the river, where Mrs. Jessop received and entertained with kindly hospitality. Under his roof the guest was free to follow his own way, to join him in a morning swim in the river, or a hard spell of gardening. He lived the free life of the country whenever he could get away from his work, and took his full share as a country magistrate, and in other ways in the social life of his neighbourhood. He lived a full life and will be greatly missed. Much sympathy will be felt for Mrs. Jessop and his daughter in their great loss.

W. T. Holmes Spicer.

COMMUNICATIONS.

BITEMPORAL HEMIOPIA: THE LATER STAGES AND THE SPECIAL FEATURES OF THE SCOTOMA.

With an examination of current theories of the mechanism of production of the field defects.

H. M. Traquair.

Assistant Ophthalmic Surgeon, Royal Infirmary, Edinburgh.

In a previous paper it was shown how by means of serial test objects, following the method of Bjerrum and Rönne, it is possible to trace the development of the changes in the field of vision which are characteristic of bitemporal hemiopia. Originally thought to represent individual types, these changes were recognised some fifteen years ago by Josefson as stages in a progressive process. The defect in the peripheral field nearly always becomes apparent first in the superior-temporal quadrant, which begins to fail from above downwards in a vertical direction. The lower-temporal quadrant is then invaded and becomes, as it were, scooped out from above, assuming a hook-shaped or uncinate form projecting from the lower-nasal quadrant outwards and upwards below and outside the blind spot. This projection shrinks gradually from without inwards until the temporal field ceases to exist, or, in many cases, the continued downward progress of the defect close to the outer side of the vertical meridian, not infrequently associated with an indentation from below, splits off the remains of the outer field forming a temporal island, which, in turn, gradually disappears, though it may remain to a relatively late period. The nasal field
now becomes encroached upon in its lower part, and the functional failure on this side progresses in an upward direction until at last the upper-nasal quadrant alone remains. At that time I wrote: "The loss occurs from above down in the temporal field, from below up in the nasal field and progresses round the fixation point clockwise in the right field and counter-clockwise in the left. In this respect the scotoma behaves in the same way as the general field." It is hardly necessary to mention that in atypical cases more irregular modes of development of the field defect are by no means infrequent. The results then obtained have been, for the most part, confirmed by Cushing and Walker, who applied a similar method of examination to an extensive material, consisting, however, solely of tumour cases.

While general agreement prevails as to the main features of the fields there is still scope for investigation in regard to certain details such as—1. The earliest stages; 2. The later stages; 3. The characteristic features of the scotoma; and 4. The mode of production of the field changes and their relation to the aetiology of the condition.

With regard to the earliest changes which our present means of examination enable us to detect it is somewhat difficult to collect much evidence, for most cases, up to the present time at any rate, are not encountered by the perimetrist at a very early stage. It is necessary to follow up suspected cases, it may be for years, to see whether they really develop into bitemporal hemiopia. During this period some are lost sight of, while in others the symptoms either disappear or fail to develop. These changes may be studied in cases (Cushing's Group III) in which the constitutional symptoms are accompanied by minimal visual defects, only to be elicited by careful examination, as in early chronic acromegalies, whose fields are still so often described as being normal, or in cases in which the field of one eye is much less affected than that of the other.

In the paper already mentioned it was shown that at a very early stage, when alterations in the periphery of the fields are either undemonstrable or so indefinite as to be valueless, distinct changes may be found towards the centre within the 30° circle, an observation since confirmed by Walker (see Fig. 27). It seems probable that in the initial stage the visual function over practically the whole of the upper-outer quadrant is to some extent depressed and that the earliest changes are to be found in the supracaeal region—above the blind spot. At some future time I hope to deal more fully with this part of the subject; the chief object of the present paper is to discuss the later stages of bitemporal hemiopia and the nature of the frequently associated scotoma.

By later stages are meant the stages of advancing blindness in the
nal field, the earlier stages being those during which the temporal field is lost. That the latter fails from above downwards is generally accepted; there is, however, less agreement as to the precise mode of progress of the defect on the inner side. Some writers have found that the upper and some that the lower-nasal quadrant remains last. The literature shows few, if any, observations directed specially towards this point, and such evidence as there is, is frequently vague. Methods of perimetry capable of providing a detailed analysis of the field of vision have seldom been used, and, while the presence of bitemporal hemiopias has often recorded, exact details as to the state of the fields are frequently omitted.

According to Wilbrand an upper or lower-nasal quadrant or both upper-nasal quadrants may remain after the loss of the rest of the fields; at the time when he wrote (1897) he had found no reported case in which both lower-nasal quadrants alone remained. Bogatsch collected thirty-four cases, in nine of which a late stage was present. In five, the remaining areas were said to be inwards; in one, down-in; and in three, up-in. Uhthoff who examined a large material, believes that a quadrant-shaped remnant in the nasal field, with vertical and horizontal boundaries, is diagnostic of chiasmal affection, even if the other eye is blind. He does not state whether the remnant is more frequently above or below, but the chart which illustrates the article shows retention of the upper-nasal quadrant, and of three fields used to illustrate hypophysis disease without acromegaly, two show upper-inner retention. In another paper of three cases described, one shows a late stage with upper-inner retention, and in his Bowman lecture two charts are given, one showing the greatest strength of the remaining field in the upper quadrant, the other the survival of a patch in the lower-nasal quadrant. Paukstat describes three cases, all showing late stages, in one of which the remains occupied the upper-inner quadrants; the other two being neutral, that is, showing nasal hemipptic fields not differentiated into upper and lower quadrants. Of two advanced cases recorded by Ronne, one had retention of the upper-inner quadrants with straight vertical and horizontal margins, the other was neutral. In Veasey's case at one time the field of one eye had entirely disappeared, with the exception of the upper-nasal quadrant. Graham has recorded two advanced cases, one showing retention of vision in the upper-inner quadrant, the other being neutral. In six cases, which the author attributed to a tabetic affection of the chiasma, Fuchs found that the upper-nasal quadrants remained most frequently. One of the most important contributions to the subject is that of Hirsch. His 26 cases include 23 bitemporal hemiopias of which 18 were in late stages. Four of these had definite retention of the upper-nasal quadrants
Bitemporal Hemiopia.

