TREATMENT.—The causes that produce softening are difficult to remove and the therapeutical treatment of their effects is generally barren in results, notwithstanding correctness of diagnosis and the most judicious efforts to meet symptoms as they occur. Once established, senile softening is not amenable to treatment. Preventive measures being out of the question, except when the premonitory symptoms have continued for a long time, a consideration of the causes becomes fundamental matter, and the state of the heart and its action the main question. A declivous position of the head and perfect rest in a uniform temperature are advisable during an acute attack, while the body should be kept warm by artificial heat, warm clothing, and the cautious administration of stimulants. The caution in regard to stimulation is the more to be observed if there be the least suspicion of hemorrhage. In such a contingency it is deemed wise to act as if the case were one of cerebral hemorrhage, since hemorrhage is more likely to occur than occlusion, and the harm following stimulation in such a case seems to justify the diagnostic doubt. Symptoms pointing to a severe collateral hyperæmia may be treated with large doses of the bromides, sinapisms, dry-cupping, and mild purgation. The actual cautery and bleeding are to be avoided; but when there is general vascular irritation, leeches may be applied to the anus and behind the ears, in connection with intestinal revulsives and cold applications to the head. Digitalis, or strophanthus with glonoin, and amyl nitrite, are indicated, if the arterial tension be weak. Their use is, however, inadvisable in old persons. Recourse may be had to nervine tonics and to mild forms of slow derivation after the attack has passed. The diet should be strictly regulated, all intellectual effort should be interdicted, the integrity of the nutritive functions should be maintained as much as possible, and the methods of treatment applicable to the chronic symptoms of circumscribed cerebral disease should be generally observed.

Irving C. Rosse.

BRAIN, SURGERY OF THE.—HISTORY.—Although in 1871 Broca located a cerebral abscess in the speech centre, and greatly relieved the patient by trephining, modern brain surgery begins properly with a modest report of a case by Macewen in the Glasgow *Medical Journal* for 1879, xii., 210, and a later more elaborate paper, by the same author, in *The Lancet* for 1881, ii., p. 541. In these papers he narrates three cases, occurring in 1876 and 1879, in which cerebral disease was located by focal symptoms. The first was a case of convulsions of the face, arm, and leg, in the order named, following a fall on the right side of the head. A trephine opening of the dura evacuated two ounces of blood, and the boy recovered without any febrile movement.

In the second case the symptoms pointed to a lesion of the frontal lobe, and, after trephining, a tumor of the dura mater was dissected out. The patient died eight years subsequently from Bright's disease.

The third was a case of cerebral abscess, existing not at the site of a prior injury marked by a distinct cicatrix, but correctly diagnosticated in a totally distinct position, that is, in Broca's convolution, by the focal symptoms. The parents declined an operation, and the child died. After death an operation was done precisely as it would have been done during life, and an abscess was found, the size of a pigeon's egg, at the spot indicated by the localizing symptoms.

In spite, however, of this remarkable paper, the surgical world seemed blind to its opportunity. But in *The Lancet* for December 20, 1884, Dr. Hughes Bennett and Mr. Godlee narrated a case of subcortical tumor of the brain, diagnosticated by the localizing symptoms alone and before operation. When the dura was opened no tumor was visible: but so certain were they that a tumor existed that an incision was made in the apparently healthy brain tissue, and a morbid growth the size of a walnut was found one-fourth of an inch below the surface. This case, though ultimately unsuccessful because of suppurative meningitis, instantly arrested the attention of the surgical world by the precision of the diagnosis, the success of the operative technique, and the evidence it afforded that we could successfully cope with heretofore hopeless cases. Its very failure, like the failure of the first Atlantic cable, but pointed the way to success.

The first American paper on cerebral tumor, by Hirschfelder and Morse, of San Francisco, appeared in the *Pacific Medical and Surgical Journal* for April, 1886. The case was that of the successful localization, but unsuccessful removal, of a brain tumor. Two most remarkable papers on brain surgery, however, were published soon afterward by Mr. Victor Horsley, in the *British Medical Journal* for October 9, 1886, and April 23, 1887. In these papers ten cases were related, all of which were correctly localized; only one died, and the remainder were either benefited or cured. These were in part cases of removal of brain tumor and of portions of diseased brain tissue the cause of epilepsy, and in part cases of trephining for relief of intense headache, etc.

In this country, besides many excellent publications that I have not space or time to enumerate, the most noteworthy early papers published have been those by John B. Roberts, read before the American Surgical Association in 1885; two by R. W. Amidon, in the *Medical News* for January 21, 1884, and the *Annals of Surgery*, vol. i., 1885, both of these authors making strong pleas for early and more heroic surgical interference in affections of the brain; and one by Seguin and Weir, in the *American Journal of the Medical Sciences* for July, August, and September, 1888. I have also published several papers to which I may allude; the earliest two appeared in the *American Journal of the Medical Sciences* for October and

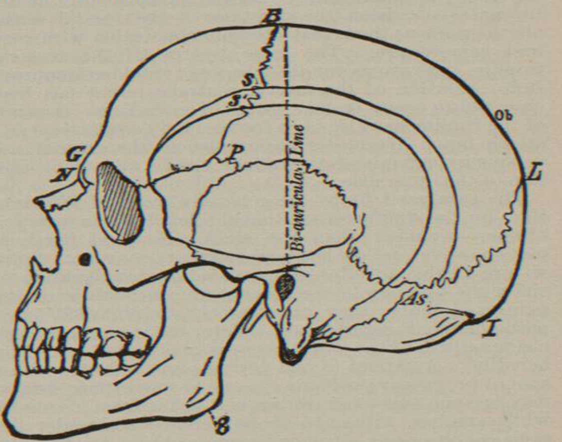

FIG. 995.—Skull Showing Points Named by Broca. *N*, Nasion (junction of the nasal and frontal sutures); *G*, ophryon (on a level with the superior border of the eyebrows, and corresponding nearly to the glabella, the smooth swelling between the eyebrows); *B*, bregma (junction of the sagittal and coronal sutures); *Ob*, obelion (the sagittal suture between the parietal foramina); *L*, lambda (junction of the sagittal and lambdoidal sutures); *I*, inion (external occipital protuberance); the basion is the middle of anterior wall of foramen magnum; *As*, asterion (junction of the occipital, parietal, and temporal bones). *g*, gonion (angle of the lower jaw); *S*, stephanion (or, better, the superior stephanion, intersection of ridge for temporal fascia and coronal suture); *S′*, inferior stephanion (intersection of ridge for temporal muscle and coronal suture); *P*, pterion (point of junction of great wing of sphenoid and the frontal, parietal, and squamous bones). This may be H-shaped, or K-shaped, or "retourné," in which the frontal and temporal just touch.

