torn in removing the brain. This is the tuber, commonly called "*tuber cinereum*," which is continuous with the infundibulum, and thus with the hypophysis. The cephalic part of the tuber is reinforced by the chiasma,

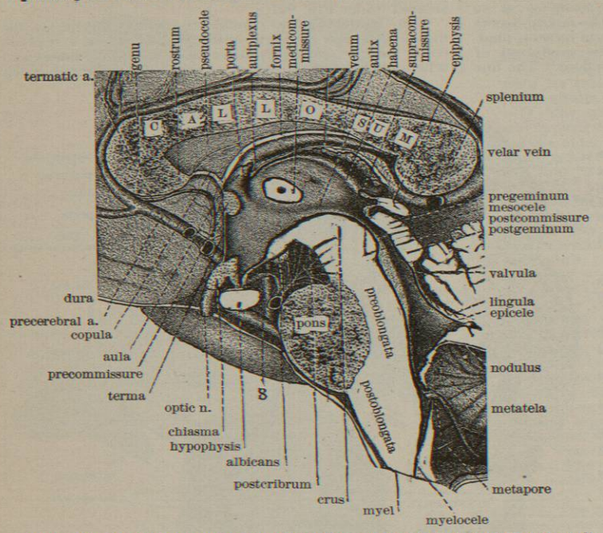

FIG. 687.—The Mesal Cavities of an Adult Brain Exposed from the Left, with Their Immediate Parietes. × .65. Fig. 801 represents the entire meson of the same specimen on a smaller scale, and its mode of preparation is there described.

Defects.—In addition to those specified under Fig. 801, the most serious are: (*a*) the non-representation of the postpontile recess, the mesal depression just caudad of the pons, shown in Fig. 702, 2; (*b*) the presence of the line curving dorso-caudad from the rostrum of the callosum; (*c*) the imperfect indication of the membranous parietes of the dorsal sac, the pouch lying upon the epiphysis; (*d*) the non-designation of the diacele.

the ental margin of which presents a marked transverse ridge, sloping caudad into the tuber and cephalad into the optic recess. In Figs. 689 and 708, the chiasma and tuber are shown with the hypophysis attached; but in Fig. 672 it is detached, leaving an orifice, the lura.

C. Directly dorsad from the chiasma, the cephalic wall of the diacele is the terma (*lamina terminalis*, or *l. cinerea*), so thin and delicate as not infrequently to be ruptured during the removal or manipulation of the brain. The proper nervous material of the terma seems hardly more substantial than the lining endyma and the covering pia, here represented by the ental and ectal lines. The ectal aspect of the terma is shown in Fig. 711.

D. Suddenly there is a marked thickening of the cephalic wall, from the reinforcement, so to speak, of the terma by a fibrous cord, oval or elliptical in section. This, the precommissure, connects the olfactory bulbs and portions of the cerebrum upon opposite sides, and hence belongs to both the rhinencephal and prosencephal; the cavity just caudad and dorsad of it is the aula, the mesal portion of the rhinocele and prosocele; §§ 362–364.

E. From the precommissure caudad to the roof of the mesocele the course of the endyma is extremely irregular, and the nature and shape of the roofs are very diverse. The immediate roof is largely membranous, and the condition is further complicated by blood-vessels large and small, and by plexuses. Finally, the parts lying directly upon the meson differ materially from those just laterad of it, and as the chances are altogether against a medisection being exactly mesal in the whole of its course, there is nearly a certainty that upon the first inspection one will miss anticipated features and see what one does not understand.

F. The recognition and comprehension of the actual facts in a given preparation will be facilitated by consulting the diagram (Fig. 725), and the representations of the brains of the cat and rabbit (Figs. 681 and 682). The important point to bear in mind is that the complete circumscription of the mesal encephalic cavities would be unaffected were the entire cerebrum removed, including the callosum, hemiseptum (the lateral wall of the pseudocele), and fornicommissure (the mesal continuity of the fornix), down to the point where the heavy line representing the endyma leaves the narrow, white area representing the fornicommissure to cross the convex surface of the fornicolumn and be reflected upon the auliplexus. The details of this, the aulic and portal region, are more clearly seen in the enlarged figures of the porta (Figs. 721 and 719).