illustrated by charts; in one the field was said to be greatly contracted outwards and below. Case No. 12 in Hirsch's series is of especial interest in regard to this question. The diagnosis is said to have been very difficult, largely owing to the vagueness of the general symptoms, and the solution ultimately rested on the visual symptoms only. Both discs were quite white; the left eye could only see hand movements (it is not stated in what part of the field), and the right eye had vision equal to counting fingers at 4 metres, with the field reduced to the upper-nasal quadrant only. The opinion expressed by competent oculists was that the characteristic field defects of hypophysis tumours were absent. It was subsequently suggested that the preserved quadrant might be the remains of an earlier bitemporal hemiopia. After operation, during which a partly intrasellar tumour was found, the upper-inner quadrant of the left field returned and the lower-inner quadrant of the right field, producing a nasal hemiopic field on the right side. The way in which function returned helps to show that the retention of one or both upper-inner quadrants is a characteristic feature of bitemporal hemiopia; had the left field been accurately examined, the power to see hand movements would without doubt have been found in the upper-nasal quadrant. Retention of the lower-nasal quadrants was found in two cases, one of which, No. 7, presented the extremely rare condition in which both lower-nasal quadrants alone are preserved, a form of field anticipated, although not actually observed, by Wilbrand. The charts given of the eleven remaining cases, while showing nothing very definite in either direction, incline somewhat in favour of the upper-in termination. In 1913 the subject of pituitary disease was discussed in the Royal Society of Medicine and a number of cases were recorded, some eight of which show late stages. Six of these afford no information as to the relative strength of the upper or lower-nasal quadrants, in one the upper-nasal quadrant was preserved and in one the remains were rather more below than above the horizontal line.

On the other hand, Cushing in 1913 found that the lower-nasal quadrant usually remained longest. In his book on the "Disorders of the Pituitary Body" some 13 of the cases recorded have field charts showing advanced hemiopia and of these two show the remnants in the upper and two in the lower-nasal quadrant. In a later paper, specially devoted to bitemporal hemiopia in tumour cases, Cushing and Walker maintain the same view, although here, again, the charts selected as illustrations show little evidence in favour of more frequent survival of the lower nasal quadrants. Of the 13 cases discussed 9 show late stages. One is an excellent example of retention of both upper-nasal quadrants—regarded by the authors as unusual—and another (case 8) showed relative strength of the upper-nasal quadrant before operation and survival of a patch mainly in the lower-nasal quad-
rant after two operations. Two other cases show survival of lower-nasal quadrants; while the remaining five give no definite indication in either direction. At the same time the authors state that after the loss of the temporal field the nasal field "begins to show contraction either above or below, but more often below." If the shrinkage of the nasal field usually begins from below and if its final remains are usually found in the lower-nasal quadrant, it is evident that a more rapid shrinkage must subsequently set in from above. Whether the authors have observed such a process is not mentioned, although one case (No. 8)—complicated, however, by operative interference—appears to support such a possibility. Walker 58 in a separate paper, although illustrated mainly by the same charts, does not refer specifically to this question, but in his scheme of the stages of bitemporal hemiopia shows the final area of vision mainly in the upper-nasal quadrant with its lower edge just crossed by the horizontal meridian. Sixteen cases are selected as examples, seven of which present late stages, one showing retention of both upper-nasal quadrants and one retention of part of one lower-nasal quadrant. Both of these cases are already figured in Cushing and Walker's paper, and the remaining five are neutral, so that as far as this particular detail is concerned, Walker's paper does not support Cushing's view. Kümme1 83 describes two cases, one in a late stage. Here the remains were in the lower-inner quadrant and the cause was an aneurism of the circle of Willis. Josefson 30 found the terminal areas in "the lower quarter of the visual field," but in the only communication to which I have had access does not give any illustrative cases.

Taken as a whole, the evidence from the literature, as far as I have been able to examine it, provides some 59 cases in advanced stages in which sufficient details of the condition of the fields are given either by charts or descriptions. Thirty-four show no definite indication as to whether the upper or the lower-nasal quadrant is retained. That the proportion of neutral cases is so large is evidently due to the fact that in few of these cases was the examination of the fields specially directed towards the elucidation of the latest stages, and possibly also to a slight extent to the presence of some in which the nasal fields were insufficiently affected to show any differentiation between the two quadrants, even had the examination been adequate. Of the remaining twenty-five cases seventeen show definite retention of the upper-inner quadrants, and only eight retention of the corresponding lower quadrants. A striking feature also is the fact that the margins of the retained portion, when this occurs above, frequently lie along the vertical and horizontal meridians of the field enclosing a definitely quadrant shaped area, while the remnant in the lower-nasal quadrant usually consists of a mere irregular patch. The conclusion would appear
to be that termination, or at least the attainment of the penultimate stages, is about twice as common in the upper-nasal quadrants as in the lower, the contrary view being supported almost solely by the statements of Cushing and Josefson.

With regard to the scotoma so frequently present in bitemporal hemiopia, a similar absence of special investigation is noticeable. The paracentral or centro-cæcal position of these scotomata, their quadrantic or hemiopic shape, and the way in which they vary in size or intensity, or enlarge in the temporal field, have been noted by several writers. Special attention was devoted to such scotomata by de Schweinitz and Holloway in 1912, but they have not been generally studied with the same care as the field of vision as a whole. The only mention of the distinctive features of what may be called the chiasmal scotoma which I have been able to find, occurs in a paper by Rönne, which is illustrated by charts showing the characteristic progression of the defect round the fixation point.