November, 1888, and in the *Medical News* for December 1, 1888. In Germany perhaps the most elaborate and important publication is von Bergmann's *Hirnchirurgie*.

In addition to these, Mr. Horsley published, in the *British Medical Journal* for June 16, 1888, an account of the removal of a tumor from the spinal cord, and Dr.

Macewen (*British Medical Journal*, August 11, 1888) published six cases in which the posterior arches of the vertebra had been removed for tumor and compression of the cord, and for an abscess in the posterior mediastinum, two of which (paraplegia from Pott's disease and fractured spine) had been published as early as 1886 (*Glasgow Medical Journal*, xxv., 210.) (See article on *Spine, Surgery of the.*) I shall refer in the course of this paper to a number of other publications, but I have thought it right to sketch thus briefly the *early* historical development of the subject.

Two things have made such brain surgery possible. First, the accurate localization of the functions (especially the motor centres) by Ferrier, Horsley, Fritsch, Hitzig, and others, by means of which we can with fair accuracy determine the site of a tumor, abscess, cyst, etc., by the focal symptoms. Secondly, the impunity with which we can trephine and open the dura mater, and interfere with the brain tissue itself, due almost entirely to the introduction of antiseptic surgery. To Horsley more than to any one else we owe the formulation of rules for successful brain surgery—rules which will be given at length hereafter.

The Danger of Trephining.—For the technique of trephining I refer the reader to the paper under that head in a later volume. But it is important further to consider the question of the danger involved in this operation. In St. Bartholomew's Hospital Reports for 1882, Dr. Walsham published a paper entitled "Is Trephining of the Skull a Dangerous Operation *per se?*" In this article he analyzes 686 cases, of which 417 survived, the mortality, therefore, being 39.3 per cent. Dividing these large numbers into classes: first, those in which preventive trephining was used (nearly all for fracture), there being no cerebral symptoms, the mortality was 21.9 per cent.; second, trephining in which severe cerebral symptoms existed, the mortality was 48.4 per cent.; third, trephining in which moderate cerebral symptoms were present, the mortality was 27 per cent.; fourth, late trephining, mostly after inflammation had set in, the mortality was 58.5 per cent.; fifth, secondary trephining showed a mortality of 22 per cent.

Walsham showed that in 122 cases of late trephining, in which there was no condition endangering life, only 10.6 per cent. died. Amidon, in the paper referred to, analyzes 100 cases of trephining reported since 1879, in most of which antiseptics were employed. Of these 100 cases 26 died, but of these 23 presented at the time of operation symptoms already endangering life. He therefore concluded (and most later writers practically concur in his conclusions) that the mortality of trephining *per se* is but 3 per cent., a conclusion which would seem to be confirmed by Prunières and Robert Fletcher, by their investigations, which show the frequency of recovery in cases of prehistoric trephining. Seydel ("Antiseptie und Trepanation") even estimates the mortality as only 1.6 per cent.

Not only have antiseptics thus diminished the danger of simply opening the cranium, but the numerous cases which have been reported of opening the dura, even when followed by removal of tumor or of some brain substance, clearly show that only moderate danger is added in any case by such surgical procedures. "Heretofore," says Amidon, "the reluctance of the surgeon to open the cranium seems avidity as compared with his hesitation in piercing the dura mater. The cerebral cortex seems to be a 'dead line' inside the prison walls of conservative surgery, across which even the most daring are tempted or the most unwilling are dragged only by sure indications or desperate chances."

The future danger seems to be, however, that temerity may take the place of timidity, and that many patients will either die or go about with multilated brains that ought never to have been touched. This word of caution, therefore, at the outset may not be out of place.

TOPOGRAPHY OF THE BRAIN IN ITS SURGICAL RELATIONS.—The relation of the chief fissures and convolu-

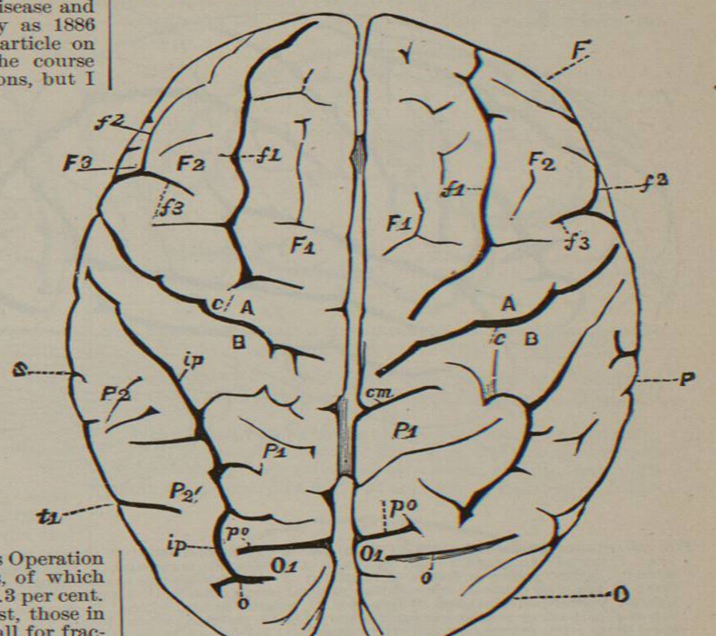

FIG. 996.—View of the Brain from Above. *F*, Frontal lobe; *P*, parietal lobe; *O*, occipital lobe; *S*, end of the horizontal branch of the fissure of Sylvius; *c*, central fissure or fissure of Rolando; *A*, anterior central or ascending frontal convolution; *B*, posterior central or ascending parietal convolution; F_1, upper, F_2, middle, F_3, lower frontal convolution; f_1, superior frontal sulcus; f_2, inferior frontal sulcus; f_3, vertical fissure (sulcus præcentralis); P_1, upper or postero-parietal lobule; P_2, lower parietal lobule, constituted by P_2, supramarginal gyrus; P_2', angular gyrus; *ip*, intraparietal sulcus; *cm*, calloso-marginal sulcus; *po*, parieto-occipital fissure; t_1, upper temporal sulcus; O_1, first occipital convolution; *o*, transverse occipital sulcus. (Ecker.)

tions of the brain to the surface of the skull is of the greatest possible importance. It is essential that we shall be able, from fixed landmarks on the skull, to locate the various fissures and convolutions, and by them the various cortical centres. The subject has been studied by Reid, Horsley and Hare, Krönlein and others, each of whose methods of research has its own merit.

