BIBLIOGRAPHY.

1. Preface to "A Synopsis of Diseases of the Eye and their Treatment," by B. Travers, page viii. 2nd Edition, 1821.
2. Idem, page vi.
3. "Breviary of the Eyes," Richard Bannister, London, 1622 (not paged).
4. Preface to "A Synopsis of Diseases of the Eye," page x.
5. Idem, page ix.
6. Idem, page x.
7. "A Synopsis of Diseases of the Eye," page cxlviii. 1821.
8. Saunders.—"Diseases of the Eye," edited by Farre, page i. 1811.
9. "A Synopsis of Diseases of the Eye," page ccxxxi.
10. Idem, page clxxxvi.
11. Idem, page cccl.
12. Norris and Oliver.—"System of Diseases of the Eye," Vol. III, page clvii. 1898.
13. "Diseases of the Eye," 3rd edition, page cclxxviii. 1840.
14. *Medical Times and Gazette*, Vol. I, page cclxxi. 1858.
15. "Biographical Memoirs of the most celebrated Physicians and Surgeons," Vol. IV. 1839.
16. *Medical Times and Gazette*, Vol. I, page cclxxii. 1858.

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.

(Continued from p. 239.)

BY

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Anatomy.

Having now studied the typical form of the field changes and the way in which they develop, it is essential, before proceeding further, to review shortly the main points in connection with the normal anatomical relations of the chiasma to the adjacent structures, more especially to those which lie beneath it.

In many, even up-to-date, text-books, whether of anatomy or of ophthalmology, the chiasma is said to lie upon the optic groove of the sphenoid, all further details being permitted to remain in obscurity. This description is not based on actual observation and is completely imaginary. Only the anterior half of the chiasma could lie on the narrow optic groove; the posterior part would lie over the olivary eminence and the anterior edge of the sella Turcica. The angle between the two optic nerves would require to be practically equal to two right angles. The infundibulum would pass

vertically downwards or even downwards and backwards to the pituitary body, leaving a wide angle between its anterior surface and the inferior surface of the chiasma. Such conditions very seldom occur.

FIG. 26.—Anatomical Relations of the Pituitary Body.

C. Chiasma. O.N. Optic Nerve. H. Hypophysis. S. Sphenoidal Sinus.

The anatomical relations of these parts have been studied by Lawrence,³⁰ Fawcett,¹⁴ Zander,⁶⁶ Hirsch,²⁹ Wallis,⁶⁰ and Cope,⁶ and most of the essential points may be regarded as established. The optic groove was found by Zander in only 34 per cent. of skulls. Behind this lies the olivary eminence, which varies greatly in size and is very often poorly developed. The sphenoidal cells, when well developed, extend beneath the optic groove, olivary eminence, and sella Turcica. The dorsum sellæ, crowned by the posterior clinoid processes, bounds the sella Turcica behind, but the anterior margin of the latter is more variable and corresponds to the posterior margin of the olivary eminence. The diaphragma sellæ is a fold of dura mater which roofs in the sella. It is attached in front to the posterior margin of the olivary eminence, a band on each side passing to the lower edge of the optic foramen, and behind to, or immediately below, the crest of the dorsum sellæ.

In, or often slightly behind, the centre of the diaphragma is an opening through the posterior part of which the infundibulum passes. This opening, or foramen diaphragmatis, varies greatly in size and is

nearly always much too large for the infundibulum. It is filled in by a thin transparent membrane, through which the hypophysis is visible, and which may form almost the whole roof of the sella, the diaphragma itself being reduced to a mere rim. In such cases there would be practically no obstruction to the easy upward growth of an hypophyseal tumour. Thus the area under consideration extends from the limbus sphenoidalis in front to the dorsum sellæ behind and consists anteriorly of a thin bony wall of variable extent covering the sphenoidal cells and posteriorly of a membranous layer of varying thickness covering the pituitary body. Above these structures lie the optic nerves and chiasma. While the plane of the area described is approximately horizontal, or sloping a little downwards posteriorly, that of the optic nerves and chiasma inclines slightly upwards behind, so that the back of the chiasma lies at a somewhat higher level than the optic foramina, and the space between the chiasma and the subjacent structure increases from before backwards.

