuminous urine to be adequate in the matter of removal of toxines, but the onset of uraemic symptoms was at once marked by the disappearance of toxines from the urine, and correspondingly recovery from uraemia was indicated in the urine by a high toxicity. May we not say that the heavy smoker subjects himself to the noxious influence of tobacco, with impunity, so long as his kidney activity is adequate, but that if from age, or from any debilitating cause, or from an extra strain being thrown on the kidneys, they have more work to do than they can cope with, then he becomes liable to amblyopia?

Of course it is not claimed that the results of our experiments prove such a theory to be correct, but they are very strongly suggestive of its feasibility, and it is proposed now to bring forward clinical evidence tending in the same direction.

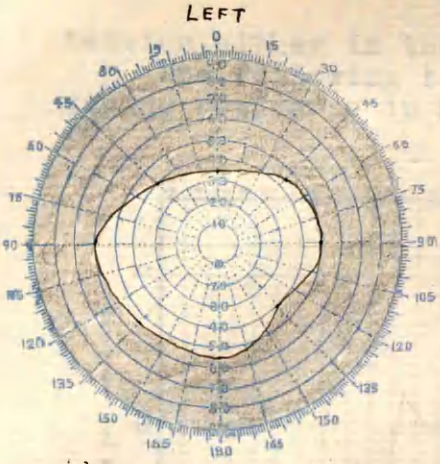
D. W., a painter, aged 59, came to the dispensary on December 8th, 1899 complaining of dimness of vision, worst in bright light, of six months' duration.



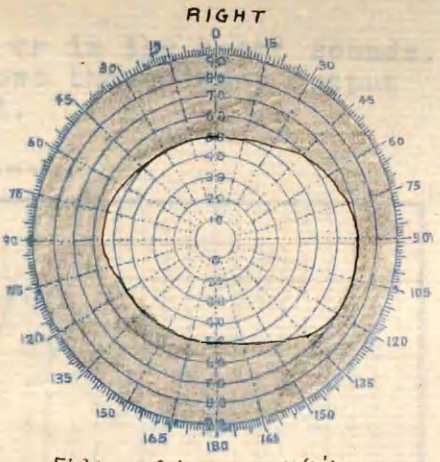
Scotoma for Red & Green

FIG. 20

As he had been a heavy smoker since eighteen years of age and there was typical temporal pallor of both optic discs, his case was diagnosed one of tobacco amblyopia and he was treated accordingly. He attended regularly for a month, by the end of which time his vision had improved to 6/36, then he left off coming, but the improvement continued and he made a good recovery. He had reduced his smoking to one ounce per week. He continued well till eleven months from the time of his first seeking advice, when he contracted a chill while working outside, as a result of which he was confined to bed for a fortnight with a very severe cold. When he got about again he found that his sight was very defective. He returned to the dispensary and the following charts show his visual condition.



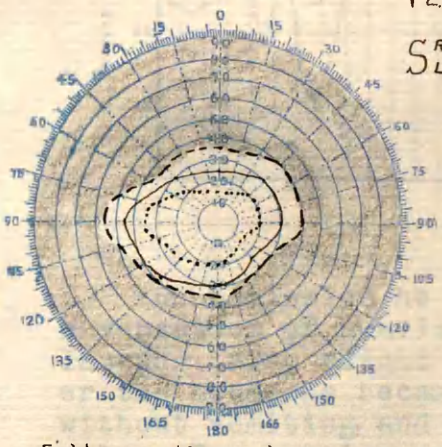
Field of Vision for White



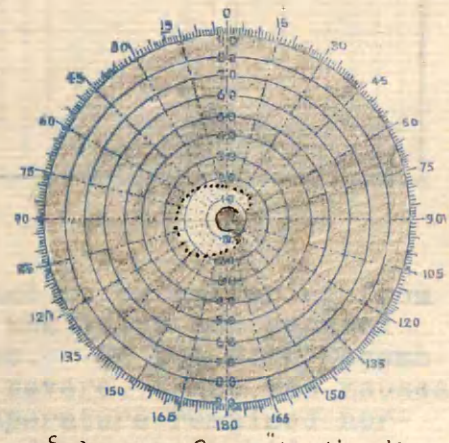
Field of Vision for White

V R. - 6/24 - J10.
L. - 6/24 - J10.

S R.r.-4
L.r.-4. g.-r



Fields for blue, red, & green



Scotoma for Green "breaking through"

FIGURE 21

The perimetric results were noted as being markedly subject to fatigue variations.