I shall give a brief outline of the four methods, and in doing so I must take it for granted that the reader is fairly well acquainted with the chief outlines of the cerebral cortex. In order, however, to facilitate the study of the external topography of the brain, I have introduced cuts.

First: Fig. 995, from Broca, giving the points named upon the skull.

Secondly: Figs. 996–998, from Ecker, giving the names of the principal sulci and convolutions.

I have also appended two figures from Ferrier's "Functions of the Brain" (Figs. 999 and 1000) in order to fix as nearly as possible the relations of the various centres, so far as known at present. The figures in these two cuts are placed as follows:

1, On the postero-parietal lobule (precuneus), the centres for movements of the opposite leg and foot in locomotion. 2, 3, 4, At the upper end of the fissure of Rolando, and hinder part of the first frontal convolution, the centres for various complex movements of the arms and legs, as in climbing, swimming, etc. In this area Horsley states that the arm and leg of the same side are involved together. 5, At the posterior part of the

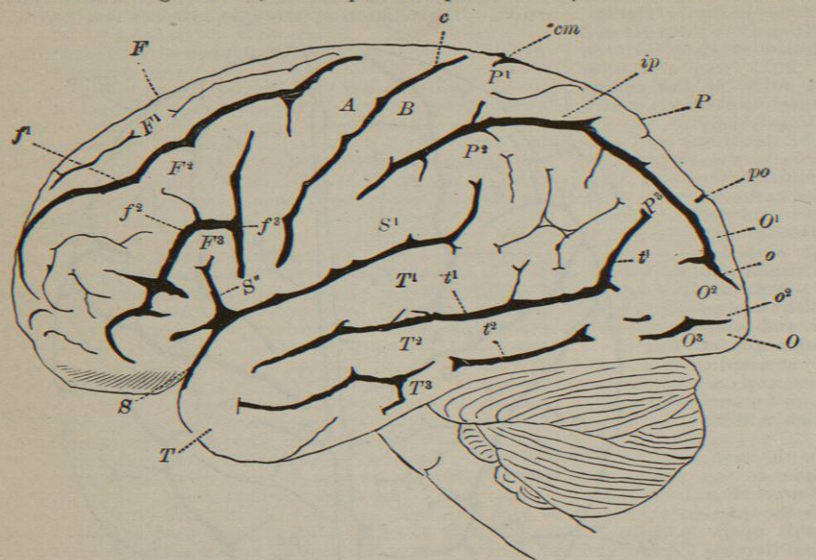

FIG. 997.—Outer Surface of the Left Hemisphere. *F*, Frontal lobe; *P*, parietal lobe; *O*, occipital lobe; *T*, temporo-sphenoidal lobe; *S*, fissure of Sylvius; *S'*, horizontal, *S"*, ascending ramus of the same; *c*, central sulcus or fissure of Rolando; *A*, anterior central or ascending frontal convolution; *B*, posterior central, or ascending parietal convolution; F^1, superior, F^2, middle, and F^3, inferior frontal convolutions; f^1, superior, f^2, inferior frontal sulcus; f^3, præcentral sulcus; P^1, superior parietal or postero-parietal lobule; P^2, P^3, inferior parietal lobule, viz.: P^2, supramarginal gyrus; P^3, angular gyrus; *ip*, intraparietal sulcus; *cm*, termination of the calloso-marginal fissure; O^1, first, O^2, second, O^3, third occipital convolutions; *po*, parieto-occipital fissure; o^1, transverse occipital sulcus; o^2, inferior longitudinal occipital sulcus; T^1, first, T^2, second, T^3, third temporo-sphenoidal convolutions; t^1, first, t^2, second temporo-sphenoidal sulci. (Ecker.)

superior frontal convolution—extension forward of the arm and hand, as in putting forth the hand to touch something in front. 6, On the ascending frontal (pre-Rolandic) convolution, just behind the upper and hinder end of the middle frontal convolution—movements of the hand and forearm in which the biceps is particularly engaged, viz., supination of the hand and flexion of the forearm. 7 and 8, Respectively for the elevators and depressors of the angle of the mouth. 9 and 10, As one, mark the centre for movements of the lips and tongue, as in speech. This especially occupies the posterior portion of the inferior frontal (generally known as Broca's) convolution. Disease of this region on the left side produces aphasia. 11, The centre for the platysma, retraction of the angle of the mouth. 12, A centre for the lateral movements of the head and eyes, with elevation of the eyelids and dilatation of the pupils. 13 and 13', On the supramarginal lobule and angular gyrus, including also the occipital lobe, indicate the centre for vision. 14, On the superior temporo-sphenoidal convolution, indicates the centre for hearing. *a, b, c, d,* On the ascending parietal (post-Rolandic) convolution, indicate the centres for movements of the fingers and wrist. The centre for smell is situated in the hook of the hippocampal region (Fig. 998, *U*). In close proximity, but not exactly defined as to limits, is the centre for taste. The centre for touch is situated in the hippocampal region (Fig. 998, *H*) and gyrus fornicatus (*Gf*).

To these I also add Figs. 1001 to 1009 from Horsley's article (*Amer. Jour. of the Med. Sciences*, April, 1887) for the same purpose. I also add a figure from Gowers (Fig. 1010) to show the relations of the convolutions to the skull.

The reader desirous of further information will find it briefly stated in the American edition of Gray's "Anatomy," for 1887, p. 681, or very fully in the works of the authors already referred to, together with Ferrier's "Functions of the Brain." (See also article *Skull*, etc.)

It must be borne in mind that, as pointed out by Stokes, the relations between the brain and the skull vary at different ages, a fact reinforced by Cunningham's models of the brain hardened *in situ*, and then exposed by removing the bones of the skull, leaving bridges at the sutures. Symington points out that the Sylvian fissure lies much higher above the squamo-parietal suture in the child than in the adult, and is from half an inch to even an inch above it. He thinks that they attain the adult relations at about the eighth or ninth year.