G. From the auliplexus (at or very near the meson) or from the portiplexus (if the section plane passes through the right or left porta instead of the mesal aula) the endyma may be traced caudad upon the ventral surface of a membranous fold, the velum. Strictly speaking, between the endyma and the velum, which is a fold of pia, intervenes the remnant of the primitive nervous roof of the diacele. This may persist in some animals, but in the adult cat and in man, so far as I am aware, there is practically nothing between the pia constituting the velum and the endyma. At each side of the meson there depends a more or less distinct vascular fringe, the diaplexus, continuous with the auliplexus, the portiplexus, and thus with the paraplexus, these last three being successive members of the prosoplexus.

H. The relations of the endyma to the velum and plexuses are more clearly shown in Fig. 732, representing a transection of the diacele. There also are shown the relations of the habena. This is a low ridge following a curved line along the mesal aspect of the thalamus from the dorsal end of the porta to near the epiphysis; it is covered by endyma, but just dorsad of it, dimly seen in the figure, is a shallow furrow, the habenal sulcus, from which the endyma is reflected first dorsad, and then mesad, upon the velum and the diaplexuses. The habena unites with its opposite (fellow of the other side) at the supracommissure. The endyma line is seen to leave the velum, and descend to the dorsal (really cephalic) surface of the epiphysis, whence it extends cephalad to and over the margin of the supracommissure, then into and out of the epiphyseal recess, and over the convex cephalic surface of the postcommissure; thence it enters the mesocele, where the tracing of its continuity was begun, only it is now the lining of the roof, the geminal bodies, instead of the floor.

I. Continuing caudad, there is but slight change in the direction of the roof of the mesocele; a great reduction in its thickness occurs in the transition from the postgeminum to the valvula. The succeeding part, the lingula, is somewhat thicker and trends slightly dorsad, to become continuous with the cerebellum proper. The cavity here resembles a gable roof, with a sharp dorsal angle. The caudal slope is formed by the nodulus, a comparatively massive mesal lobe; but from its margin, commonly more rounded than appears in this figure, the endyma

TABLE II.—PROVISIONAL GROUPING OF SOME NEURAL PARTS ACCORDING TO THEIR SEGMENTS AND SOME OTHER CHARACTERS.

	1. Segment.	2. Chief constituent.	3. Cavity.	4. Membranous portion.	5. Plexuses.	6. Thin and riparian parts.	7. Commissures, etc.	8. Some other parts.
I.	Rhinencephalon.	Bulbi olfactorii.	Rhinocœlia.	Rhinotela (in some "fishes")	.....	.....	Præcommissura (pars olfactoria).	Præcribrum, limen, crista.
II.	Prosencephalon.	Cerebrum.	Prosocœlia (including the mesal aula and lateral paracœliæ).	Prosotela (including the mesal aulatela and lateral paratelæ).	Prosoplexus (including the mesal auliplexus and lateral paraplexus).	Tænia, fimbria, pala, terma.	Præcommissura (pars temporalis), callosum, fornix.	Pallium, insula, lenticula, caudatum, paraphysis.
III.	Diencephalon.	Thalami	Diacœlia	Diatela	Diaplexus	Habena	Supracommissura, medicommissura, chiasma.	Posteribrum, tuber, hypophysis, epiphysis, genicula.
IV.	Mesencephalon.	Quadrigemina.	Mesocœlia	Mesotela (in the lamprey).	.....	Valvula	Postcommissura, decussationes tegmentorum.	Crus, tegmentum, crusta, lemniscus, intercalatum.
V.	Epencephalon.	Cerebellum	Epicœlia	.....	Epiplexus	Lingula	Pons	Præoblongata, vermis, flocculus, denticulum.
VI.	Metencephalon.	Postoblongata.	Metacœlia	Metatela	Metaplexus	Metaporus, ligula, obex.	Decussatio pyramidum.	Pyramis, oliva, trapezium.
VII.	Myelon	Myelon	Myelocœlia	Myelotela (in lumbar enlargement of birds).	.....	.....	Commissura ventralis, c. dorsalis.	Conus, filum.