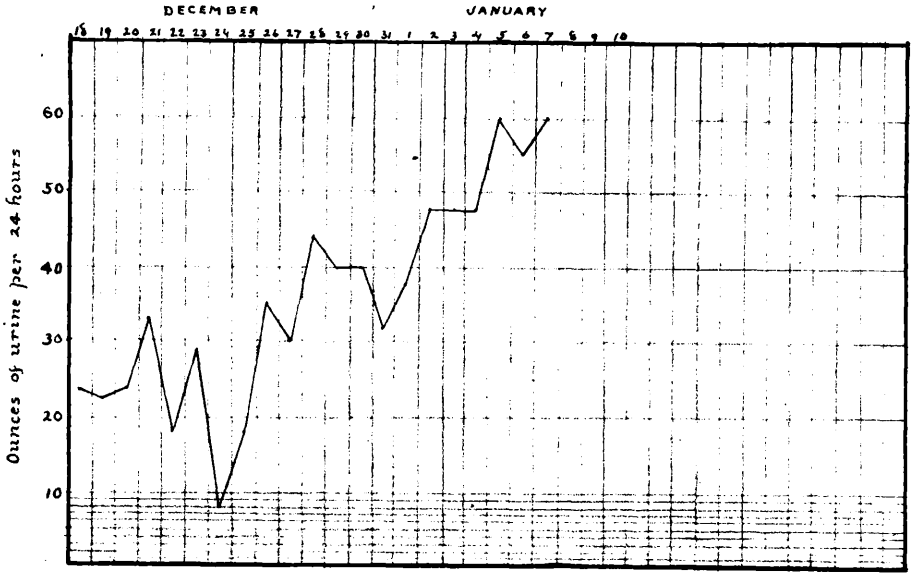
Careful enquiry into the previous history of the patient was made, and it was found that eighteen years previously he had had a bad attack of lead poisoning, with discolouration of the gums, weakness of the limbs, and colic. Further, three years previously, he sought medical advice on account of passing less urine than usual. His urine was tested, and he was told that there was something wrong with his kidneys. Under treatment he made a good recovery.

As he stated that he did not think he was passing enough water, and as his vision was not improving, he was admitted as an indoor patient.

His general appearance was suggestive of chronic renal disease, but no albumen was found in the urine, nor was there evidence of high arterial

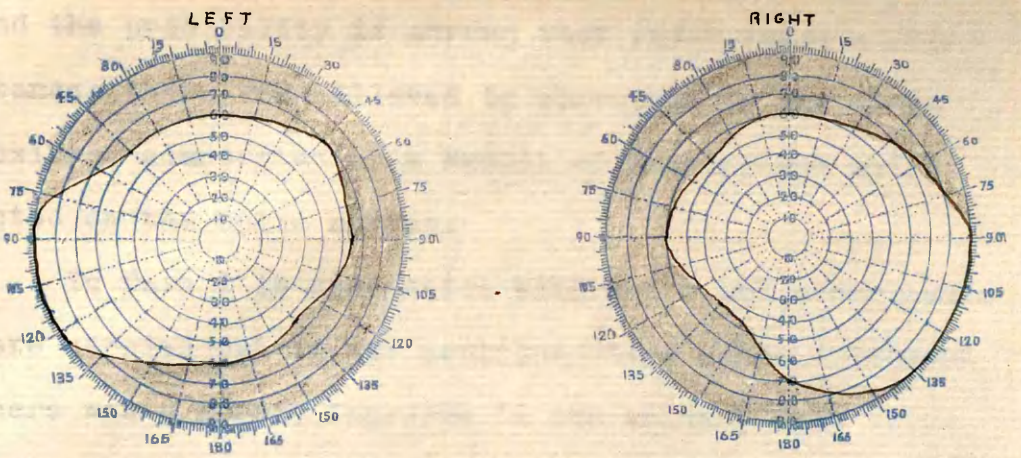
tension, either in the pulse or in the heart sounds.

The following table shows the urinary output during residence in hospital.



On admission he was found to be suffering from a sensation of heaviness in the loins and general languor, also slight headache. On the 24th December the headache became very severe, there was nausea without vomiting, and the temperature remained normal. Dry cupping was applied over both kidneys, and he was put on a diuretic mixture containing Spt. Aetheris. Nitros: Tinct. Ferri. Perchlor: and Liq. Ammon. Acetatis. The effect on the kidneys can be seen from the chart, and the uraemic symptoms were speedily dissipated. The urine became pale in colour, of low specific gravity, and only on one occasion was a faint haze of albumen discovered.