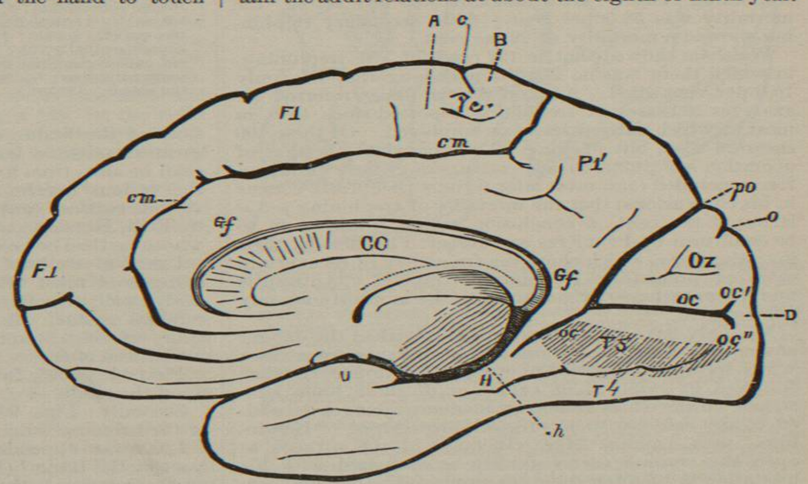

FIG. 998.—Inner Surface of the Right Hemisphere. *CC*, Corpus callosum, longitudinally divided; *Gf*, gyrus fornicatus; *H*, gyrus hippocampi; *h*, sulcus hippocampi or dentate fissure; *U*, uncinate gyrus; *cm*, calloso-marginal sulcus; *F*1, median aspect of the first frontal convolution; *c*, terminal portion of the central sulcus, or fissure of Rolando; *A*, ascending frontal, *B*, ascending parietal convolution; *Pc*, paracentral lobule; *P1'*, precuneus; *Oz*, cuneus; *po*, parieto-occipital fissure; *o*, transverse occipital sulcus; *oc*, calcarine fissure; *oc'*, superior, *oc"*, inferior ramus of the same; *D*, gyrus descendens; *T4*, gyrus occipito-temporalis lateralis (lobulis fusiformis); *T5*, gyrus occipito-temporalis medialis (lobulus lingualis); *cf*, collateral or occipito-temporal fissure. (Ecker.)

The fissure of Rolando is also much more oblique in its direction (52°, Hamy) in the child, and lies farther forward on account of the imperfect development of the

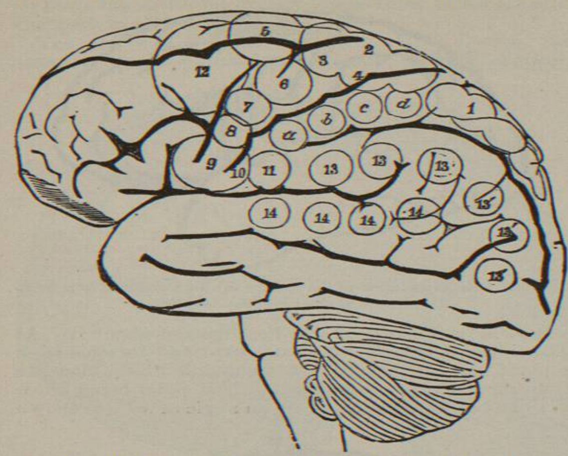

FIG. 999.—Side View of the Brain of Man. (Ferrier.) (For references see pp. 399, 400).

frontal lobes. Gradually as these are developed, especially the third frontal convolution, the lower end of the fissure is pushed back and assumes its adult angle and position.

First: *Landmarks on the Skull.* Most of these are readily determined by reference to the foregoing figures,

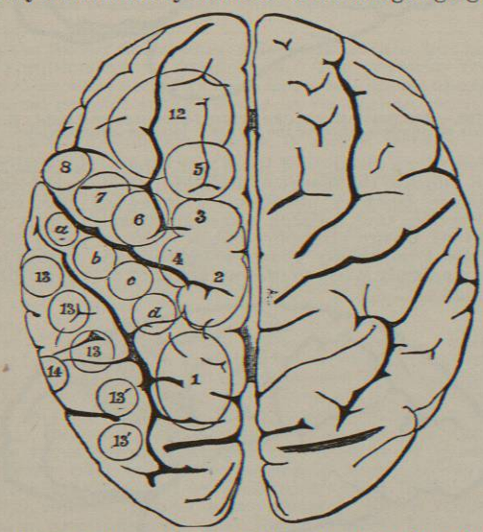

FIG. 1000.—Top View of the Brain of Man. (Ferrier.) (For references see pp. 399, 400.)

but there are some which must be more minutely described.

The *temporal ridges* (Fig. 995) are two in number: the upper for the temporal fascia, the lower for the upper border of the temporal muscle. The upper is the better marked, and can be easily followed by the finger from the external angular process backward. It marks the sudden change in the slope of the skull, from the curve of the upper surface to the more vertical direction of the side. The lower one is best made out by closing and relaxing the jaw, when the upper edge of the temporal muscle can be located by the finger. Like the upper, it begins at the external angular process, but runs at a lower level than the fascial ridge. Its middle is about two-fifths of an inch below it. The points where the

FIG. 1001.—Representation of the Centre for the Upper Face and Angle of the Mouth. (Horsley.)

coronal suture crosses these two ridges are called respectively the upper and the lower stephanion (Fig. 995, *S* and *S'*).

The *coronal suture* starts at the bregma (Fig. 995, *B*).

Drawing the bi-auricular line (Fig. 995), measurements on 185 skulls have given me as a mean result, that in the adult the *bregma* lies 0.375 of an inch in front of this line.

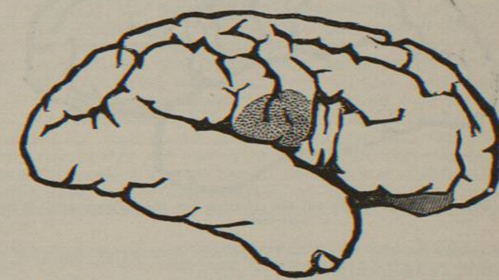

FIG. 1002.—Representation of the Centre for the Vocal Chords (Adduction). (Horsley.)

The greatest distance was 1.2 inch. In 16 of these skulls, the bregma coincided with the point where the bi-auricular line crosses the sagittal suture. In only 7 did it lie behind it, the maximum being 0.9 inch. Starting from the bregma, by shoving the scalp backward and forward, the finger can perceive (but with some difficulty, especially in the aged) the irregularities of the coronal suture,

FIG. 1003.—Representation of the Centre for the Lower Face and Floor of the Mouth. (Horsley.)

but toward the stephanion they become more marked and can be pretty well appreciated. The *parieto-squamosal* suture lies beneath the temporal muscle. The highest point of its curved line is at the junction of the upper and middle thirds of a vertical line drawn from the upper

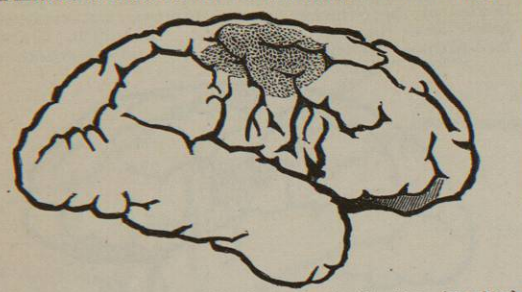

FIG. 1004.—Representation of the Centre for the Shoulder. (Horsley.)

border of the zygoma to the ridge for the temporal muscle in front of the temporo-maxillary articulation.