**Method of Examination.**—The method of examination is one which has been in use in the eye department of the Royal Infirmary of Edinburgh for some years, and was described by the writer as "The Quantitative Method of Perimetry." Its essential feature is the use of a series of graduated test objects varying from 1·0 mm. or even 0·5 mm. up to 60 mm. or 70 mm. in diameter at distances of from 250 mm. to 2000 mm. or more. As the visual angle employed depends on the diameter of the test object and its distance from the eye, a wide range is obtained by this means.

Bjerrum's method was always used in the examination of scotomata and of the central field, for which it is essential, as without the large projection thus obtained thorough examination and analysis of defects within the 25° circle is impossible. The most useful test-objects are 5 mm. and 1 mm. with the ordinary perimeter, and 2 mm. and 1 mm. with Bjerrum's screen. Objects larger than 40 mm. are rarely required.

It will be convenient from this point onwards to refer to the upper-outer quadrant of the field as the first quadrant, the lower-outer

---

**GUIDE TO FIGURES.**

**Coloured Plates.**—Only white, red, and green test objects were used. Areas coloured red or green indicate the extent of the field for that colour with the object specified. Areas coloured orange or yellow indicate that a red object was thus described when seen in the area so coloured.

**Text Figures.**—Areas coloured black or grey indicate areas of total or partial blindness according to the depth of shading.

Fields for red, green, and blue are indicated by vertical, horizontal, and oblique shading respectively.

Each chart is marked with two scales of which one is stroked out. Those marked 1 mm. = 1° are on the large scale and show only the central part of the field out to 45°. Those marked 1 mm. = 2° show the field to 90°.

The fractions 1/20, 1/100, etc., indicate that 5 mm. or 1 mm. was the size of the test object and 300 or 2000 mm. the distance of the eye from the fixation point respectively.

Where not otherwise specified the object used was white.
as the second, the lower-inner as the third, and the upper-inner as the fourth quadrant.

The clinical material now brought forward includes 22 cases of bitemporal hemiopia, and two of similar but less definite nature. They may be divided into the following groups:—

Group I.—Ten cases in the later stages.

II.—Six cases (five with scotomata) in relatively early stages but with features definitely bringing them into line with group I.

III.—Six cases with only early changes.

IV.—Two cases allied to, although not definitely, bitemporal hemiopia.

Group I. Ten cases in the later stages showing complete, or nearly complete, loss of the temporal field of one or both eyes to a medium-sized test object. Eight of these (Nos. IX, XII, XIV, XV, XVIII, XIX, XXIII, XXIV) showed retention of the fourth quadrants, in one (No. X) this sign was not looked for, and in one (No. XXI) it could not be elicited. This is the only advanced case in which differentiation of the nasal quadrants was looked for and not found in one field at least.

Group II. These six cases (Nos. I, III, V, VII, XI, XXII), although showing relatively early changes in the peripheral fields, had characteristic typical features, in five in association with scotomata, in the sixth (No. V) in the colour fields. They all showed relative retention of the fourth quadrants.

Group III. Five were cases of chronic acromegaly (Nos. II, IV, VI, VIII, XIII). The sixth (No. XVI) was probably due either to tumour or to syphilis. This was the only case with a scotoma in which differentiation of the nasal field into upper and lower quadrants was not demonstrable. The field changes were all early and these cases therefore do not fall within the scope of this paper, but have been included for the sake of completeness.

Thus of sixteen cases of bitemporal hemiopia (Groups I and II) which showed well-developed defects either central or peripheral, or both, fourteen showed the typical clockwise and counter-clockwise progress of the defect in the right and left fields respectively with relative retention of the superior-nasal quadrants.

Group IV. Two other cases, with field changes evidently closely allied to, if not actually, bitemporal hemiopia, showed similar features.

These eighteen cases (Groups I, II, and IV) have been selected for more detailed examination.

The changes in the peripheral field are illustrated by Cases III, IX, XII, XIV, XV, XVIII, and XXIV. All stages are shown from the early depression of the upper-outer margin (Plate I, Figs. 1, 6; Fig. 7) to the stage at which the fourth quadrant alone remains (Figs. 15, 25). Plate II, Fig. 3, shows a very early stage requiring
Bitemporal Hemiopia.

Bjerrum's screen and very small test objects for its demonstration. In several cases where the nasal field was still practically intact, the relatively greater retention of function in the fourth quadrant was brought out by the use of coloured or sufficiently small white objects (Plate I, Fig. 3; Figs. 11, 12, 14, etc.). Case III (Plate I, Figs. 3 and 4) is particularly illustrative, as although the peripheries of the fields for a 5 mm. white object were practically unaffected, a test with coloured or small white objects showed the whole series of perimetric changes at the same time. All the cases show the typical changes at one stage or another, but the complete perimetric picture is not often met with at any one date in the history of a case. Case XVIII is of interest in that the fourth quadrant alone is retained in the left field (Fig. 20), while only very early defects are detectable in the right. As the vision and fundus were normal, and the field full to ordinary tests, the right eye might easily have passed as quite unaffected. Careful examination with Bjerrum's screen, however, showed slight temporal contraction within the 30° circle, and a more distinct temporal loss for red (Plate II, Fig. 3), changes which, although apparently trifling, are not to be disregarded, as I have observed exactly similar changes in cases in which typical bitemporal hemiopia subsequently developed. Considering the two fields together, it seems justifiable to class this case as a bitemporal hemiopia. Retention of the upper-inner quadrant with the final stage—blindness—in the other eye is mentioned by Uhthoff as diagnostic of bitemporal hemiopia, but, so far, I have not seen other descriptions of cases in which the field of the second eye showed only the earliest changes.