Up to the date of the cupping the visual condition got steadily worse, reaching 6/60, but as soon as the renal function became re-established improvement began. It was not at first discoverable by the test types, but by January the 2nd the peripheral parts of the fields of vision were normal, and the scotomata exceedingly small.



Fields of Vision for White

$V^{R.}_{L.} = \frac{6}{36}$ q J10 . $S^{R.\ r=3.\ g=5}_{L.\ r=2.\ g=4}$

FIG. 22.

On January 8th when he left hospital V = 6/12 and J5 and by January 25th V = 6/9 and J1 with no central scotoma.

It seems pretty certain that in this case there was a chronic renal lesion, probably owing its origin to the attack of lead poisoning eighteen years before. Are we to consider it then as a case of tobacco amblyopia complicating chronic Bright's disease, or are we to call it retrobulbar neuritis of uraemic origin? In favour of the tobacco causation we have the curative influence of abstinence on the previous attack, the fact that the ocular symptoms were practically identical on both occasions, and the history of smoking during the interval, though to a modified extent. It must at least be admitted that the cause of the central amblyopia was intimately associated with the obvious renal inadequacy,

and the probability is strong that under these circumstances there were allowed to circulate in the blood toxines, elaborated as a result of smoking, and which acted on the optic nerves.

In Case I in connection with which the experiments were carried out it was mentioned that under treatment there was a steady increase in the urinary flow coincident with the greater toxicity. A daily register of the amount was not kept, but the diuresis was quite distinct, and only passed off as the toxicity fell and the case went on to recovery.

In Case III a daily register was made, and is here given in chart form (Fig. 23). It is seen that the increased toxicity and visual improvement coincided with a definite increase in the amount of urine passed.

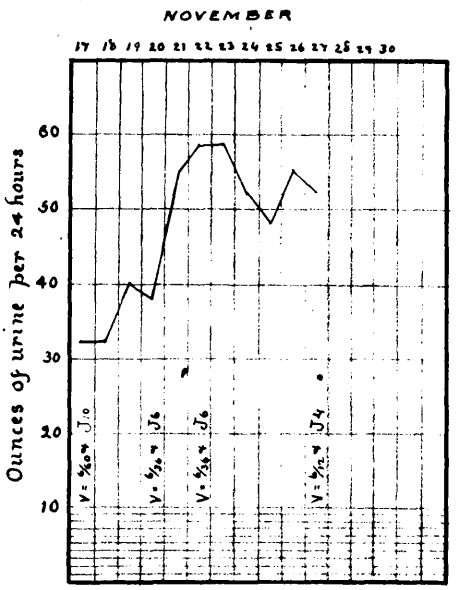


FIGURE 23

Lastly there falls to be recorded another case of uncomplicated toxic amblyopia, in which the urinary output was daily noted.

J. D., plumber, aet. 45, had amblyopia of about five months' duration. He had smoked at the rate of three to five ounces of black tobacco per week since eighteen years of age, and his indulgence in alcohol had been habitually free. Previous history as regards general health was perfectly good.

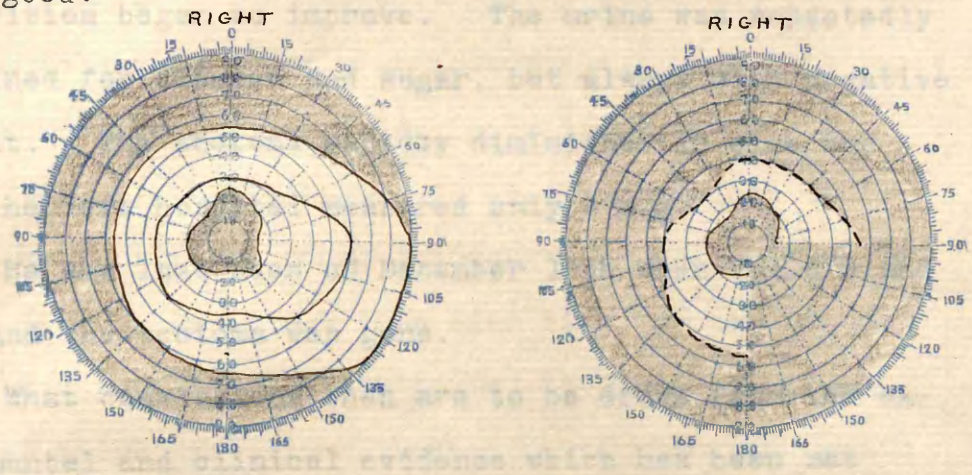


FIGURE 24

He was admitted to hospital on October 19th, 1900, and his progress is indicated in the chart (Fig. 25) as well as the amount of urine passed each day.