The point of junction of the great wing of the sphenoid, frontal, parietal, and squamous bones is called the *pterion* (Fig. 995), and is about half-way between the superior stephanion and the zygoma. It is usually H-shaped.

The Relation of the Fissures and Convolutions to the

FIG. 1005.—Representation of the Centre for the Elbow and Wrist. (Horsley.)

Landmarks on the Skull.—There are five great fissures of the brain to be localized:

First, the *great longitudinal fissure* separates the two hemispheres of the cerebrum. This does not lie precisely in the middle line, but in consequence of the slightly larger size of the left hemisphere, it lies about an eighth of an inch to the right of the middle line.

Second, the *great transverse fissure,* or the fissure of

FIG. 1006.—Representation of the Centre for the Thumb. (Horsley.)

Bichat, between the cerebrum and the cerebellum. This lies in a line from the external auditory meatus to the *inion* (or external occipital protuberance). This marks also the position of the tentorium and of the lateral sinuses. The other three great fissures (viz., the *fissure of Sylvius,* the *fissure of Rolando,* and the *parieto-occipital fissure*) may be located by the following rules.

Horsley's Method.—The *fissure of Rolando,* in relation to the motor region, is the most important in the whole brain. As will be seen by reference to Figs. 996 and 997,

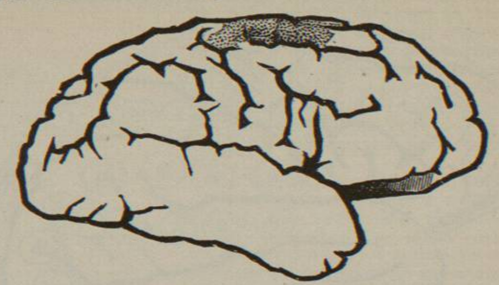

FIG. 1007.—Representation of the Centre for the Combined Synchronous Action of Both Limbs. (Horsley.)

almost all the motor centres lie clustered about it. As Thane has shown, it runs downward and forward from a point half an inch behind the middle of the distance from the glabella to the inion. This point being fixed, if a line be drawn laterally at an angle of 67° (as shown

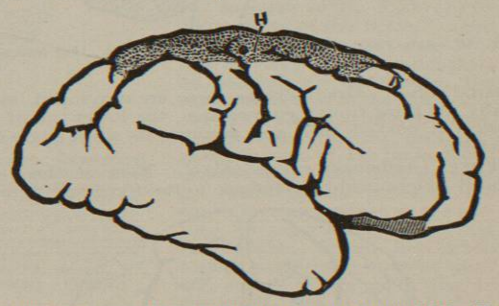

FIG. 1008.—Representation of the Centre for the Lower Limb. H, Focus of representation of the hallux. (Beevor and Horsley.)

by Hare) for a distance of three and three-eighths inches, it will indicate the fissure of Rolando; the lower third of the fissure, however, changes to a somewhat more vertical direction, thus forming a knee-like bend. To fix this important fissure, Horsley uses a strip of metal or of parchment paper, say fourteen inches long, with a second strip firmly fixed to it at an angle of 67° (Fig. 1011).

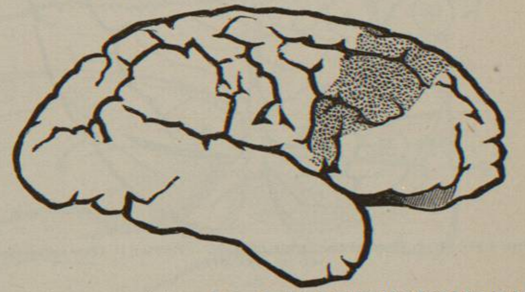

FIG. 1009.—Representation of the Centre for the Head and Neck, together with Conjugate Deviation of the Eyes. (Horsley.)

The zero point of the scale of the longer piece (as suggested by Dr. Morris J. Lewis, of Philadelphia) is placed half an inch in front of the angle formed by the two arms. From this zero point the scale (in quarter inches) leads both forward and backward. The longer arm is placed in the middle line of the shaven head, in such a

position that the reading of the two scales at the glabella and at the inion shall be identical. The lateral strip will then mark the fissure of Rolando (three and three-eighths inches); the direction of the lower third being slightly changed, as above indicated.

The *fissure of Sylvius* commences at the pterion, the anterior branch running upward and forward, continu-

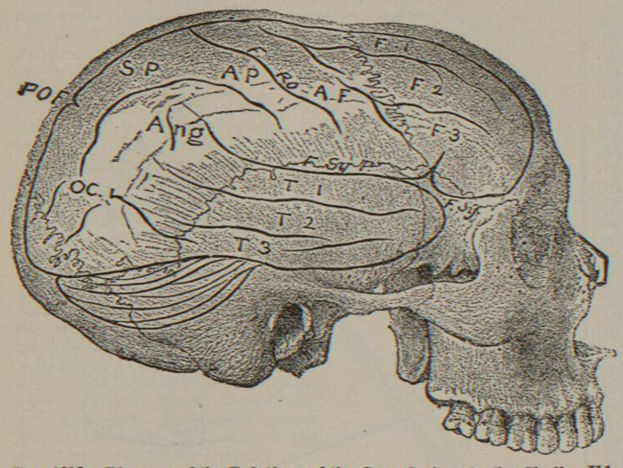

FIG. 1010.—Diagram of the Relations of the Convolutions to the Skull. *F* 1, 2, and 3, Upper, middle, and lower frontal convolutions; *A F, A P,* ascending frontal and parietal convolutions; *S P,* superior parietal lobule; *Ang,* angular gyrus; *OcL,* occipital lobe; *T* 1, 2, 3, the temporal convolutions; *P O F,* parieto-occipital fissure; *F Sy* and *F Sy P,* fissure of Sylvius and its posterior limb; *F. Ro,* fissure of Rolando. (Gowers.)

ing the line of the squamo-sphenoidal suture, but one or two millimetres in front of it. The posterior branch passes upward and backward half a millimetre above the squamo-parietal suture, as far as its highest point, and from there curves slightly upward toward the centre of the parietal eminence, which it nearly reaches. This fissure limits the motor region anteriorly by its anterior limb, and postero-inferiorly by its posterior limb.