The intracranial part of the optic nerve varies greatly in length from 4 mm. to as much as 21 mm., averaging 13 mm. (Zander). The position and relations of the chiasma obviously depend to an important degree upon this factor, as the shorter the nerves are the more relatively anterior will be the chiasma and *vice versâ*. The angle between the optic nerves is usually more or less acute, quite unlike the very obtuse angle so often shown in illustrations and diagrams, and it is only in cases where the intracranial optic nerves are unusually short that this angle becomes wide and the chiasma therefore occupies a forward position. In such cases, which are not common, a well developed olivary eminence is beneath and possibly in contact* with the anterior border of the chiasma. In eleven subjects Wallis⁶⁰ observed one case in which more than one-half of the chiasma lay upon the optic sulcus and the olivary eminence. Judging by the findings of others, the proportion of such cases must be much less than one to eleven.

If the chiasma with the apex of the third ventricle be left *in situ* after removal of the rest of the brain and viewed from above, a wedge-shaped portion of the diaphragma sellæ, extending backwards to the extent of a third or a half, or even more of its antero-posterior diameter, will usually be seen in the angle between the optic nerves and frequently also a portion of the foramen diaphragmatis. Thus the chiasma lies well behind and above the usually described position. Its posterior edge projects behind the level of the dorsum sellæ to an average of 1.58 mm. (Zander) and is very rarely found in front of this point. A large subarachnoid space lies

* It must be remembered that the true height of the chiasma above the subjacent structures cannot be ascertained when the skull is opened in the ordinary way, even by removing the brain piecemeal.

beneath the chiasma, and the vertical distance between its lower surface and the diaphragma sellæ is as much as 5 mm. to 10 mm., according to different observers.

The writers mentioned pay scant attention to the position of the infundibulum. This structure, as is well known, resembles a much elongated funnel, being thin at its termination and considerably thicker where it leaves the third ventricle. At this point it lies behind the level of the dorsum sellæ, over which it passes in a forward and downward direction. Immediately beyond its commencement it is in contact with the centre of the lower and posterior surface of the chiasma. As it arches over the dorsum sellæ, its direction is almost parallel to the plane of the chiasma. In front of the dorsum sellæ it is directed more downwards, leaving the chiasma at a very acute angle, and passes to the posterior edge of the foramen diaphragmatis keeping close to the dura covering the dorsum sellæ.

It is important to remember that it is the infundibulum and not the hypophysis which is in immediate contact with the chiasma. Thus a commencing primarily infundibular tumour or a thickened and congested infundibulum pressed upwards by a subjacent hypophyseal enlargement would impinge directly upon the mid-line of the under surface of the chiasma and might exert an approximately central longitudinal pressure at a comparatively early stage. Apart from producing actual pressure, the infundibulum is so vascular, and so closely bound to the lower surface of the chiasma by the pia mater that any congestive or irritative condition in it might easily be communicated to the chiasma.

The pia mater stretches across between the optic nerves like an apron and is closely adherent to their lower surfaces. At the sides it is attached to the carotid arteries and behind to the anterior border of the chiasma and to the infundibulum which it closely surrounds. Delicate connections pass between the pia and the dura over the roof of the cavernous sinus and over the dorsum sellæ. In front of the infundibulum and anterior border of the chiasma, over the diaphragma sellæ and the sphenoid, there is a free space, apparently without connecting filaments.

The relation of the chiasma to the circle of Willis is of some importance in that the anterior communicating artery lies across the two optic nerves. When the chiasma is forced upwards by a tumour, the optic nerves are compressed between the vessels, usually the beginning of the anterior cerebrals, and the tumour. This point is referred to by Uthoff⁵⁴ and others, especially by Hirsch.²⁹ Bartels² states that if the constriction is slight and slowly developed, direct damage to the nerve need not result.

Another pathological anatomical feature is the indentation of the optic nerve at the entrance to the optic foramen when the chiasma

is pressed upwards. This condition is referred to by Walker and Cushing⁵⁹ and by Uhthoff⁵⁴ who, however, failed to find any true constriction of the nerve at this point.

Relation of field defects to cause.