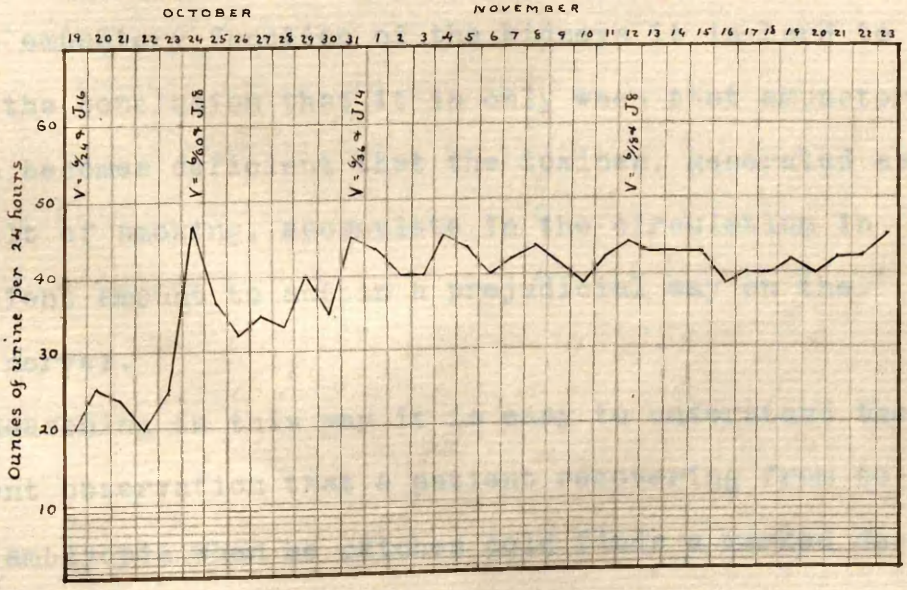


FIGURE 25

It is seen that on admission the kidneys were acting insufficiently, and for a few days the vision depreciated. On October 25th the kidneys became more active, and vision began to improve. The urine was repeatedly examined for albumen and sugar, but always with negative result. The scotoma rapidly diminished in size, and when he left hospital measured only 4 m.m.

He was last seen on December 15th, when V = 6/9 and J6, and the scotoma was gone.

What conclusions then are to be drawn from the experimental and clinical evidence which has been set forth?

Using the term renal inadequacy in a qualitative and quantitative sense it would seem that the toxic amblyope suffers from renal inadequacy. And while it may be contended that the one cause is independently responsible for the optic nerve and renal lesions, yet in view of the emunctory function of the kidneys it is hard to avoid the conclusion that it is only when that emunctory action becomes deficient that the toxines, generated as a result of smoking, accumulate in the circulation in sufficient amount to act in a prejudicial way on the optic nerves.

Reasoning in this way it is easy to understand the frequent observation that a patient recovering from tobacco amblyopia when he catches cold finds a marked de-

preciation in his vision, for we have experiments of Bouchard to show that when a person contracts an ordinary cold his urine at once becomes very highly toxic. There is an abnormal toxicity of the blood, and this of course will tell heavily on nerves which have only partially recovered from a lesion toxic in origin.