The *precentral* or *vertical sulcus* is of great importance also, as it divides two convolutions of very different functions, and on each side of it has convolutions of great motor importance. It runs parallel to and just behind the coronal suture, and is almost vertical to a horizontal tangent at the bregma; hence its second name. Its upper end reaches to the level of the middle of the fissure of Rolando. From it, about on a level with the superior stephanion, the *inferior frontal sulcus* runs forward. Above the origin of this latter sulcus, the precentral sulcus continues vertically half-way across the root of the middle frontal convolution. Its lower end is separated from the fissure of Sylvius by a horseshoe-shaped convolution of great importance (the *operculum*), which is nearly always one centimetre wide, and overlies the island of Reil.

The *superior frontal sulcus* starts from the ascending frontal (pre-Rolandic) convolution midway between the fissure of Rolando and the line of the precentral sulcus. Its posterior end, therefore, lies behind the precentral sulcus. The superior and inferior frontal sulci run forward and slightly downward, practically parallel with the great longitudinal fissure.

The *intraparietal sulcus* lies behind the fissure of Rolando, and bounds the motor area posteriorly. It begins opposite the knee-like bend at the junction of the middle and lower thirds of the fissure of Rolando. As it goes upward it lies about midway between the line of the Rolandic fissure and the parietal eminence. It then separates farther from the fissure of Rolando, and so widens the area of the ascending parietal (post-Rolandic) convolution that its upper end is known as the *superior parietal lobule.* In the middle of its course it runs about parallel to the great longitudinal fissure, and midway between it and the parietal eminence. Farther on, it passes by the external end of the parieto-occipital fissure and goes downward and backward into the occipital lobe.

The *parieto-occipital fissure* on the upper surface of the cerebrum is a short fissure about an inch long, at right angles with the great longitudinal fissure, and two or three inches in front of the *lambda* (the junction of the lambdoidal and sagittal sutures) (Fig. 995, *L*). This fissure, on the median surface of the cerebrum (Fig. 998, *po*), is a long fissure running downward and forward. It is joined at its middle by the *calcarine fissure* (Fig. 998, *oc*). Between these two fissures is the *cuneus* (*Oz,* Fig. 998), in which lies the cortical centre for sight. Injury to the cuneus, therefore, produces blindness in the half of each retina on the side corresponding to the injury (hemianopsia).

In front of the parieto-occipital fissure, on the middle surface of the hemisphere, lies the *precuneus* or *quadrate lobule* (Fig. 998, P_1'), bounded in front by the upper end of the *calloso-marginal fissure* (*cm*).

In front of and behind the fissure of Rolando (Figs. 997 and 998) are two most important convolutions. The one in front is chiefly known as the ascending frontal or precentral, or, as I prefer to term it, the *pre-Rolandic convolution.* The one behind the fissure of Rolando is known as the ascending parietal or postcentral, or, as I prefer to term it, the *post-Rolandic convolution.* At their upper ends they fuse into the *paracentral lobule,* and at their lower into the *operculum.* The two frontal sulci divide the frontal lobe horizontally into three convolutions, viz., the first, second, and third, or respectively the *superior, middle,* and *inferior frontal* convolutions. The third or inferior convolution is frequently known as *Broca's convolution.* On the left side the *centre for speech* is located (in left-handed persons this speech centre lies in Broca's convolution on the right side). For the location of other centres in these various convolutions the reader is referred to Figs. 999–1009.

Below the intraparietal sulcus, between its beginning and the posterior limb of the fissure of Sylvius, lies the *supramarginal convolution* (Fig. 997, P^2). Below the posterior portion of the intraparietal, and behind the superior extremity of the horizontal limb of the Sylvian fissure, lies the *angular gyrus* (Fig. 997, P^3).

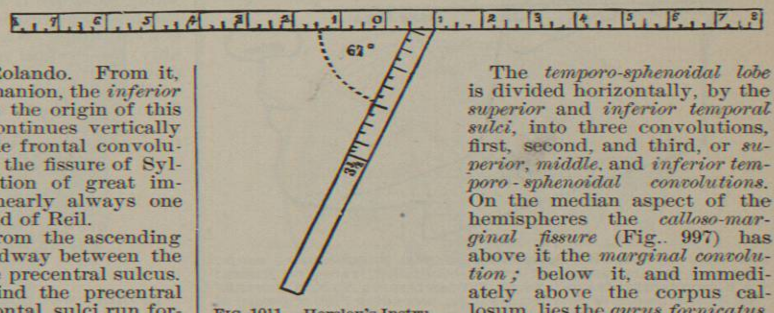

FIG. 1011.—Horsley's Instrument for Fixing the Fissure of Rolando, as Modified by Dr. Morris J. Lewis.

The *temporo-sphenoidal lobe* is divided horizontally, by the *superior* and *inferior temporal sulci,* into three convolutions, first, second, and third, or *superior, middle,* and *inferior temporo-sphenoidal convolutions.* On the median aspect of the hemispheres the *calloso-marginal fissure* (Fig. 997) has above it the *marginal convolution;* below it, and immediately above the corpus callosum, lies the *gyrus fornicatus.*

Reid's Method.—Reid's "base line" (Fig. 1012) is a line running backward from the infra-orbital ridge through the middle of the external auditory meatus, and prolonged to the middle line of the head posteriorly. The *fissure of Sylvius* runs from a point an inch and a quarter behind the external angular process of the frontal bone to a point three-fourths of an inch below the most prominent point of the parietal eminence. Measuring from above backward, the first three-fourths of an inch will represent the main fissure; the rest indicates the horizontal limb. The ascending limb starts at a point three fourths of an inch back of the anterior extrèmity, that is, two inches behind and slightly above the external angular process, and runs vertically upward and forward about one-fourth of an inch.

To find the *fissure of Rolando*, draw the base line and the lines for the great longitudinal fissure and the fissure of Sylvius. Then draw two lines perpendicular to the base line: one from the depression in front of the external meatus (Fig. 1012, D E) and the other (F G) from the posterior border of the mastoid process at its root. We shall thus have on the surface of the head a four-sided figure, bounded above and below by the lines for the longitudinal fissure and the horizontal limb of the fissure of Sylvius, respectively, and in front and behind by the two perpendicular lines just described. Next draw a diagonal line (F H) from the posterior superior angle to the anterior inferior angle. This corresponds to the fissure of Rolando, which, however, as a rule, does not quite join the fissure of Sylvius.

Cunningham states, however, that this (Reid's) mode of locating the fissure of Rolando is not reliable, and I much prefer Horsley's, Krönlein's, or Hare's, both as more accurate and much more easily applied.