is abruptly reflected, together with the pia which had covered its caudal surface; these two membranes, closely united, and with apparently little or no trace of the primitive nervous roof, constitute the metatela. This is interrupted or modified at the orifice here called metapore, but commonly known as "foramen of Magendie"; in the present figure it is at the point where an artery appears. Later observations indicate that the above accounts of the metatela and metapore do not apply to all specimens; see §§ 77–83.

§ 67. *Encephalic Variations.*—Excepting as to the fissures and gyres, and the pyramidal decussation, treatises upon anatomy seldom refer to variations or anomalies of the surfaces or ental structures of the brain,* yet they are frequent, and sometimes significant, morphologically if not physiologically. So far as I can determine from my own materials, and from figures and descriptions, there is hardly a feature of the human brain respecting which it can be stated confidently what is normal, or how frequently certain peculiarities occur.

§ 68. *Classification of the Parts of the Brain.*—The foregoing account of the brain as a whole constitutes an introduction to the description of each of the six segments, beginning with that immediately succeeding the myel.

§ 69. *Commentaries upon Table II.*—A. It is substantially identical with Table VII. in my paper, 1896, *h*. Compare the tables in the first edition of this work (1889, *a*),

* The subject is treated with unusual fulness by Krause, 1889, 192–195.

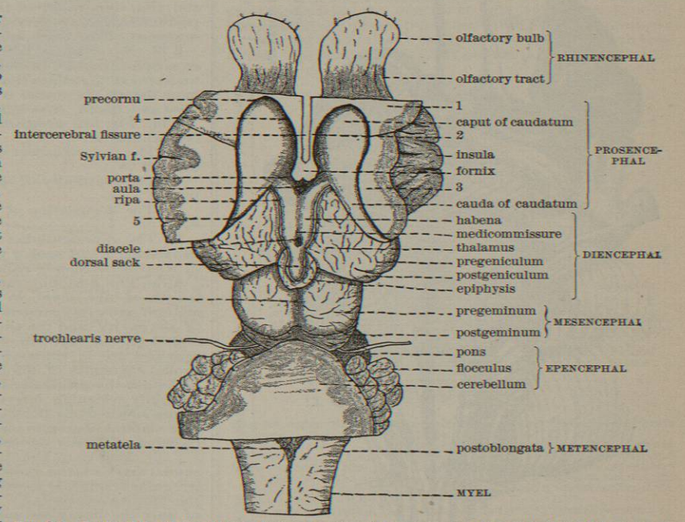

FIG. 688.—Brain of the Sheep, dissected so as to exemplify the segmental constitution of the organ in mammals. From "Physiology Practicums." 1, Cephalic slope of the cut surface of the cerebrum; 2, mesal wall of the paracele—at a higher level this would be one of the hemiseptums; 3, horizontal cut surface of cerebrum; 4, the mesal, vertical portion of the paracele; 5, indicates the location of the ripa between the thalamus and caudatum, but it is overhung by the latter so as not to appear in this view; 6, mesal furrow of the pregeminum.

From the cerebellum have been cut both caudal and dorsal parts. On the cut dorsal surface are seen the central alba and the peripheral cinerea, but the outline of the latter is diagrammatic only. At the sides are the tiers of foliums constituting the flocculus.

From the cephalic end of the cerebrum have been cut the parts projecting over the olfactory tracts, but part of the cephalic slope is here marked 1. With the dorsal portion were removed the entire callosum and the fornix excepting the cephalic vertical part. This and the mesal walls of the paracele are really cut at a lower level than the larger cut surface on the left. On the right the insula has been exposed by pushing up and breaking off the overhanging parts. The ectal surfaces, covered by pia, are indicated by irregular lines representing the blood-vessels.