In attempting to study the relation of the field defects to the underlying causal condition little help is to be obtained from the literature. While bitemporal hemiopia due to tumours in the neighbourhood of the chiasma has been studied by Cushing and Walker and others, I have failed to find any report in which the field changes, in cases due to a variety of causes, have been critically compared. Apart from tumours, tabes has been mentioned by Fuchs¹⁹, whose findings have already been referred to. As far as the tabes is concerned Fuchs's view has been strongly opposed, and on apparently sound grounds, by Langenbeck.⁸⁴ Uhthoff⁵⁴ found that in brain syphilis the chiasma was a favourite site for gummatous processes and gives three typical fields of vision, one of which especially shows the retention of the upper-inner quadrant. Bogatsch⁵ gives an analysis of 315 cases of which 50 per cent. were due to proved or suspected tumours, 11 per cent. to syphilis, 1 per cent. to tubercle, 20 per cent. to various causes, while 18 per cent. were without ætiological indications. Only one case was due to post-nasal sinus disease, but others have been mentioned by Glegg and Hay,²³ Jameson Evans,¹³ Grönholm,²⁶ and Wallis.⁶² Case No. III in my series was probably due to this cause, although the right antrum only was proved to be affected, and case No. XX was of similar nature. In regard to case No. XIX in which the only diagnosis was cervical tuberculosis, Bogatsch mentions three cases as due to tubercle. Fleischer¹⁶ mentions a case of tuberculous tumour of the cerebellum with optic neuritis, blindness, and enlargement of the sella Turcica, but the presence of bitemporal hemiopia is not definitely stated. Pituitary tuberculosis is referred to by Uhthoff⁵⁴ as a rarity. Unfortunately the frequent absence of perimetric records and the lack of uniformity in method and detail in regard to such perimetry as has been done has greatly reduced the value, for our present purposes, of the greater part of the observations which have been recorded. In the present series of 22 cases, in three, or about fourteen per cent., the cause was undiagnosed, a figure which closely corresponds with the eighteen per cent. found by Bogatsch.

If we now review the pathological conditions in these 22 cases we find that acromegaly was present in nine (Nos. I, II, IV, V, VI, VIII, IX, XIII, XXIII) and absent in 13. Group I contains two acromegalies (IX, XXIII), one infantilism (XXIV), and three cases with X-ray signs of tumour (XIV, XV, XXI). One case (X) showed a large tumour *post-mortem*, one (XIX) had cervical tuberculosis, and

one was undiagnosed (XVIII). The remaining case, No. XII, was probably syphilitic, as it responded rapidly to mercury and iodide.

Group II includes two acromegalias (I, V), one case of suppurating maxillary sinus (III), one of syphilis (XXII) judging by the history and the result of treatment, and two (VII, XI) for which no cause was ascertained.

Group III contains five chronic acromegalias (II, IV, VI, VIII, XIII) and one case (XVI) of doubtful ætiology, either tumour or syphilis, probably the former. It may be noted that in all cases of acromegaly field changes were found.

Group IV includes one undiagnosed case (XVII) and one of well-marked syphilis with nasal sinus involvement (XX).

Scotomata.

As already mentioned, there were ten cases with scotomata (Nos. I, III, VII, IX, XI, XII, XV, XVI, XIX, XXII) and several others (*e.g.*, XIV, XXIII) had probably had scotomata, although they were not observed at the time of examination. Scotomata were not found in the very chronic acromegalias, all the cases in which they occurred being of a relatively active type; that is to say, the history of visual defect was comparatively short and the fields were in a more or less fluid state, showing changes from time to time. This bears out the view put forward in my previous paper that these scotomata are usually associated with relatively greater activity of the lesion, such as is present in active pituitary tumours or in inflammatory conditions, than occurs in the more slowly moving lesions, such as the very chronic forms of hypophyseal enlargement. The five cases in which scotomata showed typical features were due: one to acromegaly (I), one to antral suppuration (III), one to syphilis (XXII), and two were undiagnosed (VII, XI). The other five were due: one to acromegaly (IX), one to syphilis (XII), one to tumour (XV), one to either tumour or syphilis (XVI), and one to cervical tubercle (XIX). There is therefore no special ætiological relationship as far as the form of the scotoma is concerned.