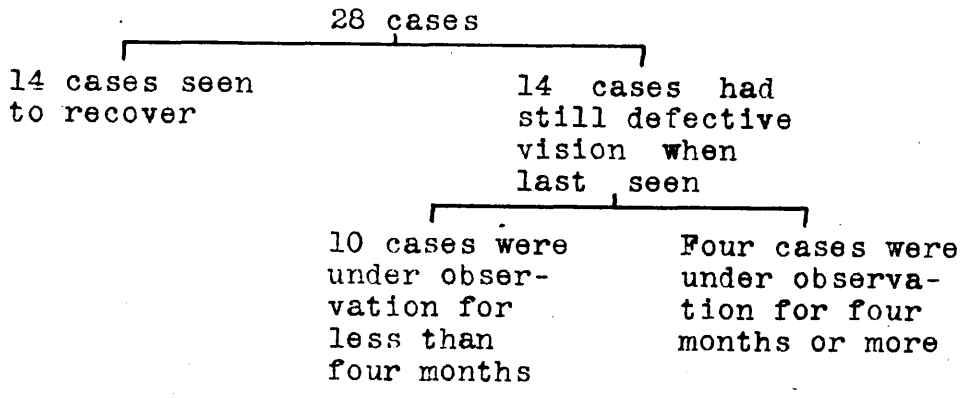
Finally, having regard to this association of tobacco amblyopia and renal inadequacy, we are enabled to bring tobacco amblyopia into line with the central amblyopia occurring in diabetes and lead poisoning, in both of which conditions there is disturbance of the renal function: and inasmuch as diabetic central amblyopia - which varies with the degree of glycosuria - is known to be due to an axial optic neuritis, we forge another link in the chain of clinical evidence that tobacco amblyopia has the same pathology.

Further, by having regard to the importance of renal adequacy we are able to explain why in the earlier stages of tobacco amblyopia the patient is so often benefited by a night's sleep, for then the nerve lesion can be little more than a hyperaemia, and Bouchard has shown that during rest the kidneys are very active, as indicated by the relatively greater toxicity of the urine of sleep.

PROGNOSIS

If tobacco amblyopia is diagnosed in its early stages when the visual defect is not profound and the colour scotoma small, there need be little hesitation in promising that the adoption of total abstinence from smoking will be followed by complete restoration of vision. But when regard is had to the advanced stage of a large proportion of the cases seeking hospital advice, and to the extreme difficulty experienced in obtaining total abstinence, it is found that the question of prognosis becomes somewhat complicated. In illustration it may be mentioned that out of forty-five cases only fourteen gave up smoking entirely.

In an analysis of sixty-four cases Hutchinson[39] reported forty-eight as having recovered. Of the remainder, four remained stationary and seven became worse. The following table shows the progress of twenty-eight cases all of which were under the writer's observation for at least a month.



Of the fourteen cases which were seen to recover

1	case	took 6	weeks to recover
1	"	7	"
4	"	2-3	months to recover
7	"	4-6	"
1	"	7	"

Average time taken to recover, four months

Of the fourteen cases which had not recovered when last seen, ten had been under observation for less than four months, that is to say, for less than the average time taken to recover. In eight of these the rate and degree of progress were such as to warrant expectation of complete recovery. In the remaining two practically no progress was made.

To sum up:- Out of twenty-eight cases, fourteen recovered and eight were on the way to recovery when last seen, leaving six in which progress was at least very slow.

A short account of these six cases is here given with a view to explaining if possible their unusual

course.

CASE I J. O., a calico printer, complained of typical symptoms of five months' duration. Coincidently with the onset of his visual difficulty he got very much out of sorts, but his doctor was unable to discover any evidence of organic disease. He was put on a diuretic-mixture, and he reduced his smoking from three ounces to one ounce of tobacco per week. On one occasion a faint trace of albumen was discovered in the urine. He continued under this treatment for four months, but with only very slight improvement in his condition. He now went for a holiday which had the effect of restoring his general health to normal, and immediately his vision began to improve so that in three months from the date of the holiday his vision rose from 6/60 to 6/18, and the colour scotoma had disappeared.

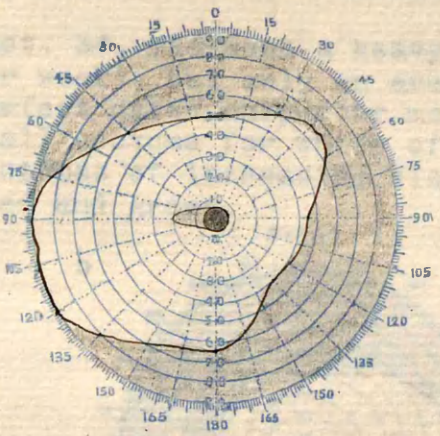
CASE II W. L., aet. 44, a labourer, had symptoms of nine months' duration. His habitual consumpt of tobacco was three and a half ounces per week, and he indulged heavily in alcohol. Immediately before the onset of the amblyopia he had for a period of three months been drinking to great excess, and was suffering from sleeplessness and nervousness in consequence. Under advice he abstained altogether from smoking, and after thirteen months had improved only from 3/60 to 6/60 vision, but his colour scotoma was reduced to 2 m.m.