The ental surfaces, covered by endyma, are those of the caudatums in the paraceles, the habenas, medicommissure, and dorsal pouch; and the floor of the aula and portas.

The irregular line laterad of the habena and extending around the endymal area on the epiphysis represents a ripa (shore line). It consists of the cut or torn edges of the pia from the dorsum of the thalamus and of the endyma from the habena which united to form a membranous roof of the diacele, the diatela, which has been removed.

Similarly the plal, dorsal surface of the thalamus is demarcated from the endymal surface of the caudatum by a ripa which meets the other at the porta.

The epiphysis, although a constituent of the diencephal, is tilted caudad so as to rest upon the pregeminum, and the mesal part is covered by the dorsal sack.

and in Wilder and Gage, 1882, 409. From the tables of Schwalbe (1881, 397) and His (1893 and 1895) it differs especially in the absence of any attempt to indicate the relative "values" of the several segments upon embryologic or other grounds.

B. Its purpose is twofold: (*a*) To indicate, according to my present information and belief, the number and constitution of the definitive encephalic segments. (*b*) To illustrate the verbal correlations between the names of the segments themselves (column 1), and those of (3) their major cavities, (4) their membranous parietes, and (5) their vascular plexuses.

C. The Latin form of the names is employed (see § 10).

III. METENCEPHAL.—§ 70. Synonyms: Metencephalon, after-brain, myelencephalon, macromyelon.

§ 71. *Tabular Arrangement of Parts.*—Chief part: postoblongata (caudal portion of "medulla oblongata"). Cavity: metacele (caudal portion of "fourth ventricle"). Floor: postoblongata. Sides: restes ("restiform bodies") and ligula. Roof: metatela and obex. Plexuses: metaplexuses. Orifice or evagination: metapore ("foramen of Magendie"). Decussation: Dec. of the pyramids. Other ectocelian parts and features: Ventral sulcus; ventral column; pyramid; oliva; arciform fibres; lateral column; funiculus of Rolando; tubercle of Rolando; cuneate funiculus; *funiculus gracilis;* clava; ligula; obex. Other entocelian parts and features: Mesal sulcus; *ala cinerea;* postfovea; *eminentia cinerea.*

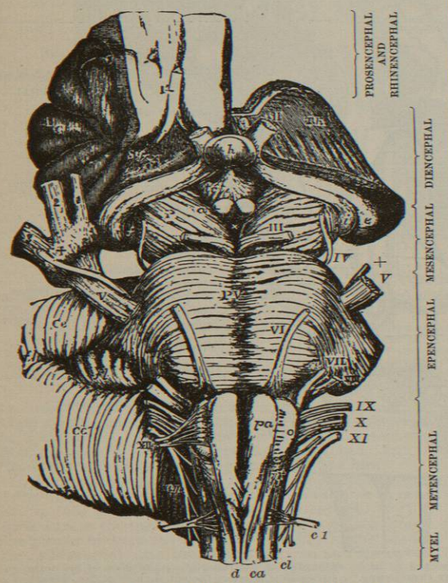

FIG. 689.—Ventral Aspect of the Entire Brain Stem. × 1. (From Quain.) Compare Fig. 672. The Roman numerals I.–XII. designate the twelve pairs of cranial nerves; *ii*, the optic tract, more completely exposed than in Figs. 672 and 728; *a*, albicans; *c*, insula; *ca*, ventral column; *c* 1, first cervical, or suboccipital nerve; *ce*, cerebellum; *cl*, lateral column; *d*, ventral fissure of the myel, just cephalad of which is seen the decussation of the pyramids; *e*, pregeniculum; *f*, lemniscus; *fl*, flocculus; *h*, hypophysis; *i*, postgeniculum; *o*, oliva; P, crus; *pa*, pyramid; PV, pons; *r*, "lateral tract of oblongata," direct cerebellar tract; *Sy*, at the ventral margin of the insula, indicates where the basisylvian fissure begins; *tc*, tuber ("*tuber cinereum*"), between which and the hypophysis is the infundibulum; *Th*, thalamus, cut surface; ×, postcribrum ("posterior perforated space"); × ×, precribrum ("anterior perforated space"); +, motor root of trifacial nerve.