In the central part of the field two types of defect occur, either separately or together. The non-scotomatous type consists usually in an upper-outter or outer flattening or indentation of the central isopters. It is demonstrated by reducing the size of the test-object, coloured if necessary, until the resulting field extends only a few degrees from the fixation point. It is then frequently found that only the fourth quadrant remains, Figs. 11, 14; Plate II, Fig. 6. This type differs from the scotomatous type in that the defective area is not surrounded by an area of relatively stronger function. It is really a defect of the peripheral type which can only be shown by a very small object necessitating a very small and central field. Its presence seems to show that the lower-nasal field, although apparently normal, is really slightly affected right up to the fixation point. Where there is a scotoma on the temporal side, as in Plate II, Figs. 2, 4, it might be suggested that the absence of the small third quadrant for red is due to a true scotomatous defect of slight intensity in that area of practically equal extent. In Plate II, Fig. 2, the red test object appears as yellow in the apex of the third quadrant, and if the above explanation were valid, the yellow area.
should be surrounded by a red band of some five degrees in width. Plate I, Fig. 1, for example, shows a true scotomatous defect of the apex of the third quadrant for green with a band of preserved field between the scotoma and the periphery.

The second type of central defect is the scotoma. Figs. 1, 2, 3, 4, 5, and Plates I and II, show its various stages. It behaves like a small field within the field, being most dense in the first quadrant where it makes its appearance, and becoming progressively less dense in the second, third, and fourth quadrant. Plate I, Fig. 2, shows an interesting stage. In the temporal field the scotoma affects the apices of both quadrants, being practically absolute in both. On the nasal side there is a relative hemiopic scotoma for red, which is seen as yellow in the lower and as orange in the upper part, illustrating the relative preservation of the fourth quadrant. Figs. 3 and 4 illustrate the changes in the scotoma in the right field of Case III during six days on a larger scale, and show how closely the development of the scotoma follows that of the field as a whole. Figs. 2 and 4, Plate II, show good examples of cases in which both types of central change occur together, the scotomatous type occupying the temporal side of the vertical meridian. Such cases are of interest as showing that the scotoma may sometimes be preceded by a defect of peripheral type and less intensive nature, suggesting that not only the central fibres, but practically the whole chiasma, is affected.

In the twenty-two cases of bitemporal hemiopia scotomata could be demonstrated in ten, five of which showed what have been described as typical characteristics. Of the remaining five, one (Case IX) had a half-ring scotoma (Fig. 8). Case XV showed a very atypical scotoma, and the course of the peripheral field was also somewhat irregular. Case XVI had oval centro-caecal scotomata which could not be satisfactorily differentiated into upper and lower quadrants, and in Cases XII and XIX the scotomata were so dense that analysis was impossible. Only the first two can be regarded as valid exceptions to the rule, as the two latter were either too little or too much developed to permit of their nature being ascertained. Such exceptions suggest no alternative type, but merely that, as is to be expected, deviation from the type may occur.

Relative retention of function in the fourth quadrants may be regarded as the typical penultimate stage in the normal progress of bitemporal hemiopia. In the cases described in this paper this sign has only been recorded as definitely present when it could be satisfactorily and consistently demonstrated and confirmed by a variety of tests. In several of the cases the sign was at times somewhat indefinite; it would be found and then again prove incapable of confirmation with another test. In Case XXIII, for instance, it was quite definitely present at one time for objects equal to $\frac{13}{2000}$ green
and 9/2000 red but became less distinct when the patient's condition and some of the eye symptoms, central vision, nystagmus, etc., had improved, although the defect in other parts of the fields had progressed. In such cases, where the relative superiority of the fourth quadrants is not very pronounced, but is, so to say, hovering on the threshold determined by the lesion, on the one hand, and our methods of examination and the patient's ability to respond to them, on the other, it is only to be expected that such a symptom should be somewhat inconstant and variable. The fact that its presence varies with the other symptoms, indicates that it is a definite response to the activity of the lesion.

**Cases.**

**Case I.**—J. W., female, age 31 years, under the care of Dr. Mackay. Seen April, 1912, complaining of bad sight. Obvious acromegaly was present which had been slowly progressing for four years, but more rapidly during the last nine months. R.V. = 6/60, optic disc pale; L.V. = 6/12, disc normal. Typical bitemporal hemiopia with well-marked splitting of the fields of vision and temporal islands. Plate I, Fig. 1 shows field of right eye on June 3rd, 1912. There is a large centro-caecal scotoma with straight mesial edge. While the field for 5/300 white is little altered, that for 1/300 is vertically split in the typical way. The field for 20/300 green shows on the temporal side a horizontally oval island rather stronger centralwards. On the nasal side this test gives a peculiar hemiopic field; the upper quadrant is much larger than the lower and the apex of the latter is absent, being occupied by a clean-cut quadrant scotoma. Thus, the central loss for green is progressing clockwise and has affected three quadrants, the peripheral loss proceeding more slowly. The scotoma for 1/300 white is also seen to be slightly encroaching upon the apex of the lower-inner quadrant from the outside. The process is further illustrated by Plate I, Fig. 2, which shows the field for red 20/300 in the same eye taken at the same time. The temporal island is very weak and approximately indicates the position of a "glimpse" of red colour. The nasal field for red shows a hemiopic scotoma which resolves itself into two quadrant scotomata corresponding respectively to the apices of the lower and upper-nasal quadrants. In the lower apex red appears as yellow; in the upper as orange. Ordinary red colour, when passed from an area of greater to one of lesser defect, often appears first as a grey or whitish, then as yellow and orange successively before it is recognised as red. Similar conditions occur in other forms of loss of conductivity of the visual fibres.

