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#### ESSENTIAL CONSIDERATIONS IN REGARD TO THE FIELD OF VISION: CONTRACTION OR DEPRESSION?

BY

H. M. TRAQUAIR

EDINBURGH

THE increasing interest which has been taken in the field of vision during recent years indicates that the value of examination of the field, ordinarily spoken of as perimetry, or by some, and with more justification, as campimetry, as a clinical procedure is becoming more widely appreciated.

This being the case it is desirable to scrutinize our attitude towards some fundamental points in the purely clinical aspect of this form of subjective examination. When we begin to think of what the field of vision is and of what we are doing when we test it, a host of more or less scientific and abstruse problems arises, most of which fortunately may be left on one side. Certain essentials, however, must be grasped if perimetry is to be understood as well as practised.

Before we can "take the field" and interpret our results with real advantage it is desirable to have clear ideas as to what we are undertaking and some kind of mental picture will be found most helpful. Any attempt at a complete explanation of the field, with its physics and its psychology, is likely to produce more confusion than elucidation; we must aim at a simple image which

will illustrate the essential features in such a way as to assist the clinician.

To define the field of vision as the projection into space of the light rays which fall upon the sensitive retina during fixation of the eye may be accurate, as far as it goes, but is clinically sterile. It will be found more useful to regard it as a portion of an immense hollow sphere upon the inner surface of which is spread a panoramic picture of external objects showing the central feature depicted with minute detail and vivid colouring while objects at increasing distances from the centre are indicated with correspondingly diminished clearness and duller hues. But the most helpful mental picture of the visual field is obtained when we regard it from the standpoint of visual acuity.

We may imagine the field as an island of vision surrounded by a sea of blindness. The coastline is somewhat ovoid in shape and rises steeply so that the island is surrounded by cliffs vertical at one side, sharply sloping at the other. Above the cliffs is a gently sloping plateau which rises more rapidly again towards the somewhat eccentrically situated summit. This is crowned by a sharp pinnacle whose sides curve steeply upwards from a narrow base. To one side of this point is a pit with sides almost vertical at first but soon becoming perpendicular which extends down to the level of the surrounding sea. To an observer situated in the air above the pinnacle a panoramic view of the whole island is presented. On the shore only large objects can be seen and colours cannot be distinguished. Immediately within the coastline along the top of the cliffs smaller objects are visible and colours can be recognised if in large enough patches, and as the neighbourhood of the summit is approached smaller and smaller objects become apparent until at the apex of the pinnacle the most minute details can be detected. Imagine the surface of such a hill not stationary but subject to slight fluctuations in height and we obtain a glimpse of the normal field of vision.

If we choose to exercise our imagination still further and picture to ourselves this hill under abnormal conditions we must think of it as distorted or partially destroyed by subsidence. Depressions of every variety may occur on its surface, of all shapes, sizes and depths, with straight, curved or irregular margins, with sloping or steep sides, isolated or extending to the shore or to the pit or partly or wholly involving the central pinnacle. Or the coast may be encroached upon by the sea, eroded as it were, while the unaffected parts of the island retain their original altitude and configuration; or combinations of depression and erosion may occur.

If we think of the visual field in this way it becomes apparent that its examination entails not merely the delimitation of the