The ring scotoma in Case IX (p. 229) is of sufficient interest to merit a more detailed discussion. From Fig. 8 it is apparent that a fairly wide bundle of fibres both upwards and downwards is affected and that the number of fibres involved is greater towards the centre of the bundle. Also the fibres concerned are only affected in so far as they belong to the crossed fasciculus, the defect stopping sharply at the area of the uncrossed fasciculus. In bitemporal hemiopia the occurrence of a half ring scotoma has been seldom described. Rönne⁴¹ illustrates a quadrant ring scotoma; and Fuchs,¹⁹ using Bjerrum's method, found a hemiopic ring scotoma foreshadowing bitemporal hemiopia in cases which he considered to be tabetic

atrophy. A scotoma of this nature but without the straight vertical mesial boundary is figured by Cushing and Walker⁹ (Figs. 45-47). It occurred in a child of fourteen with hypopituitarism and "a large irregular calcareous tumour wrapped around chiasm." Explanations have been attempted by Gallus²², who attributes this form of defect to retrobulbar neuritis affecting the optic nerve between the chiasma and the outer end of the optic canal, and by Marx³⁷, who suggests the same condition affecting the nerves between its commencement and the entrance of the central vessels. While it seems quite probable that some form of retrobulbar neuritis is concerned, both of these explanations are theoretical and do not take into account the occurrence of the hemiopic ring scotoma. Whatever the cause may be, it is evidently not dependent on anatomical conditions, such as close confinement by unyielding bony walls, which are limited to a particular portion of the nerve, but may also act further back where the conditions are quite different. The escape of the usually so easily affected macular fibres presents an interesting and hitherto unsolved problem.

Radiography.

Fourteen of the 22 cases were X-rayed and also the 2 extra cases; 3 of the 6 cases with early field changes were X-rayed and gave positive results; 2 were acromegalies (Nos. II, VIII) and showed slight enlargement and deepening of the sella, the third (XVI), with only visual symptoms, showed expansion of the sella with erosion of the clinoids. Eight of the ten advanced cases were examined, 6 giving positive results: 2 acromegalies (IX, XXIII), 1 infantilism (XXV), and 1 undiagnosed case (XXI) had enlargement of the sella to a greater or less extent; and 2 (XIV, XV), with only visual symptoms, had extensive flattening of the sellar area with erosion of the clinoids. In this connection it is of interest to note that Hirsch and Frankl-Hochwart¹⁷ have found that tumours in this region may be very large without producing any symptoms other than visual-field changes and some drowsiness and lassitude. This was exactly the case in Nos. XIV and XV in which tumour was suspected, and also in No. XVI, in which, however, considerable benefit resulted from iodide and mercury. The 2 cases with normal sellæ include 1 (XVIII) undiagnosed, and 1 (XIX) with cervical tubercle. Fearnside¹⁵ has noted that suprasellar tumours, unless they are large, may cause no sellar deformity, while Gilbert Scott⁴⁹ states that in acromegaly there may be practically no alteration. These observations, together with that of Hirsch and Frankl-Hochwart, may explain some of the difficulties of diagnosis. In the 6 cases with typical scotomata or central changes and relatively early peripheral field defects sellar deformation to any great extent would *a priori* not be expected. Unfortunately only three of these were X-rayed;

one (No. I) had acromegaly and sellar enlargement, the other two (III, XXII), with antral suppuration and syphilis respectively, had normal sellæ. Four of the five other scotomatous cases (IX, XII, XV, XIV, XIX), as already described in other groups, were X-rayed and positive results were found in three (IX, XV, XVI). Case XII was not examined and Case XIX was negative. Both the extra cases (XVII and XX) were examined with negative results.

It is well to bear in mind, when interpreting skiagrams of suspected hypophyseal or infundibular tumour that deformation of the sella with absorption of the posterior clinoids has been shown by Heuer and Dandy²⁸ to be by no means certain evidence of a local lesion, but a common general pressure phenomenon, especially in cases of cerebellar tumour. The trabecular or honeycomb-like shadow occasionally seen in the neighbourhood of the sella Turcica in transverse radiograms of the skull is due to the presence of aircells in the cellular or pneumatic type of temporal bone, which from one cause or another have been in the path of the rays passing through the sella when the photograph was taken. This shadow is sometimes mistaken for evidence of a pathological condition.