Thus, the central defect is here advancing from below upwards. The field for white 1/300 was taken nearly three weeks later than that in Fig. 1 (Plate I), and shows further advance. In this particular case the condition shown represents the most advanced stage reached, as at this point the patient became very ill, completely lost the sight of the right eye, and then recovered with left homonymous hemiopia. She was in very good health

*(51) Case I.*
when last seen, July, 1916, vision being R. counting fingers close to face on temporal side only; L. 6/6. Acromegaly stationary.

**Case II.** — C. R., June, 1912. Chronic acromegaly (See (1) Case V.) Fields in early stages only.

**Case III.** — Mrs. S., age 30 years. Seen August 7th, 1912. History of dimness of sight following a bad headache two weeks previously. Was subject to "bilious attacks." Acute suppuration of right maxillary antrum; sella Turcica normal. Relative bitemporal hemiopia with scotomata. R.V. = 6/36, L.V. = 6/24; optic discs normal. On August 11th, R.V. = counting fingers at 4 meters, L.V. = 6/60. Plate I, Figs. 3 and 4, show fields at this date. The peripheries for 5/300 white are practically normal; in the right field is a hemiopic scotoma composed of a dense upper and a less dense lower portion corresponding respectively to the apices of the upper and lower temporal quadrants. The right field for 10/300 red is characteristically split through the centro-caecal area, a weak temporal is landremaining in the lower-outer quadrant. Colour vision for a 10 mm. red object is thus absent in the first, and weak in the second quadrant, rather stronger in the third, and normal in the fourth quadrant. The left field, Plate I, Fig. 4,

**Fig. 1.**

**Fig. 2.**

shows a similar, though less advanced, condition. There is still weak colour perception in the first quadrant and the two quadrants on the nasal side are as yet of equal strength. A temporal hemiopic centro-caecal relative colour scotoma is present in which the colour was not perceived in the upper part and only very faintly in the lower.

The colours in Figs. 3 and 4, Plate I, are intended to show only the gradation in which red was perceived and not the exact tints seen as these became more tinged with orange or yellow as the redness diminished.

*(51) Case II.*
This case illustrates extremely well the regular progression of the field defect round the fixation point, clockwise in the right field and counterclockwise in the left, and the similar nature of the scotoma which behaves like a small field within the field. See Figs. 1 to 5, showing scotoma on different dates.

The interrupted line indicates the field for 1/300 white. This object was only dimly seen in the dotted area.

By the end of August, 1912, there was definite pallor of both optic discs; nevertheless vision improved. When last seen in August, 1915,
R.V. = 6/12+, L.V. = 6/12; pallor of both discs. By Bjerrum's method and by colour testing, evidence of bitemporal hemiopia resembling early stages could still be obtained.

In this case had delicate tests not been employed, the bitemporal hemiopia might have been completely missed. At the same time peripheral defects for the usual 5/300 white test were absent, an instance of Rönne's "disproportionality." This indicates the activity of the lesion, which was undoubtedly a chiasmal retrobulbar neuritis, possibly of oxic origin, depending on the suppurating antrum, or perhaps the sphenoidal cells.


CASE V.—A. H., female, age 33 years. Under the care of Dr. R. H. Blaikie. Seen November, 1912. Acromegaly, duration 13 years. R.V. (corrected) 6/9. L.V. (corrected) 6/9. Optic discs show relative pallor more marked on left side. The ordinary outward signs of acromegaly are well marked, but patient is in good health, and works as a laundress. Fields of vision: Figs. 6, 7. There is flattening of the first quadrant on each side, especially on the left, where the first quadrant of the field for 1/300 white has almost entirely disappeared. Red 10/300 gives bitemporal hemiopia, with retention of a narrow mesial strip of the second quadrant on the left side, and of the major portion of the second quadrant on the right side. On each side, red is called "bright red" in the fourth quadrant, "not so bright" in the third quadrant, "yellowish" in the second, and "yellow" in the first quadrant. It was, however, not possible to chart exact boundaries in this case for these quadrants.

CASE VI.—Miss B., age 54 years. Chronic acromegaly. Fields in early stages (See Fig. 28).
CASE VII.—W. D. H., age 39 years. Seen December, 1912, under the care of Dr. Mackay. History of sudden loss of vision eight months previously. No nasal disease or venereal trouble. Is very healthy except for eyesight. For the last six months vision has got no worse. R.V. = 6/60. L.V. = counting fingers at 6 metres. Optic discs show partial atrophy suggesting in its appearance a previous neuritis. Fields: Plate I. Figs. 5, 6. Peripheries for 5/300 white are practically normal. Right field for green 3/300 shows a small scotoma corresponding to the apex of the upper outer quadrant. The periphery of the left field for 1/300 white shows an upper outer shallow depression and a scotoma in the centro-caecal area. The left field for green 7/300 shows this depression considerably accentuated while the scotoma is more fully developed, being hemiopic in form and embracing the central portions of both upper and lower temporal quadrants. Although there was no suggestion of toxic amblyopia, stoppage of tobacco was followed by improvement in a month to R.V. 6/24+; L.V. 6/60. These fields illustrate the growth of the scotoma in advance of the peripheral defect, both being of the same type. Probably some form of chiasmal retrobulbar neuritis has been the original cause.

The ordinary centro-caecal scotoma of tobacco amblyopia is not divisible into quadrants by analysis with serial test objects whether white or coloured, but shows one or two foci of greater intensity.

CASE VIII.—Mrs. D., age 60 years. Chronic acromegaly. Early fields.

CASE IX.—P. B., age 24 years. Seen March, 1913, under the care of Professor Gulland. Well-marked progressive acromegaly. At this time only very early changes in the central fields were detectable. Vision = 6/4.5 in each eye. Right optic disc normal, left showed very
faint relative pallor. Sella Turcica enlarged. The fields developed typically with the exception of the scotoma which became a hemiopic temporal ring scotoma, Fig. 8. Figs. 9 and 10 show fields in March, 1916, taken by Bjerrum's method, illustrating relative retention of the fourth quadrants.