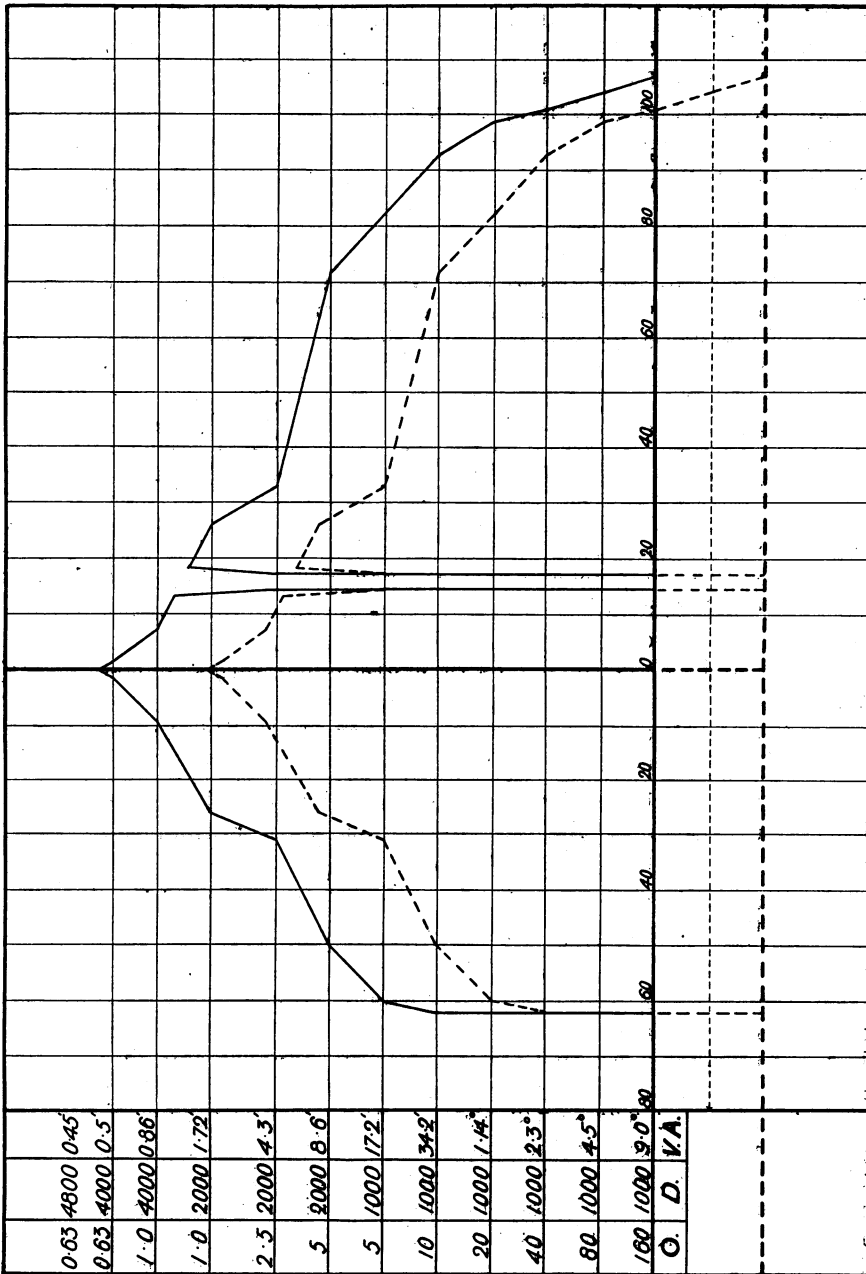


FIG. 1.

The field of vision in horizontal sections. Modified from Roenne's figures (3). The continuous horizontal base line indicates the extent of the field in degrees, the central vertical line the acuity of vision. The figures in the side columns indicate the distance of the test object in mm., O, its distance from the eye in mm., D, and the visual angle subtended at the nodal point, V.A. Beginning with an angle of 9° the visual angle is halved for each successive isopter; a modification is introduced by the substitution of 1/2000 and 1/4000 for the original figures (Roenne) of 2.5/4000 and 1.25/4000. The interrupted line shows the alteration produced by a *uniform* depression of the acuity over the whole field. The blind spot is shown as a pit with crateriform mouth.

coast line of the island or "perimetry," but the measurement of its whole surface. What is required is an orographical survey with all differences in level shown by contour lines, neglecting no depression be it never so restricted or so shallow.

The first essential of perimetry is therefore :

I. The field of vision should be thought of as a hill whose surface sinks and rises, and not as an area whose extent contracts and expands.

It is now easy to understand that visual acuity stands for altitude, and that perimetry consists in establishing the height of the hill and its slope by the determination of isopters which correspond to contour lines. In the same way as each contour line encloses an area of not less than a certain height so each isopter encloses an area of not less than a certain visual acuity. This is the principle of quantitative perimetry which fulfils our requirement of an orographical survey, and for which we have to thank Bjerrum and Roenne.

The practical method of determining the isopters need not be discussed here. It may be emphasized, however, that it is not the use of a small test object or the use of white as opposed to colour tests which constitutes quantitative perimetry, but the determination of isopters by means of a graduated series of test objects.

We are now in a position to affirm the characters—for clinical purposes—of the normal uniocular field.

1. The external or lowest isopter must lie in the normal average position; in other words, the periphery must show normal but not necessarily maximal limits.

2. The internal isopters must occupy normal average positions for the stimuli they represent, *i.e.* the field must show a normal average slope.