To find the *parieto-occipital fissure* continue the line for the horizontal limb of the fissure of Sylvius (Fig. 1012, *Sy.h.fis.*) to the line of the longitudinal fissure. The portion of this line, about an inch long, next to the longitudinal fissure, will usually approximately correspond to it. The position of the various convolutions can now be readily indicated by reference to Fig. 1010.

Hare's Method.—Mr. A. W. Hare has pointed out that neither the cranial sutures nor the prominences of the

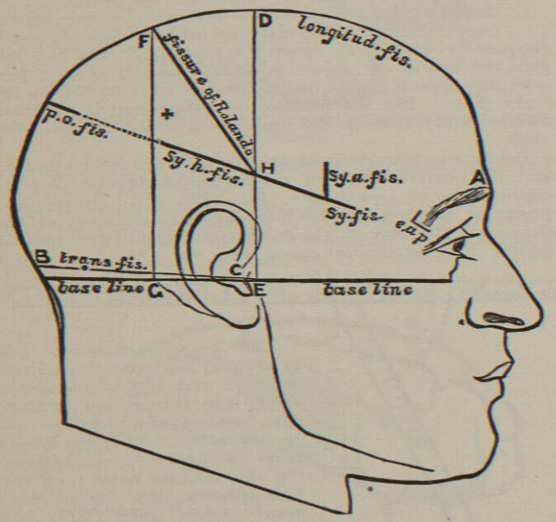

FIG. 1012.—A, Glabella; B, external occipital protuberance; *e.a.p.*, external angular process of frontal bone; B C, transverse fissure; A B, longitudinal fissure; *Sy.fis.*, Sylvian fissure; *Sy.h.fis.*, horizontal limb of fissure of Sylvius; *Sy.a.fis.*, ascending limb of fissure of Sylvius; D, E, perpendicular line from depression in front of external auditory meatus to middle line of top of head; F, G, perpendicular line from posterior end of base of mastoid process to middle line of top of head; F, H, fissure of Rolando; *p.o.fis.*, parieto-occipital fissure; +, most prominent part of parietal eminence. (Reid.)

face are available for mapping out the brain; the former, because they are too indistinct or obliterated, the latter, because they have no direct relation to the cranium as a whole on account of the unequal development. The same observation, he points out, is true of the bony landmarks on the lower portion of the skull. If the external auditory meatus or the mastoid process has lines drawn from it over the convexity of the skull, they will give inconstant results according as the anterior or posterior portions of the head are more or less developed. Four

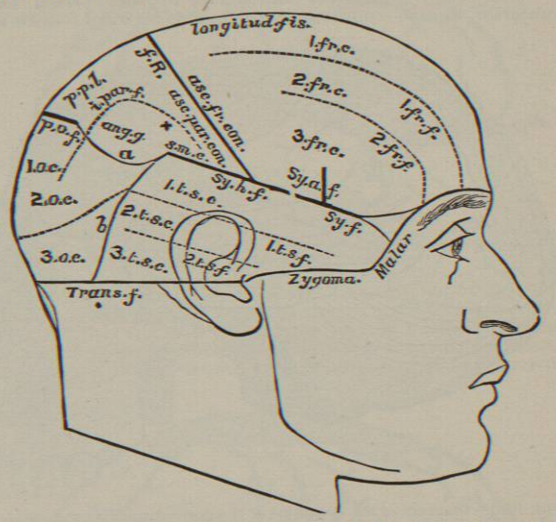

FIG. 1013.—+, Most prominent part of parietal eminence; *a*, convex line bounding parietal lobe below; *b*, convex line bounding temporo-sphenoidal lobe behind; 1.*fr.c.*, first frontal convolution; 1.*fr.f.*, first frontal sulcus; *f.*R, fissure of Rolando; *Sy.f.*, Sylvian fissure; *Sy.h.f.*, horizontal limb of Sylvian fissure; *Sy.a.f.*, ascending limb of Sylvian fissure; *p.o.f.*, parieto-occipital fissure; *i.par.f.*, intraparietal sulcus; *ang.g.*, angular gyrus; *s.m.c.*, supramarginal convolution; 1.*t.s.c.*, first temporo-sphenoidal convolution; 1.*t.s.f.*, first temporo-sphenoidal sulcus; 1.*o.c.*, first occipital convolution; *p.p.l.*, postero-parietal lobule. (Reid.)

points, however, are of value, viz., (1) the glabella, which corresponds to the base of the anterior lobe of the brain; (2) the inion, which corresponds to the base of the posterior lobe of the brain, and also to the junction of the falx with the tentorium; (3) the third constant landmark is the external angular process of the frontal bone which limits the cerebrum laterally and has also a uniform relation to the fissure of Sylvius; (4) finally, the parietal eminence is valuable, since it marks the greatest lateral expansion of the brain and bears a special relation to the supramarginal convolution. While its cranial relations vary considerably, its cerebral relations are much more constant. The distance from the glabella to the upper end of the *fissure of Rolando* will be 55.7 per cent. of the total distance from the glabella to the inion. For instance:

If the distance from the glabella to the inion is—	The distance from the glabella to the upper end of the Rolandic fissure will be—
11 inches.	6.1 inches.
11½ "	6.4 "
12 "	6.6 "
12½ "	7.0 "
13 "	7.2 "

In other words, however the proportions of a head may differ, the pre-Rolandic and post-Rolandic regions of the brain are uniformly proportionate to each other, the pre-Rolandic being 55.7 per cent. and the post-Rolandic 44.3. Moreover, the fissure of Rolando runs downward and forward at an angle of 67°, and its average length is 3⅜ inches.

Dr. Claude Wilson, of Tunbridge Wells, has constructed a cyrtometer (Fig. 1014) consisting of two strips of flexible metal forming a letter **T**, with a tape to secure the short horizontal limb in place; the mode of using

which is shown in Fig. 1015. On the antero-posterior arm it will be noticed that there are two scales. The posterior scale is lettered in *capitals* from A to Q. The anterior scale is lettered in *small letters* from *a* to *q*, and they are so placed that when in position the distance from the glabella to small *a*, *b*, *c*, etc., is 55.7 per cent. of the distance from the glabella to capital A, B, C, etc. The horizontal limb being placed on the forehead, so that its inferior border corresponds to the glabella, if the capital letter A falls over the inion, then the small *a* will correspond to the beginning of the fissure of Rolando, and so on for the other letters. The small strip for marking the fissure of Rolando is movable on the antero-posterior limb, and is also reversible to suit both sides. This is now slid along until it corresponds for instance to the small *a*, when its anterior border marks the line of the fissure of Rolando. Similarly, if the inion corresponds to B or C, the Rolandic strip is slid to *b* or *c*, etc.