The most striking feature of this analysis is the great variety of conditions which may be associated with the same type of changes in the fields. It has been shown that the perimetric defect in the majority of cases travels round the centre of the field clockwise in the right eye and counter-clockwise in the left, and that this occurs whether the defect is chiefly peripheral or central or when both forms progress together. This type of field change occurs whether the primary condition is a mere enlargement of the hypophysis as in the usual form of acromegaly, still within the bounds, although these may be somewhat expanded, of the sella Turcica, or an unconfined and more extensively spreading tumour in the chiasmal neighbourhood, excepting, of course, laterally placed tumours, which produce homonymous hemiopia. In post-nasal sinus disease, in lues basilaris, and in other conditions the same type of field also occurs. It may be noted that pronounced sellar deformity is practically always associated with marked field defects, though the converse is by no means true. Beyond the association of scotomata with the more active cases and the severity of the field changes due to large tumours, there appears to be almost no relationship between the nature of the causal lesion and the type of field defect produced.

Where there is severe and lasting disturbance in the fields, with sellar deformation, a tumour of considerable size may be suspected, even in the absence of other symptoms of intracranial growth. In scotomatous cases in which the field changes vary rapidly from week to week or even from day to day, where central vision is relatively severely affected in association with a normal sella Turcica,

an inflammatory condition, such as nasal sinus disease or lues basilaris, should be thought of.

Mechanism of production of the field defects.

We are now faced with the interesting and difficult question :— How are these field changes brought about? It is obvious that, as the same type of field change may be associated with different pathological conditions, any consideration as to the mode of production of these changes must take into account all known causal conditions and must therefore be based upon a study of bitemporal hemiopia in general. The search for the necessary common factor must not be limited to an examination of bitemporal hemiopias produced by any one form of lesion.

Three theories have been advanced, depending on pressure, traction, and local intoxication respectively, and we may now proceed to examine them in the light of our present clinical and anatomical observations.

Pressure.

Up to the present, consideration of this subject has been based mainly, if not entirely, upon a study of tumour cases, and thus great importance, perhaps too much importance, has been attributed to pressure upon the chiasma. It is hardly necessary to mention that tumours interfere with the function of nerve fibres upon which they press and it is well known that a laterally placed tumour in the chiasmal region produces homonymous hemiopia, as might be expected. A strong argument is furnished by the well-known beneficial effects of operative interference. The favourable result of operation, repeated, if necessary, several times, is well shown by the cases recorded by Hirsch, Cushing, and others. In several cases repeated evacuation of a cyst caused improvement in the visual symptoms on each occasion and in many the removal of a piece of tumour from the sella, varying in size from a cherry or hazel nut downwards, produced benefit, sometimes so great and so lasting as almost to be a cure.

An apparent difficulty is created by the fact that the upper surface of the pituitary tumour is rounded and relatively broad and can hardly exert a limited antero-posterior "knife-edge" pressure upon the chiasma such as might be considered requisite to produce the very definite and clean-cut defects often found in the fields. A thorough examination with serial test objects will show that in most cases these defects are not so clearly defined as might be supposed, a feature which is in agreement with the diffuseness of the degeneration picture observed by Walker and Cushing⁵⁹ in cross sections of the nerve fibres. It must be remembered, too, that by no means all of the nerve fibres are destroyed which subserve

an area which has lost all perception of light even for a considerable period, and thus a sharply demarcated field defect, which is the expression of a purely subjective functional test, need not necessarily be represented by a corresponding area of degenerated fibres. Within certain functional limits, however, the field defects are often quite clearly defined and it would appear that an antero-posterior "knife-edge" pressure upon the chiasma is not *necessary* to produce apparently clean-cut bitemporal hemiopic fields. Circumstances which may favour this are that at the lower and posterior part of the chiasma, the part upon which the tumour usually first impinges (Bartels²), only crossed fibres are present (Wilbrand and Saenger⁶⁴), and also the close relationship of the infundibulum to this part of the chiasma. Uthoff⁵⁴, who has specially studied the effects of hypophyseal tumours on vision, writes emphatically in favour of the action of direct pressure, and states that the exceptional occurrence of indirect effects may be disregarded.

There are, however, difficulties to be overcome before mechanical pressure effects can be accepted as a satisfactory explanation. Amongst these the following are prominent:

- (a) The great deformation which the chiasma and its connections may undergo without the production of much perimetric change.
- (b) The frequent difficulty of connecting the anatomical relationship of the tumour to the chiasma with the field changes present.
- (c) The existence of a standard type of field change common to bitemporal hemiopias arising from a large variety of causes.
- (d) The preponderance in some cases of central over peripheral defects.