3. The central peak of the field must attain an average normal height. This does not mean that the recognition of alphabetical or other symbols must attain to any arbitrary standard but that the fixation area is to be regarded as part of the field. The presence, however, of 6/9 or 6/6 vision with a normal field periphery does not necessarily indicate a normal condition of the central field, for normal central vision is sufficiently acute to undergo considerable impairment before an obvious reduction is demonstrable by a test such as Snellen's types. Where such impairment exists the patient is usually aware that his vision is not as good as previously and the central isopters will be found altered in position although the test card may show excellent

acuity. Similarly expressions such as “ $V=6/24$ , field normal” are unsatisfactory if without explanation.

4. Colour vision and the position of isopters for colour tests, *i.e.* the slope of the field for colour, should be normal. Here a relatively wide allowance for physiological variation is necessary, and the particular standard of ability to recognize colours possessed by the individual must be taken into account, *e.g.* congenital colour blindness may be present.

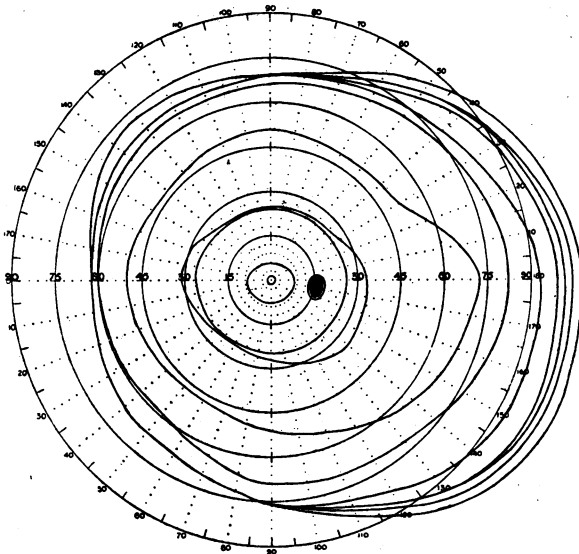


FIG. 2.

Plan of the visual field showing the same isopters as in Fig. 1.

In practice it is only necessary to determine two or three selected isopters, which should not lie close together normally, in order to establish the integrity of the field. The second essential of perimetry is:

II. The condition of the visual field whether normal or abnormal cannot be ascertained by the determination of one isopter, that is to say, by the use of one test-object.

Pathological changes in the field are usually classed as *contractions*, and *scotomata* or gaps.

Contractions may be concentric when the field retains its shape approximately but becomes smaller; irregular, partial or local;

sector-shaped and so on. In a leading text-book contraction of the field is referred to as "a pushing in of the boundary" at some point.

Reverting to our simile of a hill or island of vision standing in a sea of blindness it will be evident that depression of the island if great enough will produce a reduction in the coast line, slight at first but rapidly increasing once the cliffs become submerged and the tide flows over the sloping plateau.

From Fig. 1 it is clear that a uniform depression of the field will produce contraction at first very slight and confined to the temporal side if the periphery alone is examined. It is only when a considerable degree of depression has occurred that any concentric shrinkage of the peripheral isopters becomes manifest. But long before this stage is reached the central and intermediate isopters which are normally situated on the sloping plateau show an easily demonstrable contraction.

The early signs of general depression of the field are therefore to be sought not at the periphery but in the intermediate and central parts of the field.

Most so-called contractions of the field, whether concentric, irregular, or local, are in reality depressions which appear as contractions when only one isopter is examined. When several are determined the true state of the field is immediately disclosed. Since the slope of the field is less steep on the temporal than on the nasal side a uniform depression, when sufficiently advanced to alter the peripheral boundary, will produce restriction earlier and to a greater extent on the temporal side. Before the stage is reached at which the nasal isopters also begin to show contraction the limitation may appear to be confined to the temporal field simulating a temporal, or if bilateral, a bitemporal "contraction." This is, of course, not the same thing as bitemporal hemianopia, which is distinguished by its own special characters. The difference is shown at once by the positions of the internal isopters.

Uniform or approximately uniform depression is not common and when associated with a normal and healthy eye always suggests the probability of a functional cause as it is unlikely, though presumably not impossible, that a local organic interference will produce a uniform impairment of conductivity of the optic nerve. At any rate, from the point of view of diagnosis, the choice of lesions would be limited.

As a rule depression is more pronounced in one part of the field and irregular or sector-shaped contractions are really local depressions. When the depression is confined or almost confined to the periphery an approximation to true contraction is produced. Here again only the determination of internal isopters can show the real character of the alteration.

A little recognized field change is central depression. The peripheral isopters occupy their normal positions but the central isopters are contracted. Direct vision by Snellen's types may be good, from 6/12 to 6/6 partly or thereabouts. There is no demonstrable scotoma as ordinarily understood, but the condition really comes into the class of relative scotomata of low intensity.