Preparation.—The entire left hemicerebrum has been removed by an incision described as passing (in the capsula?) between it and the thalamus; on the right side are left the insula, the adjacent part of the frontal lobe, the olfactory tract, and the precribrum.

Defects.—Several parts, notably the albicantia (*a*) and the flocculus (*fl*), are represented in a somewhat conventional way, and the cimbia ("*tractus peduncularis transversus*") is omitted. The crura, especially the left, are shaded so as to appear twisted.

§ 72. The postoblongata (Figs. 670, 688, 689, etc.) is so obviously a continuation of the myel that if there were no parts cephalad of it, and if it were wholly contained within the spinal canal, it would probably be regarded as merely a somewhat modified region of the myel, comparable with the lumbar enlargement near its other extremity, which also in birds contains a distinct and thin-roofed dilatation, the rhombocele.* There is, therefore, ample etymological warrant for the name *macromyelon* (large myel region), applied by Owen, and for *myelencephalon* (myel-like brain region), employed by Huxley, His, and others. On account, however, of its equally obvious continuity with the preoblongata (especially in animals lacking the pons, *e.g.*, the turtle, Fig. 680); its location, mostly within the cranium; and the number, peculiarity, and vital importance of the nerves connected with it, the postoblongata is conveniently regarded as a definitive segment† of the brain under the title, *metencephal.*

§ 73. Nevertheless both the macroscopic and the microscopic structure of the postoblongata are much better understood in connection with those of the myel. For more details the reader is referred to the articles *Spinal Cord* and *Brain, Histology of the.*

§ 74. *Fig. 689 illustrates:* A. The ectal origins of the cranial nerves.

B. The ventral aspect of the adult insula (comp. Figs. 672 and 781).

C. The continuity of the optic tract with both geniculums.

D. The decussation of the pyramids (see under Fig. 672).

E. The representation of all six segments upon the ventral aspect of such a preparation, including the parts of what is commonly called the "brain stem."

§ 75. The postoblongata differs from a corresponding length of the myel in size, shape, amount of alba, amount and arrangement of cinerea, the extent and form of the cavity, and the nature of its roof.

§ 76. In the myel the two halves dorsad of the commissures are in contact; this is the case also with the caudal extremity of the postoblongata; but for most of its length the originally mesal surfaces are separated by a rapidly widening interval, so that what was mesal becomes successively dorsal, and finally lateral, while what was lateral becomes approximately ventral. These changes materially increase the width of the segment.

§ 77. *Metacele.*—The cavity, a tube in the myel and caudal part of the postoblongata, is expanded into an irregular triangular fossa, the metacele or caudal part of the "fourth ventricle." The roof of this cavity consists of only the lining endyma and the covering pia, constituting the metatela.

§ 78. *Metapore* (*foramen of Magendie*).—In 1826–27 Magendie described (1827, 1–29) an orifice in the roof of the "fourth ventricle" by which that cavity communicates with the subarachnoid space. Magendie designated the orifice as *entrée des cavités du cerveau* or *entrée des ventricules cérébraux.* In 1855 Luschka published a description and figure of the orifice, which he renamed *foramen Magendii.* In the present article these and various other polyonyms are replaced by the mononym *metapore,* Latin *metaporus,* signifying an orifice in the metatela, the membranous roof of the metacele, the cavity of the metencephal.

* This dilatation of the myelocele has also been called *sinus rhomboidalis;* and this name has likewise unfortunately been applied to the "fourth ventricle," the continuous cavity of the metencephal and epencephal; furthermore, there have come into use derivatives like "rhomboidal lip" and "secondary rhomboidal lip."

† As stated in § 43, this region represents several potential segments or neuromeres.