At this time R.V. = 6/9 part. L.V. = 6/18. Some pallor of optic discs, especially the left. At the end of March an operation was performed by
BITEMPORAL HEMIOPIA.

Col. Caird, about a drachm of soft material being removed from the sella. Central vision remained the same, while the remains of the temporal fields became still more reduced. The patient's general condition, however, improved somewhat, and about six weeks after the operation a slight increase in the lower temporal fields occurred. When last heard from in November, 1916, he stated that his sight was no better.

Figs. 11, 12, show fields taken in April, 1916, after the operation.

Case X.—D. M., male, age 45 years. Under the care of Professor Gulland. Seen October, 1913. R.V. = no perception of light; optic atrophy. L.V. = 6/12, disc pale. Field of vision: complete temporal hemiopia for 20/300 white. Smaller objects down to 1/300 white show commencing shrinkage of lower nasal quadrant. A minute analysis of the nasal half field was not undertaken. The patient died in December, 1913. A large and very soft pituitary tumour extending upwards into the brain was found. The shrinkage of the lower nasal quadrant found suggests that the upper nasal quadrant was relatively the stronger.

Case XI.—J. A., male, aged 47 years. Seen November, 1913. History of gradual loss of sight for last five or six months, more rapid recently. Corrected vision: R. 6/60. L. 6/60 +. Slight pallor of right optic disc. Plate II, Fig. 1, shows field of R.E. by Bjerrum's method. Boundary for white 1/2000 practically normal; a small scotoma with straight vertical and horizontal inner and lower margins occupied the apex of the upper-outer quadrant. For red 10/2000 there is a large centro-caecal defect. The left field (Plate II, Fig. 2) for 1/2000 white is very weak in its upper-outer quadrant (dotted area) and a similar, but larger scotoma is present Red 10/2000 is only detected in the apex of the upper-inner quadrant, in the corresponding part of the lower-inner quadrant it appears yellow, and colourless in the apex of the lower outer quadrant. No other symptoms were present; the peripheral field of the left eye was normal, right not examined. This patient was a poorhouse inmate, and was not seen again. Here the lesion apparently affected mainly the more central fibres in the chiasma. The similarity between Figs. 2 and 4, Plate II, is very striking. See also Figs. 3, 4 and 5.

Case XII.—J. M., male, age 43 years. Seen November, 1913. Under the care of Dr. Paterson. History of severe headaches for five or six years, which ceased about September, 1913. Gradual loss of sight occurred, which became more marked about a month before the cessation of the headaches. During the last five weeks he thought his sight had been a little better. R.V. = hand movements before face. L.V. = 6/18, optic discs slightly pale. Skiagraphic and rhinoscopic examination negative. Figs. 13, 14, show fields taken in January, 1914. Relative retention of fourth quadrant marked in each field, more especially the right. A larger test object showed the remains of the temporal field on the left side, with a scotoma upwards and inwards from the blind spot. Potassium iodide and mercury were ordered, and in June, 1915, patient was reported to be back at work and in good health. He could not be persuaded to return for further examination. Probably syphilitic lesion.

Case XIII.—Mrs. G., age 29 years. Seen May, 1915, under the care of Dr. Boyd. Commencing acromegaly. Very early field changes only.
CASE XIV.—W. A., male, age 65 years. Seen June, 1915, under the care of Dr. Paterson. Loss of sight "at sides" had been noticed for 10 to 12 years. Headache had been present for six months, just at present better. R.V. = 6/36. L.V. = 6/12. Both discs show incipient atrophy.

Neurological examination negative. Fig. 15 gives the field of the right eye for 5/300 and 1/300 white, showing clean-cut retention of the fourth quadrant, slightly larger for the larger object. The left field, Fig. 16,
BITEMPORAL HEMIOPIA.

showed an undifferentiated nasal half field for 5/300 white, to which a portion of the lower-outer quadrant could be added by 30/300 white, forming a hook-shaped outline indicating the previous presence of a scotoma. Last seen in July, 1916. The condition of the fields is much as before, but now small white and coloured objects are, in the left field, only recognised in the fourth quadrant, i.e., this field is now differentiated into a stronger upper and weaker lower nasal quadrant. A skiagram shows great enlargement of sella with absorption of dorsum sellae.

CASE XV.—W., male, aged 53 years. Seen July, 1915, under the care of Dr. Mackay. History of progressive dimness of sight for six months. No other symptoms excepting an occasional feeling of "fulness" in the head and a tendency to drowsiness. In July, 1915,

![Fig. 17](image1)

![Fig. 18](image2)

R.V.=6/9+; L.V.=6/60. Optic discs normal. Some old choroiditis in left eye. Skiagram shows erosion of clinoid processes and great flattening of sella Turcica. The fields of vision showed characteristic bitemporal hemiopia, but with somewhat atypical scotomata. Figs. 17, 18 show the fields in August, 1915, by Bjerrum's method, when R.V.=6/12, and L.V. = hand movements in upper-inner field. Mercury and iodide, and thyroid were tried without benefit. In September, 1915, the nasal field of the left eye disappeared, while the temporal field was partially restored, the condition having changed to a modified right homonymous hemiopia. The right field also improved slightly, still retaining its greatest strength in the upper-inner quadrant. Since the fields became homonymous, the condition has remained practically stationary. In June, 1916, there was definite pallor of both optic discs, especially the left, and R.V.=6/12+, L.V.=hand movements best seen down out. Probably a tumour in this case, now well out of the sella.