The Fissure of Sylvius.—To locate this fissure a line is drawn from the external angular process backward to the occipital protuberance (Fig. 1018, EAP to OPr) by the *shortest route* between these points. This line droops a little toward the external auditory meatus in avoiding the great convexity of the skull, which convexity lies in the course of the *direct horizontal* line between these two bony prominences. It usually passes about half an inch above the meatus, and thus closely corresponds to the floor of the middle fossa at this point. In front of the meatus it lies above the level of the floor of the middle fossa; behind it, it runs parallel to, and nearly coincident with, the attachment of the tentorium and the posterior half of the lateral sinus. A point one inch and a half posterior to the external angular process on this line marks the commencement of the fissure of Sylvius. Even in heads of the most varied shapes and sizes this measurement remains constant. From this point a straight line to the centre of the parietal eminence marks accurately the course of the posterior limb of the fissure and nearly corresponds in part with the squamo-parietal fissure (Fig. 1018, SF). The ascending limb of the fissure corresponds closely with the squamo-sphenoidal suture in its entire length, and is continued upward in the same line for half an inch (A). The middle meningeal artery is also shown in Fig. 1018 in its relation to the Sylvian and Rolandic fissures. To expose the tip of the temporo-sphenoidal lobe, trephine behind the upper extremity of the great wing of the sphenoid (TS). To expose Broca's convolution, trephine immediately in front of the great wing of the sphenoid (B).

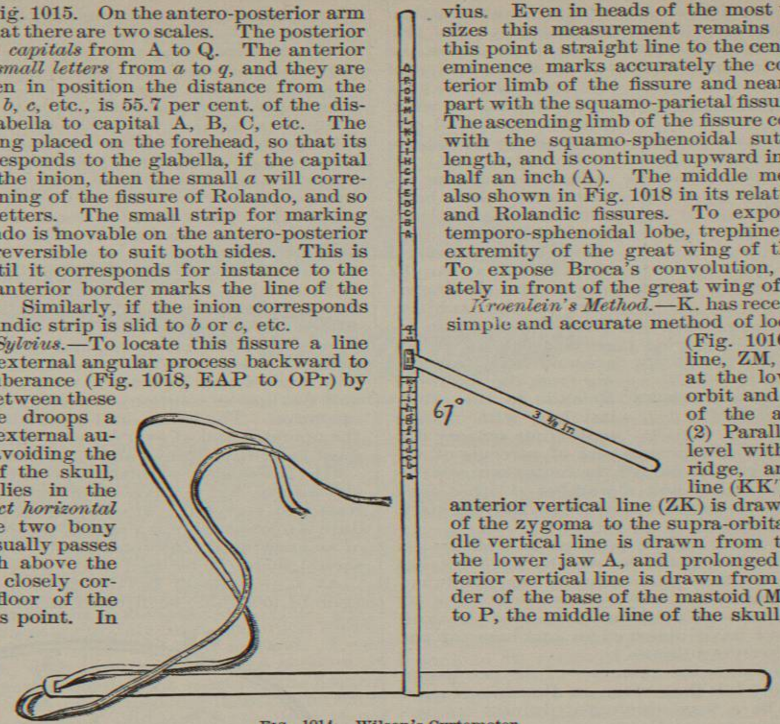

FIG. 1014.—Wilson's Cyrtometer.

Kroenlein's Method.—K. has recently proposed this simple and accurate method of locating the fissures (Fig. 1016): (1) The base line, ZM, runs horizontally at the lower border of the orbit and the upper border of the auditory meatus.* (2) Parallel with this, on a level with the supraorbital ridge, another horizontal line (KK') is drawn. (3) An anterior vertical line (ZK) is drawn from the middle of the zygoma to the supra-orbital line. (4) A middle vertical line is drawn from the articulation on the lower jaw A, and prolonged to R. (5) A posterior vertical line is drawn from the posterior border of the base of the mastoid (MK') and prolonged to P, the middle line of the skull. (6) Draw a line from K to P. Between the points R and P' it corresponds to the fissure of Rolando. (7) Bisect the angle PKK' by the line KS. This line corresponds to the fissure of Sylvius from its bifurcation to its posterior end. The point K is over the bifurcation of the fissure of Sylvius. K and K' are the points for trephining to reach the anterior and posterior branches of the middle meningeal artery. The method applies equally to all varieties in the shape of the head, both brachi- and dolicho-cephalic.

Chiene's Method.—Mr. John Chiene, of Edinburgh, has proposed a method of fixing the position and length of the Rolandic fissure which is at once simple, ingenious,

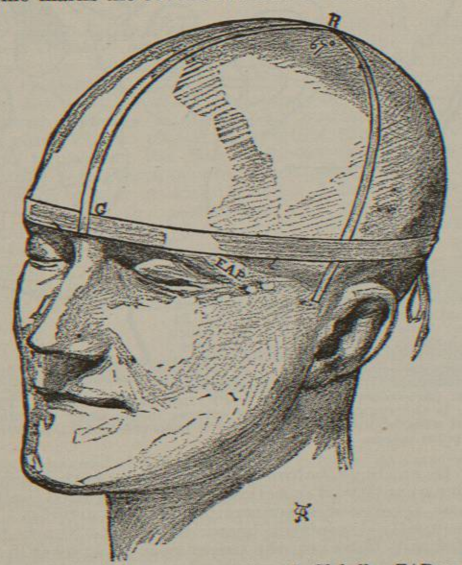

FIG. 1015.—Wilson's Cyrtometer *in situ*. G, Glabella; EAP, external angular process; R, fissure of Rolando, its position and direction marked by the lateral strip of metal.

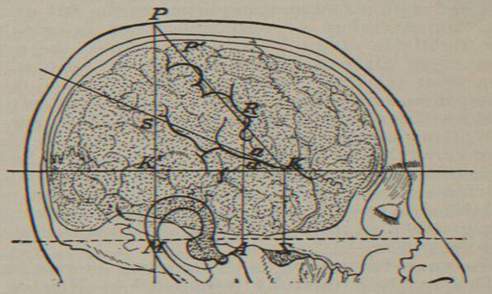

FIG. 1016.

and always available. He folds a square piece of paper once (Fig. 1017, A, B, C, D), on the diagonal line A, C. The angle B A C is then evidently 45°. The angle D A C (45°) is then halved (22.5°) by folding the paper again on the line A E. The sum of the angles B A C and C A E

* I perhaps ought to state here that in different parts of this article I have utilized to a small extent portions of the text contributed to other publications.