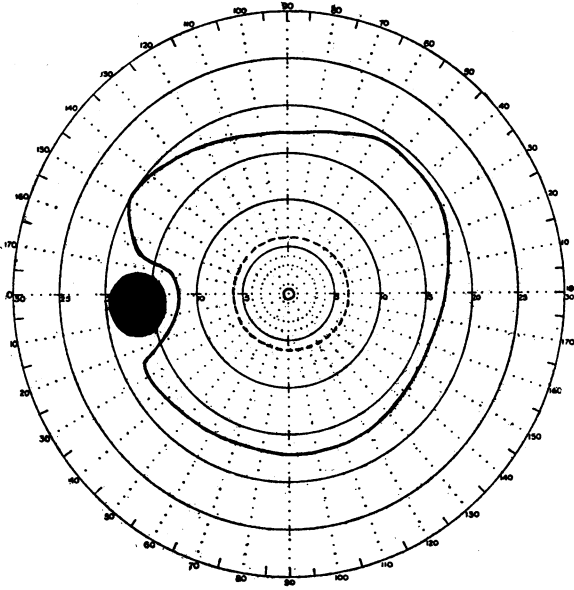


FIG. 3.

Central depression after retrobulbar neuritis. The periphery showed normal limits 1/330 being seen temporarily to 85°. The continuous line shows the field for 5/2000 white, the interrupted line that for 1/2000 white, and the small central area the field for 5/2000 red. These isopters are greatly contracted. The discrepancy between the results of the 5/2000 and 1/330 tests (which subtend almost the same visual angle) shows that the depression is not limited to the central area. Central vision 6/9.

It is present in cases of apparent complete recovery after retrobulbar neuritis, associated with good central vision and relative pallor of the disc, and, in a minor degree, is common, if not constant, as the only field change in the early stage of chronic glaucoma before the appearance of nerve-fibre bundle defects.\* It may be that the depression is general, but more easily detected in the central field.

\* While correcting the proofs of this article I noticed that similar observations have been made by Ransom Pickard, *Brit. Med. J.*, 1923, Vol. II, p. 129.

True contraction of the field, the "pushing in of the boundary" or coast-erosion type of change, must be very rare or at any rate much less common than the familiar use of the term suggests. Personally, I have never met with a case nor have I ever seen one reported. If the field "contracts" from without the edge becomes perpendicular and the seeing part remains unaltered. The isopters within the restricted periphery would retain their normal positions

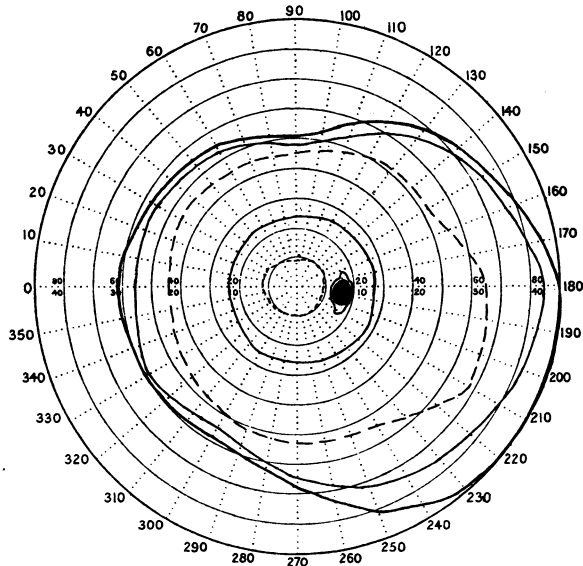


FIG. 4.

Depression in chronic glaucoma. L.E. enucleated for absolute glaucoma. R.E. watched since then for 22 months. Tension usually about 30 to 35 Schiötz. Central vision has dropped from 6/9 plus to 6/18 during the period of observation. Disc slightly pale, but no sign of cupping. No scotoma of Bjerrum type was ever detected. Isopters shown from without inwards for 20/330, 5/330, 1/330, 2/2000, 1/2000; corresponding visual angles are  $3^{\circ}28'$ ,  $52^{\circ}1'$ ,  $10^{\circ}4'$ ,  $3^{\circ}4'$ ,  $1^{\circ}7'$ . The 2/2000 isopter gives an amblyopic area around the blind spot with projections corresponding to the large vessels.

and the central peak its normal height. It is very doubtful if this kind of field change ever occurs as the result of direct organic interference, though it may be present as a final result in certain conditions, such as injuries of the visual path or absolute homonymous hemianopia. But even the latter is more comparable to a "fault" (in the geological sense) with subsidence than to a shrinkage from the periphery inwards. When the field is limited by



the brow or nose (relative field) the peripheral isopters coincide and the margin is perpendicular. The possibility of a purely functional change should be carefully considered when a peripheral concentric or temporal "contraction" with normal remaining field is found.