CASE III W. W., aet. 60, in six months improved from 6/60 to 6/24. His symptoms as regards central amblyopia were unexceptional, but there was found in each eye a tendency to increased intra-ocular tension, especially in the right eye, and although the fields of vision were unaffected peripherally there was distinct reduction of the light sense.

CASE IV J. K., aet. 35, had been discharged from the Royal Navy after two months' treatment in hospital, during which he had smoked none, and at the end of which time his condition was unimproved. When he came under observation his visual difficulty was of nine months' duration, and he had been abstaining from smoking for about two and a half months.

He had been a heavy smoker for twenty years, and for seven years at the rate of four ounces per week. Alcoholic indulgence had been slight and

confined to beer. Vision was reduced to 6/60 and J16, and there was a typical central scotoma. Ophthalmoscopic appearances were normal. There was no history of renal or specific disease, nor was there found any abnormality in the urine, either as regards character or amount.

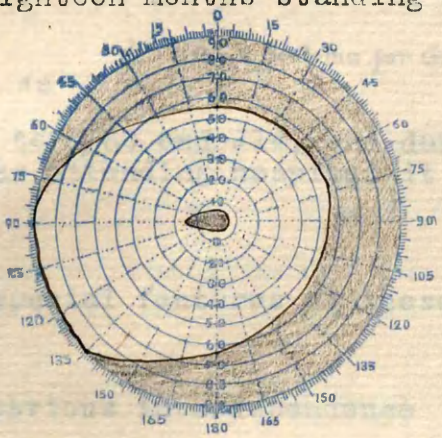


Field of Vision for White
Circular Scotoma for Green
Oval Scotoma for Red

FIG. 26

After a month's further abstinence from tobacco, and the use of a diuretic mixture vision improved to 6/24 and J16, and the scotoma was so far reduced in size that red and green were recognised in 5 m.m. apertures. At the end of nine months, i.e., nearly a year from the time he had stopped smoking, the scotoma for colours was less than 2 m.m. in diameter and V = 6/24 and J4, but by fixing a little to the temporal side of the field of vision, i.e., by using retina to the nasal side of the macula he could laboriously make his way down to some of the letters of 6/12. There was evidently a small central absolute scotoma, which could not however be demonstrated by the perimeter, even with 2 m.m. objects.

CASE V An engine driver, aet. 49, whose dimness of vision was of eighteen months' standing and whose indulgence in tobacco had been for many years at the rate of six ounces per week. His visual symptoms were typical of tobacco amblyopia, but he had albuminuria. He was under observation for three months,

