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## THE TONOMETER OF SCHIÖTZ.

BY

BERNARD CRIDLAND, D.O. (Oxon.), F.R.C.S.E.,

HON. ASST. SURGEON, WOLVERHAMPTON AND MIDLAND COUNTIES EYE INFIRMARY;  
HON. OPHTHALMIC SURGEON, STAFFORD GENERAL INFIRMARY.

THE tonometer of Schiötz appears to have met with but little recognition in this country, although it has been in use on the Continent for several years, and has been highly spoken of by those who have worked systematically with it.

As a preliminary note, therefore, a description of the instrument, with its method of use may not be out of place.

Ophthalmotonometers, as is well known, have been devised for many years; they are of two kinds, impression tonometers and applanation tonometers, according to the principle on which they act.

Impression tonometers measure the depth of the indentation of the globe by a given weight or the weight necessary to produce a given depth. Applanation tonometers, on the other hand, measure the area flattened by a given weight or the weight necessary to flatten a given area.

Both kinds are inaccurate as compared with the manometer; but inasmuch as the latter requires perforation of the globe, it is, of course, inapplicable for clinical purposes.

Although tonometers give only a relative measure of the intraocular pressure and are inaccurate on account of certain sources of error which cannot be eliminated, it does not necessarily follow that they are useless for clinical purposes.

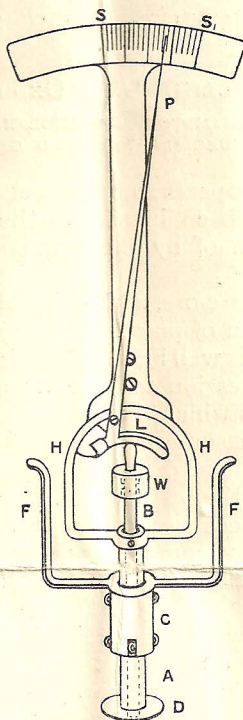
Whatever tonometric instrument be employed, if it be thoroughly understood and carefully applied by the same observer, variations in the tension of an eye can be noted and recorded which escape digital estimation—the least accurate method of all. If a standard can be obtained for any given tonometer which will give the limits of what is estimated by digital impression to be normal tension, the value of such an instrument is undoubtedly increased and may fairly be relied on clinically. The writer is at present engaged on the examination of tension in the normal eyes by means of the Schiötz tonometer, but does not consider that any number short of one thousand is likely to furnish trustworthy statistics.

Schiötz's instrument is an impression tonometer, and records the indentation of the surface of the cornea by one of several known weights. It is subject, to a certain extent, to the sources of error present in the application of all impression tonometers. They are chiefly that (1) the indentation of the globe is dependent on the curvature of the surface, a variable quantity in different eyes and in different parts of the same eye; (2) the indentation is dependent on the extensibility of the membranes, a variable quantity in different eyes; and (3) the intraocular pressure increases with any pressure upon the globe, such as the weight of the instrument and the pressure unconsciously exerted by the fingers in applying the instrument. In Schiötz's tonometer, however, the following advantages are present: the area impressed for the purposes of measurement has a diameter of 3 mm. only; the variations in curvature therefore, of so small an area need hardly be taken into account; the pressure



exerted by the fingers in steadying the instrument in place is practically *nil*, for the pointer will remain stationary, although the collar by which the instrument is held to be moved gently up or down.

The weight of the tonometer itself is constant, and although it must produce a slight increase in the intraocular pressure, it need not be considered in comparative results.



A. Hollow cylinder with lower end (D) shaped to rest on cornea, B. Rod sliding in A. C. Collar movable on wheel bearings on A. F. Projections from C. to hold the instrument. W. Weight slipped over B. L. Curved lever giving movement to pointer P. S S. Scale in millimetres with zero at S. H. Horseshoe-shaped support for scale and pointer.