Scotomata are, of course, local depressions. In the sense of a gap in the field a scotoma is a depression which is surrounded by an area in which vision is normal or less depressed. A scotoma is, therefore, enclosed by its own isopters which are approximately concentric and isolated from the isopters of the field as a whole, as in the case of the blind spot. It is often inconvenient to adhere strictly to the letter of a definition and the term scotoma is freely used with regard to field defects which extend to the periphery. In such scotomata the peripheral isopters turn inwards along the side of the defect. To revert again to our simile we may imagine a crater on the hill or a lake draining through a valley or cleft to the shore.

In all forms of depression the earliest signs are most easily demonstrable in that part of the field where the isopters are normally most widely separated. This is well within the periphery and in all cases of disease in which "contraction" may be expected or should be excluded this part of the field should be examined. Where a peripheral restriction is already manifest the positions of the internal isopters must still be determined, otherwise only a part—and too frequently not a significant part—of the field changes is disclosed.

The third essential is :

III. Changes in the field of vision are to be regarded and measured as depressions not as contractions.

The measurement of depressions is carried out on the same quantitative plan, test-objects subtending larger visual angles being used for deep depressions and others subtending smaller angles for shallow depressions. Otherwise the shallow depressions may be missed altogether and the depth of the deep ones may remain undiscovered. The choice of test-objects is, therefore, important and they must be adapted to the conditions present in each individual case.

In the normal field the isopters for colour are comparable with those for white, except perhaps at the extreme periphery. Owing to the size of the object usually employed, colour isopters are internal isopters and in depression of the field, as we have seen, the apparent contraction is more pronounced in the internal isopters. Thus, although the normal relationship of the isopters for colour and for white may not be disturbed, there may seem to be an excessive impairment of colour vision. On the other hand.

in pathological conditions a true disproportionate depression of the colour field is common. For this reason it is desirable, as Roenne<sup>(2)</sup> points out, in estimating the relationship of isopters for colour to those for white, to use objects whose isopters normally lie together (e.g., 10/300 red and 10/2000 white : Roenne<sup>(2)</sup>). The statement that contraction of the colour field exceeds or precedes contraction of the field for white must, therefore, be carefully scrutinized in relation to the sizes of the objects employed. If the colour test used gives an isopter lying normally considerably above that corresponding to the white test an apparent undue loss for colour may be discovered quite apart from any special impairment of colour perception.

The fourth essential is:

IV. In all perimetric work the size of each test object and its distance from the eye should be carefully selected with a view to the requirements of the individual case and *should be recorded*.

#### LITERATURE

1. \*Roenne.—“Ueber das Gesichtsfeld beim Glaukom.” *Klin. Monatsbl. f. Augenheilk.*, Vol. I, p. 12, 1909.
2. \*Idem.—“Gesichtsfeldsstudien über das Verhältnis zwischen der peripheren Sehschärfe und dem Farbensinn speziell die Bedeutung derselben für die Prognose der Sehnervenatrophie.” *Ibid.*, Vol. I., p. 154, Feb., 1911.
3. \*Idem.—“Zur Theorie und Technik der Bjerrumschen Gesichtsfelduntersuchung.” *Arch. f. Augenheilk.*, Vol. LXXVIII, Pt. iv., 1915.
4. \*Traquair.—“The Quantitative Method in Perimetry with Notes on Perimetric Apparatus.” *Ophthal. Rev.*, p. 65, 1914.

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### BUEDINER'S MODIFICATION OF DIFFENBACH'S OPERATION FOR EARLY EPITHELIOMA OF THE LOWER LID

BY

MAJOR R. E. WRIGHT, I.M.S.,

SUPERINTENDENT, GOVERNMENT OPHTHALMIC HOSPITAL, MADRAS

AN epithelioma of the lower lid satisfactorily dealt with by Buediner's operation is perhaps sufficiently uncommon to merit a published note. Briefly it consists in removal of the lower lid and its conjunctiva by two incisions starting at the canthi and meeting on the cheek below. The triangular skin defect thus produced is made good by carrying a horizontal incision from the outer canthus for a distance somewhat greater than the length

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\*Bibliography appended.