CASE XVI.—J. R. J., male, age 36 years. Seen August, 1915, under
the care of Dr. Mackay. History of dimness of sight beginning very gradually eighteen months or two years ago. About a year ago he began to feel "unfit," and during July, 1915, his sight got worse. Now R.V. = 6/18, L.V. = 6/6. Discs normal. No other symptoms. Skiagram shows enlargement of sella with erosion of clinoids. The fields of vision showed bilateral centro-cecal scotomata, loss of the upper-outer quadrants for fairly large objects and complete bitemporal hemiopia for small objects. Differentiation into upper and lower-nasal quadrants was absent. Although there was nothing definite in the history and a Wassermann examination was negative, mercury and iodide were tried in view of the possibility of syphilis. Judging by his letters this treatment was beneficial, at least at first: his last letter, written in November, 1916, suggests some doubts. Cope' quotes a case in which he considers that enlargement of the sella was caused by syphilitic periostitis. This case has been included among the early cases as the lower temporal fields were retained excepting for very small test-objects. The X-rays suggest tumour, although the patient's statements as to his improved vision after treatment point to syphilis. The absence of other symptoms is no contra-indication of tumour and the slowness of real improvement is in favour of tumour, which seems the most probable diagnosis.

![Fig. 19](http://bjo.bmj.com/content/10/4-6/234/suppl)

**Case XVII.**—B. M., female, age 20 years. Seen September, 1915, under the care of Dr. Logan Turner. History of gradual loss of vision without other symptoms. R.V. = counting fingers at one metre; L.V. nil. Both discs show post-neuritic optic atrophy. Rhinoscopy and skiagraphy negative. Fig. 19 shows fields of right eye for 5/1000 white and 10/1000 red with retention of upper-inner quadrant. Here again the cause is unknown and is evidently transient. It is, of course, not quite certain whether this is a case of true bitemporal hemiopia, but the total loss of
sight in one eye together with the temporal loss in the other with relative retention of the fourth quadrant show that it is at least closely allied to that condition.

**Case XVIII.** Mrs. R. T., aged 46 years. Seen September, 1915, under the care of Dr. Paterson. History of failing vision in the left eye more rapid during the last year. The sense of smell is poor and there is some deafness, otherwise patient is in good health. Skiagraphy negative. R.V. c. –1 D. sph. = 6/9; optic disc normal. L.V. = counting fingers at 2 feet; disc pale. Fig. 20 shows field of left eye, very little extension being obtained by an object as large as 40/300. Plate II, Fig. 3, gives the field of the right eye by Bjerrum’s method, showing very early signs of temporal hemiopia as indicated by the shrinkage on the temporal side, especially above, and the temporal loss for red. In this case also the exact cause is doubtful.

![Diagram](image)

**Fig. 20.**

**Case XIX.** A. S., male, age 20 years. Seen September, 1915, under the care of Dr. Flett. History of tuberculosis of cervical vertebrae, with paralysis of lower limbs, which lasted for about three years. Then deafness for about four months, and about the same time dimness of vision was noticed. When seen, R.V. and L.V. = hand movements on nasal side. Advanced optic atrophy. Bi-temporal hemiopia, with large central defects, giving fields a somewhat crescentic shape. Skiagraphic and rhinoscopic examination negative. Figs. 21, 22, show fields by Bjerrum’s method at 1,000 mm. The small white object was much better seen above, and red 70/300 was recognised in the upper inner quadrants only. When seen in January, 1916, the blindness was worse, if anything. In this case one must assume that there is, or has been, a tuberculous lesion of, or near, the chiasma.

**Case XX.** E. K., female, age 26 years. Seen October, 1915, under
the care of Dr. Logan Turner. History of syphilis contracted in 1906, and treated with salvarsan. Dimness of vision came on shortly afterwards, but apparently disappeared later. In May, 1914, left eye became painful and watery, and a gumma developed on nose. About the end of August, 1915, there were very severe headaches, with much pain in the eyes, and the left eye rapidly became blind. When seen, R.V. c. − 3D. sph. = 6/60. L.V. = nil. Optic discs normal. Severe headache; pain on pressing eyeballs back especially on the left side. Field of vision, Fig. 23, shows much enlarged blind spot with relative retention of upper-inner quadrant. The blindness of the left eye, together with the state of the right eye, seemed to justify the inclusion of this case as one of probable bitemporal hemiopia, or at least a very closely allied condition. There was a large perforation in the nasal septum, and a skiagram showed relative dullness of left and right ethmoidal cells and of left antrum.

In November, 1915, there was still no vision in the left eye, but the right had improved to 6/12.

In July, 1916, patient was admitted to the Infirmary under the charge of Dr. Rainy. She had been ill and had bad headaches again. R.V. (corrected) = 6/12. L.V. = counting fingers at one metre in the upper inner quadrant. The right optic disc is a little pale, the left markedly so. Fields of vision now show only a little contraction on the right side and the upper inner quadrant only on the left side. Fig. 24. The sight began to return to the left eye in November, 1915. It is to be noted that the left eye was totally blind for about three months and then recovered its upper inner quadrant. Probably the cause was a basal syphilitic periostitis.

CASE XXI.—N. D., female, age 26 years, under the care of Dr. Mackay. Seen November, 1915. History of slow failure of vision for about a year. In September, 1915, patient was unable to read but sight then improved somewhat. R.V. = 6/18—, L.V. = 6/18. The right disc was slightly pale, the left distinctly atrophic. The fields show complete bitemporal hemiopia, a test as large as ⅔ white not being seen in the temporal field of either eye. There was no differentiation into third and fourth quadrants either for white or colour, and no scotoma was present in the nasal fields. Skiagraphy showed slight enlargement of the sella. Thyroid treatment was instituted.