The instrument consists of a hollow metal cylinder (A) about 3.5 c.m. long, shaped at its lower end (D) to rest on the cornea, whilst to its upper end is attached a horseshoe-shaped support for the scale (SS) and pointer (P). The pointer has at its attachment a short curved lever (L), roughly at a right angle, which is moved by contact with a rod (B) sliding in the centre of the cylinder. This rod rests by its lower surface on the cornea, whilst the upper part, projecting above the cylinder, comes into contact by its rounded end with the curved lever of the pointer. One (W) of several known weights—namely, 5.5 grammes, 7.5, 10, and 15—can be slipped over the upper end of the rod, a small projection on which can be made to fit over a collar inside the weight and so prevent the rod from slipping out when the instrument is lifted from the cornea. Surrounding the cylinder is a collar (C) with two L shaped projections (F) for the fingers to hold, friction between the two being much reduced by means of small wheel bearings.

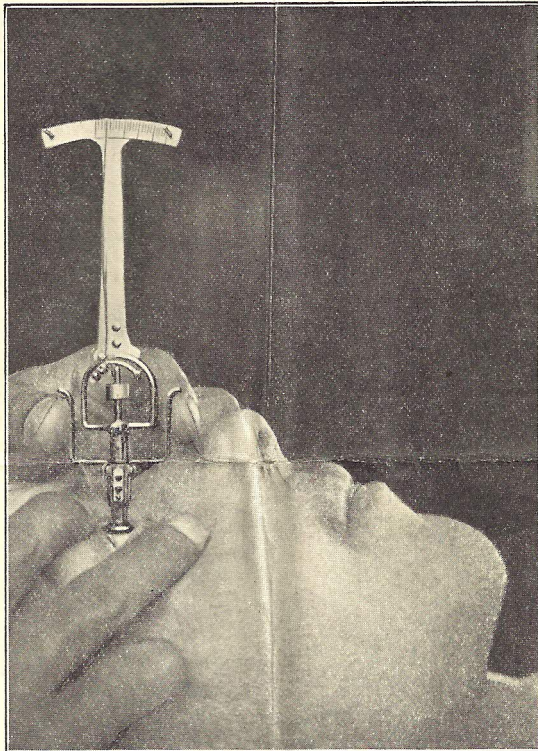
The weight of the rod (4 grammes), *plus* the known weight slipped on, indents the cornea to a greater or lesser degree according to the tension of the globe, the amount of indentation is communicated, *via* the curved lever, to the pointer and is recorded on the scale.



The scale is marked off in millimetre spaces with a long mark at every fifth millimetre. They are not numbered, but in using the instrument it will be easily noted that the central end of the scale must be taken as zero.

For each of the known weights a curve is given on a chart supplied with the instrument, the horizontal axis representing the scale readings and the vertical axis the corresponding tension-value in millimetres of mercury.

To obtain an estimation of tension, the patient is placed on a couch with the head in a slightly backward position, whilst the eyes look upwards. The eye whose tension is to be measured is anaesthetised with a 1 per cent. or 2 per



cent. solution of holocaine, which acts rapidly and does not dilate the pupil. A good position in which to stand for either eye is a little behind the head on the left side, the right hand can thus be used to hold the instrument, whilst the fingers on the left lightly separate the lids. It is important that no pressure be exerted on the globe by the desire to close the lids, since a forcible attempt at contraction will move the pointer through two gradations on the scale.

The instrument is got ready by placing the rod in the cylinder and slipping on the 5.5 grammes weight. The patient is directed to fix a point vertically above him on the ceiling, and the tonometer is gently applied to the cornea with the scale facing to the patient's left, so that the zero is away from the observer. The latter is thus enabled to make his own observations, a point not without importance. With an eye estimated by the fingers to be of normal tension, the pointer will give a reading somewhere between 2.5 and 6 mm.; if the tension is raised, the reading will be lower, and the next lowest weight, 7.5 gm. should be substituted and so on until a reading between 2 and 4 is



obtained. By taking readings between these near limits, it can be readily understood that the cornea is indented in a correspondingly limited degree in different eyes, and thus one of the sources of error is reduced. It is advised to take the mean of three readings, but this does not appear to be always necessary. A point of interest is the pulsation of the eye transmitted to the pointer. Some eyes show this in a marked degree, whilst others show practically none. The clinical significance of this from an ocular point of view remains to be seen.

If the instrument be carefully applied, no effect is produced on the cornea, but with a restless patient, or if gentleness be not observed, the corneal epithelium may be abraded.

After use, it is important to clean with alcohol or ether the parts of the instrument which have been in contact with the fingers or the cornea, and especially the rod and its groove.

The diagram illustrates the important parts of the instrument and the photograph shows it in use.

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