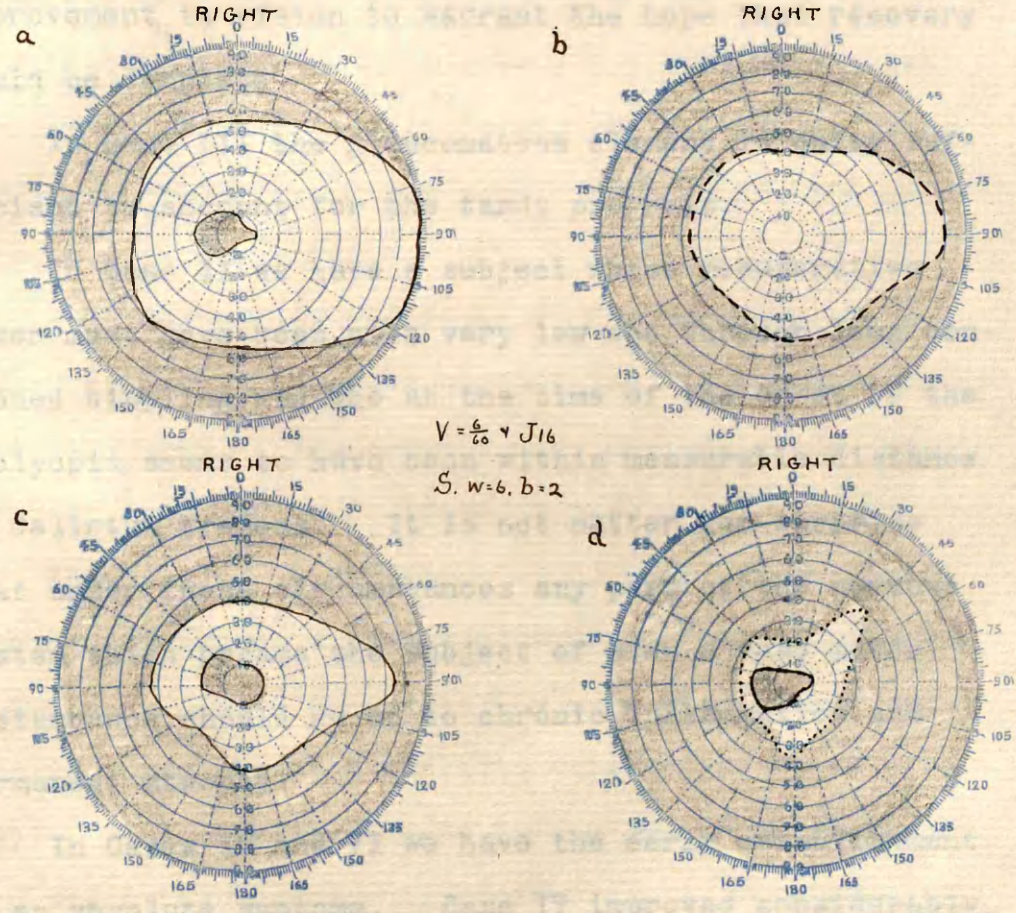


Central Scotoma for Red & Green
V = 3/60 & J20

FIG. 27

during which time his condition remained unchanged.

CASE VI W. L., aet. 34, had been a heavy smoker (three ounces per week), but only an average drinker. His visual defect dated only four months back, yet there was a small scotoma for white of 6 m.m. diameter, and scotomas of increasing size for blue, yellow, and red and green.



a. Field of Vision for White : Scotoma for Yellow.

b. Field of Vision for Blue

c. Field & Scotoma for Red

d. Field & Scotoma for Green.

FIG. 28

Vision was reduced to 6/60 and J14, and during the six weeks that he was attending hospital it did not improve.

Let us recount now the special features of these cases.

In Case I there was an obvious interdependence

between the deterioration in the general health and the amblyopia. So long as the former existed there was no improvement in the latter, but in three months from the time of re-establishment of health there was sufficient improvement in vision to warrant the hope that recovery would be complete.

In Case III the glaucomatous element is quite sufficient to account for the tardy progress.

In Case II we have a subject whose recuperative power must have been at a very low ebb through long continued tippling, and who at the time of the onset of the amblyopia seems to have been within measurable distance of delirium tremens. It is not matter for surprise that under these circumstances any part of the nervous system which became the subject of even a vaso motor disturbance should go on to chronic inflammation and permanent atrophy.

In Cases IV and VI we have the early establishment of an absolute scotoma. Case IV improved considerably, yet it seems probable that the improvement was mostly due to the training of a paramacular region of the retina. Why the condition should have gone on to scotoma is not clear, unless it be that for seven months after vision became affected smoking was continued at the rate of four ounces per week.

In Case V the consumption of tobacco had been very

heavy (six ounces per week), and had been continued unabated for eighteen months after the onset of the amblyopia. Further, there was found on one occasion a slight haze of albumen, pointing to a predisposition to renal embarrassment.

In formulating a prognosis there are three chief factors to be considered; first, the ocular condition; second, the history of the case; and lastly, the general condition of the patient.

(1) The ocular condition. The presence of an absolute scotoma, i.e., a scotoma for all colours, is of serious import. Improvement may take place, but total recovery need hardly be looked for.

Case IV (p. 56) illustrates to what degree under such circumstances a paramacular area of the retina may be trained. With regard to the mere size of the scotoma as a prognostic guide, its value seems to be very little. Of more importance is the degree of sharpness with which its boundary is demarkated. In estimating this of course we are much dependent on the intelligence of the patient, but in a person of average intelligence a scotoma, whose boundary line under the test of repeated trials never varies, may be regarded as very intense and the case may be expected to take a comparatively long time to recover. In this connection it is well to remember the remarkable shrinkage of the scotoma which

almost constantly occurs during the first week or so of abstinence, often unaccompanied by any appreciable improvement in form vision.