(a) Uthoff⁵⁶ himself writes: "Undoubtedly occasionally a non-malignant hypophysis tumour may last for many years without even causing any visual disturbance." An excellent stereoscopic picture is given of such a case in which it is obvious that the chiasma is raised upwards by the tumour, which completely fills the space between the optic nerves. Again, in relation to slow-growing non-malignant tumours: "the chiasma and basal optic tract may suffer severe compression before they fall a prey to degeneration." What is more, severe pressure apparently need not interfere even with the function of the nerve fibres. Cushing and Walker⁹ say: "It may be gathered, therefore, that the chiasmal 'cross roads' are capable of considerable distortion by a growth in the interpeduncular space without a demonstrable encroachment upon the field of vision. This, moreover, has been demonstrated in a few cases in which supposedly normal fields were plotted shortly before death and yet in which an extraordinary degree of deformation and elongation of the chiasma was disclosed *post-mortem*." Thus, although the "supposedly normal" fields would probably have

disclosed defects to a thorough application of the quantitative method of perimetry, it is evident that great distortion of the chiasma and tracts may occur with, at any rate, very little field change. Hirsch's²⁹ experience has led him to believe that in tumour cases severe visual symptoms indicate intracranial extension of the growth, so that while bad vision is a sign of relatively large tumour, good vision is no contra-indication.

(b) Cushing and Walker have found that, "contrary to expectation," the perimetric defect with suprasellar tumours does not usually begin in the lower quadrants but often follows the typical stages. It may be remarked here that there is no reason to suppose that a suprasellar tumour presses first upon the upper surface of the chiasma. The same authors refer to a field of vision, in which the upper-inner quadrants alone remained, as a "bizarre type" and attribute it to the growth having burst from its dural coverings, enveloping the chiasma and the optic nerves in an irregular way. It has, however, been shown above that this form of field, far from being unusual, is a typical feature of bitemporal hemiopia and occurs quite independently of tumours, whether encapsuled and confined or not, and that this type of defect may be present in some cases at a relatively early stage in the development of the field changes. Case 7 of Hirsch's series is of great interest, as it is an example of an extremely rare field condition—symmetrical retention of the two third quadrants only. A large growth was found *post-mortem* over which the chiasma lay extended, while the optic nerves were deeply indented by the origins of the anterior cerebral arteries. The tracts were much compressed and, together with the nerves, are described as atrophic, though it is not specified whether a microscopic examination had been undertaken. Such conditions as these are by no means rare, and yet in this case the resulting fields were most uncommon. Wilbrand⁶² mentions the possibility of such fields, but had not seen a case, and in an extensive examination of the literature I have not found another. As far as concerns symmetrical terminations, this form must be enormously rarer than retention of both upper-nasal quadrants.

In the succeeding case (No. 8) an uncommon condition was present also, for here the tumour had grown up in front of and on top of the chiasma, which was apparently displaced upwards and backwards. The chief incidence of interference would here appear to be upon the upper surface of the chiasma. The fields showed bitemporal hemiopia with a small scotoma at the apex of each first quadrant and a slightly greater failure of the second than of the first quadrant, especially on the left side. This is to some extent what might be expected from a dorsal interference, only that the scotoma should have been in the second quadrants also.

As far as the effect on the chiasmal nerve fibres is concerned, the size of the tumour and, apart from laterally placed tumours, its position, whether originally intrasellar or suprasellar, appear to have less influence than might be expected, though a difficulty of this kind is in all probability largely due to our ignorance of the exact conditions.

(c) We have already seen that the type of field change with retention of the fourth quadrants may be associated with very different causal conditions. While quantitative differences may be present, the fields are qualitatively of the same type from the beginning, whether a tumour is present or not, and whether the tumour is small or large, intra- or suprasellar. The occurrence of the typical field changes in cases where there is no tumour, as in nasal sinus disease and basal syphilitic conditions, forms one of the most serious objections to the mechanical pressure theory, and suggests that the field changes may depend upon some other factor, which is common to all causes of bitemporal hemiopia.