In August, 1917, patient was reported quite well and at work since January. She was seen again on August 28th. She felt well but her features seemed a little coarsened. R.V. = 6/5—, disc pale. L.V. = 6/24, disc pale and atrophic, eye diverges and does not fix well. Menstruation still absent. Fields show no alteration of note. In spite of the patient’s feelings the conditions present show no real improvement. This is the only one of the ten advanced cases in which the nasal field could not be divided into upper and lower quadrants by serial test-objects. The absence of menstruation and the appearance of the features lead one to suspect tumour, probably pituitary. The rather doubtful X-ray examination would not exclude an early infundibular enlargement.

Fields show typical bitemporal hemiopia in a relatively early stage, characteristic defects being present only for small objects. The vision of the right eye deteriorated to less than 6/60, the upper part of the letter only being visible. The left eye improved to 6/6 partly. Pot. iodide and mercury were ordered, and when last heard of the vision was very much better. Plate II, Fig. 4, shows the field of the right eye by Bjerrum’s method. Note the hemiopic shape of the scotoma, which is very dense in its upper part (30/2,000 not seen) corresponding to the apex of the first quadrant, less dense below (30/2,000 seen, but objects smaller than 20/2,000 not seen) in the part corresponding to the apex of the second quadrant. On the nasal side the field for 0.5/2,000 white is confined to an area corresponding to the apex of the fourth quadrant, practically coinciding with the field for 4/2,000 red. Vision is, therefore, worst in the first, and best in the fourth quadrant of the central area, the lower quadrants having intermediate values. The peripheral changes are not far advanced in this case, but the right field, as a whole, shows the clockwise course of the defect very well. In the left field there were early peripheral changes sufficiently advanced to show complete temporal hemiopia for a very small test object. There was no scotoma and no differentiation of quadrants was present. Potassium iodide with mercury was ordered, and, when last heard of in May, 1916, the sight was reported to be much better. Presumably the cause was a syphilitic basal meningitis.

CASE XXIII.—H. B., female, aged 40 years, seen March, 1916, under the care of Professor Gulland. Acromegaly of about 6 years’ duration. Sella Turcica enlarged: amenorrhoea, headache, rotatory nystagmus, and loss of convergence present. The right eye diverges and its optic disc is slightly pale. Left disc normal. Pupils small and react normally. Corrected vision: R. 6/12, L. 6/9 part. Both fields show advanced bitemporal hemiopia with some perception of large white objects still remaining in the second quadrants, which have an uncinate shape, indicating the previous presence of scotomata. Colour best recognised in upper-inner quadrants. Plate II, Fig. 5, shows field of left eye by Bjerrum’s method. In the right eye the condition was similar, though it was not easy to get a definite chart. Later, however (May 19th), a similar chart, Plate II, Fig. 6, was obtained. An operation was performed on June 11th by Colonel Caird, who thought that the sella had been entered, though nothing could be removed. On June 25th, R.V. = 6/9−1, L.V. = 6/6−1, and the headache, nystagmus, and weakness of convergence had improved. The perception of large white objects in the second quadrants was now practically lost, and the differentiation into upper and lower quadrants on the nasal side was undemonstrable. Evidently there had occurred improvement in direct vision and in the nasal fields, and also in the other ocular conditions with the exception of the temporal fields, which continued to show progressive loss. When last seen on July 14th, 1916, the corrected vision was R. 6/9−1, and L. 6/6. The discs were as before, the divergence had disappeared, but the nystagmus was more evident again. The temporal vision for a large white object, 60/300, was now absolutely lost, and colour quadrant-differentiation on the nasal side was found occasionally, although not with sufficient certainty to chart. This sign was, however, much more evident than on June 25th.
A letter from her doctor, dated November, 1916, states that the headaches are very severe again, but the vision still much the same.

Nystagmus is referred to by Uhthoff as a rare symptom occurring in about 6 per cent. of cases of acromegaly, and less often in pituitary tumours without trophic disturbance.

CASE XXIV.—K., male, aged 29 years, seen April, 1916, under the care of Professor Gulland. Pituitary infantilism with enlarged sella Turcica. Appearance is that of a boy of 13 or 14 years. R.V. = counting fingers at 1 metre, L.V. = 6/24. Discs deeply cupped and slightly pale, but not definitely atrophic in appearance. Fig. 25 shows field of R.E. The left field showed complete temporal loss without obvious differentiation into quadrants on the nasal side. The patient's mentality, however, prevented a more detailed or prolonged examination.

(To be continued.)

THE RETINAL SIGNS OF ARTERIO-SCLEROSIS COMPARED WITH THOSE DUE SIMPLY TO INCREASED BLOOD PRESSURE.*

BY

P. C. BARDSLEY,

LONDON.

In 1897, in Volume XVIII of the Transactions of the Ophthalmological Society of the United Kingdom, Mr. Marcus Gunn published his monumental work on the retinal signs of arterial sclerosis.

* Read in the Section of Ophthalmology of the Royal Society of Medicine on February 7th, 1917.
BITEMPORAL HEMIOPIA: THE LATER STAGES AND THE SPECIAL FEATURES OF THE SCOTOMA: With an examination of current theories of the mechanism of production of the field defects

H. M. Traquair

*Br J Ophthalmol* 1917 1: 216-239
doi: 10.1136/bjo.1.4.216

Updated information and services can be found at: [http://bjo.bmj.com/content/1/4/216.citation](http://bjo.bmj.com/content/1/4/216.citation)

**Email alerting service**

Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

**Notes**

To request permissions go to: [http://group.bmj.com/group/rights-licensing/permissions](http://group.bmj.com/group/rights-licensing/permissions)

To order reprints go to: [http://journals.bmj.com/cgi/reprintform](http://journals.bmj.com/cgi/reprintform)

To subscribe to BMJ go to: [http://group.bmj.com/subscribe/](http://group.bmj.com/subscribe/)