(2) History of the case. While it is interesting to note the duration and amount of the patient's consumption of tobacco, yet, such is the variation in susceptibility to the action of tobacco manifested by different individuals, that as prognostic premises they are of little use. Most important, however, is the history of the patient subsequent to the first appearance of toxic symptoms. How long is it since the optic nerves became affected, and to what extent have they since been subjected to the toxic influence of tobacco? It may be said that a healthy man who has continued to smoke as long as six months after the onset of amblyopia has still a fair chance of recovery. A longer duration justifies a cautious prognosis, and more especially if the scotoma approach the "absolute" type, and the general condition of the patient be below par.

(3) General condition of the patient. Incidental reference has already been made (p. 49) to the effect which an ordinary cold has on a person who is recovering from tobacco amblyopia, and it was shown that this action might reasonably be referred to an interference with elimination. So, in estimating the general condition of the patient from a prognostic point of view the im-

portant point is his power of elimination. If he is generally out of sorts little improvement need be looked for till his normal vigour is restored by tonic treatment, and especially fortunate is it if this treatment includes the exposure to fresh air, for then in addition to the general tonic effect we secure the highest activity in pulmonary elimination.

Chronic gastric disorders - themselves fruitful sources of intoxication - will influence prognosis in proportion to their intractibility.

The condition of the kidney activity is of the highest importance, and it is well that enquiry should always be made as to the amount of urine passed.

The presence of albumen in the urine - a not infrequent occurrence - does not of itself import a sinister aspect to the case, but indicating as it does an abnormal kidney action it demands that very special heed be given to the amount of the renal secretion. So long as this is ample there is little to fear.

The prognosis is necessarily affected by the degree to which the patient modifies his indulgence in tobacco. While it is well to enjoin total abstinence there can be little doubt that a modified indulgence of from a half to one ounce per week is quite consistent with complete recovery.

With regard to the time taken to recover, it is

variable, but a well marked case may be said to require four to six months. Improvement is manifested first in colour vision, then in distant vision, and, as a rule, vision for near objects is the last to be recovered.

DIAGNOSIS

There have been described as three distinct forms of toxic amblyopia, one due to tobacco alone, one due to alcohol alone, and a third due to the combined action of alcohol and tobacco - mixed cases.

Of the pure tobacco form the writer has seen some examples, but in the great majority of cases alcohol and tobacco have both been indulged in. In two cases in which vision was fully restored the patients had reduced their tobacco indulgence to practically nil, but had continued a free indulgence in alcohol.

While hesitating to deny the existence of a form of central amblyopia due to alcohol alone, the writer is of opinion that any prejudicial effect which alcohol exerts in so-called "mixed" cases is in virtue of its action on

the general system, particularly through disorders of the stomach and kidneys. In this way there is a disturbance of the processes of assimilation and elimination, and so the patient is rendered less able to cope with the tobacco toxines.

With regard to the diagnosis from other forms of toxic central amblyopia, of which the chief forms are carbon bisulphide, lead, and iodoform, one is guided by the history of exposure to the noxious substance in question. The difficulty is lessened by the fact that in all of these forms general symptoms of poisoning usually precede the ocular.

Retrobulbar neuritis is very often monocular, it is more rapid in its course, and is usually associated with obvious congestion of the optic papilla, and retrobulbar tenderness; the latter elicited by pressure backwards on the eyeball.

Examination of the urine will at once discover the diabetic form of central amblyopia. The detection of the presence of albuminuria will reveal the nature of the patient's weakness in resisting the toxic action of tobacco.

Inasmuch as smoking is so nearly a universal habit among men, those forms of central amblyopia associated with the early stages of spinal diseases may escape diagnosis at first. The gravity of such an error arises

from the bad prognosis which such conditions call for. A history of syphilis should lead to a careful examination of the central nervous system for some of the earlier symptoms of degenerative disease. Should the diagnosis be at first missed, the early involvement of the peripheral parts of the field of vision, which always ensues, will direct attention to the atrophic nature of the condition.

TREATMENT

Under this heading little falls to be added to what has already been indicated in connection with pathology and prognosis.

Smoking must be stopped or modified, and we have seen that when this is accomplished there is an effort on the part of nature to rid the circulation of toxines by means of increased renal activity. In many cases no therapeutic assistance is required, but it is a good routine practice to encourage the kidney function in all cases by the exhibition of an alkaline diuretic. The

urinary output will be carefully watched, and should it tend to remain below normal, more active measures will be adopted to promote diuresis.

It is also of great importance that the alimentary system be made the subject of careful supervision, and lastly, when improvement has begun, there can be no doubt that an appreciable impetus to recovery is to be gained by a change to coast or country air.

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