(d) In a fairly large group of cases (Group II) central field defects predominate, and the fields resemble those of retro-bulbar neuritis. Were mechanical pressure the main cause, it would seem natural that the peripheral fibres, being those first pressed upon, would first show signs of interference. This group of cases is also characterised by a predominance of inflammatory conditions over tumours, although actively growing tumours, which of course may be expected to produce the most marked pressure effects, also cause fields of the scotomatous or neuritic type. In either case the same typical development of the fields occurs, so that further support is afforded to the conclusion that not pressure, but a factor common to inflammatory cases and actively growing tumours is the real cause. The last two objections are the most cogent, and have, so far as I am aware, not yet been taken into consideration by the advocates of mechanical pressure.

In cases such as chronic acromegaly, also, where the tumour is very slow growing, central changes of non-scotomatous type occur with very slight, if any, peripheral field change (Fig. 27). It is open to question whether the sensitiveness of the chiasma is such that the slow gentle pressure, or, more likely, mere contact of an early pituitary enlargement, can mechanically produce changes in conductivity which affect the chiasmal fibres right through to the deeper layers. These field changes rather suggest that the fibres are spread out into flat bands, but even so the peripheral fibres should still suffer most and soonest.

Influence has been ascribed to sudden pressure, and to pressure due to the varying blood content of a very vascular tumour. Such suggestions are simply variants of the ordinary pressure theory; both postulate a tumour sufficiently large to protrude

nearly a centimeter above the normal level of the diaphragma, and both are compatible with the rapid appearance of local vascular and cellular disturbance, which in themselves may be factors of importance. In certain cases, and at certain stages, usually in

FIG 27.

Early perimetric signs of bitemporal hemiopia. From a case of acromegaly of about two years' duration. Note the character of the defect as the central field is examined with increasingly delicate tests. The dotted area indicates faint perception of 2/2000 white. Complete central hemiopia for 2/2000 blue, with almost normal peripheral fields.

the later stages, such forms of pressure very probably come into play and produce variations in the course of the field changes. They can hardly be the cause of the typical defects.

Traction.

Since pressure fails to supply a satisfactory explanation of many of the perimetric findings, traction was suggested by Fisher,⁴⁵ and he has been supported by Fleischer¹⁶ and by Walker and Cushing.⁵⁹ It is conceivable that a large tumour growing between the tracts and below the chiasma, might so stretch the nerve fibres as to cause functional interference. In favour of traction we have only the objections to pressure, and most, if not all, of these apply also to traction. The main difficulty is that traction can only, but apparently need not, result from a large tumour, whereas the field changes commence in their typical form from the beginning. It is also difficult to conceive how traction can cause hemiopic quadrant scotomata with little interference with the peripheral fields.

In connection with both pressure and traction it is evident, from

the anatomical relations of the parts, that before either, and especially the latter, can take effect an enlargement of the hypophysis must already project some distance above the normal level of the diaphragma sellæ, according to Hirsch, at least 7.5 mm. and, according to Cope, 10 mm. or more. There is no evidence to show that the earliest field changes are delayed until such dimensions have been attained by the tumour.

(To be concluded.)

SOME PHASES OF MODERN OCULAR THERAPEUTICS.*

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SINCE the days of the Ptolemies, the medical man with his healing art has been an integral part of civilization. For centuries the human race was satisfied with mysticism and occultism. But a more dignified position was given the healing art by the ancient Greeks, among whom there were three schools or sects in medicine. First: the empirics who insisted that experiment was the prime requisite. Second: the methodists who fell back upon theory. Third: the dogmatists who took middle ground.

In more recent times, experiment and experience have been relied upon as essentials in medicine, and especially that part of it which concerns therapeutics. We all concede that an ounce of prevention is worth a pound of cure. But human life is so inextricably bound up with what Samuel D. Risley has happily called "the physiologic vices" of civilization that preventive medicine, with all its boasted achievements, affords little prospect of doing away with the healing art, at least in our day and generation. So that the cure of disease is still our sacred function. Except we heal our patients, our science and art is in vain. We are become as sounding brass and tinkling cymbals. If we cannot prevent, we must cure the ills that flesh is heir to. Therapy, therefore, must and will remain the supreme effort in combating disease.

The empirical nature of nearly all of our best methods and remedies has been often recognised, and even to-day it is surprising to what an extent we still depend upon what can be credited to empiricism and this alone. I would not for a moment disparage scientific medicine nor the desire to place all medical knowledge

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