§ 79. Most later anatomical writers have admitted the existence of the metapore, but the descriptions are commonly brief and the figures unsatisfactory. That by Key and Retzius is suspiciously symmetrical, although

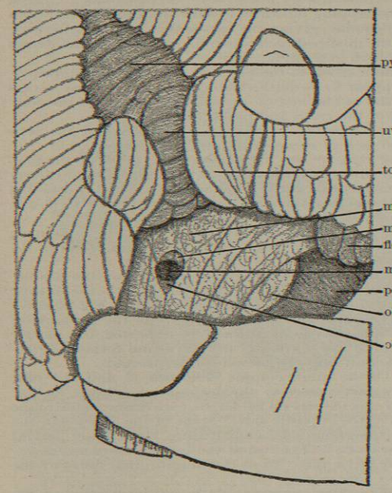

FIG. 690.—The Metapore (Foramen of Magendie) as Exposed by the Divarication of the Cerebellum and Oblongata; 3/8. × 1.

Preparation.—The brain of an adult Swedish carpenter was removed with great care, by dividing the calva sagittally at the left of the meson, so as to avoid tearing membranous adhesions. The brain was supported on a bed of cotton; the arteries and the arachnoid extending from the cerebellum to the oblongata were cut away and the two parts held asunder with fingers so as to expose the region of the metapore. A photograph was then taken, upon which the drawing is based. After hardening, however, most of the cerebellum was cut away and another photograph taken of the reduced mass. The specimen and both photographs were shown at the meeting of the Association of American Anatomists, December 28th, 1882.

Defects.—The right side of the cerebellum was displaced more than the left, giving rise to the marked obliquity. The metapore itself should be shown on a larger scale. The postcerebellar arteries are omitted; they do not appear distinctly in the first photograph, and no record was made of their locations. This is unfortunate, since in all the cases in which they are preserved their relations to the metapore are close. Had more of the caudal aspect of the cerebellum been included, there might have been shown the line of attachment of the arachnoid at the boundaries of the postcisterna. The wavy lines on the dorsum of the oblongata hardly do justice to the vascularity of the pia covering that region.

it is copied by Schwalbe; Henle's (Fig. 691) is more natural. The best figures and the fullest description are those of Carl Hess, 1885, but few figures have the appearance of having been based upon photographs.

§ 80. My own earlier scepticism was based partly upon the absence of any such orifice in the cat and sheep, and upon the presumption in favor of endymal continuity and celian circumscription. The steps of my conversion to the more common view are stated in the first edition of the REFERENCE HANDBOOK and in the papers there referred to. The examination of specimens carefully prepared for the purpose showed that:

(1) The metapore is a normal and nearly constant feature of the human brain at and after birth.

(2) It exists also in apes and some monkeys.

(3) There are two human types, viz.: (*a*) definite, as shown in Fig. 690; (*b*) indefinite, Fig. 691. The latter is the more common.

§ 81. *Fig. 690 illustrates:* A. The existence of a natural orifice in the membranous roof of the "fourth ventricle."

B. The simplicity of the form and relations of the metapore in this specimen. It is mesal, symmetrical, and oval.

C. The appearance of the metaplexuses just within the cephalic margin of the metapore with no such extension upon the cerebellum as is shown in Fig. 691.

§ 82. *Fig. 691 illustrates:* A. The admission of the normal existence of the metapore in the adult by so expert an anatomist as Henle.

B. The attachment of an extension of the metatela from the cephalic border of the metapore upon the uvula and pyramis of the cerebellum.

C. The extension of the metaplexuses upon the thus everted ental aspect of the metatela, whereas in the specimen represented in Fig. 690 they barely appeared at the margin.

D. The topographical relation of the contorted postcerebellar arteries to the metapore.

E. The relation of the flocculus to the lateral recess (Fig. 698).

§ 83. *The Metapore the Outlet of an Ecagination.*—In accordance with the general morphological relations of the germ layers Minot published (1892, 676) this passage:

"Several writers have thought that the membrane [endyma] was broken through at certain points, but it probably is really continuous throughout life. The fourth ventricle is to be regarded, then, as an expansion of the central canal permanently bounded by the original medullary walls."

In the following year, in a letter which he authorized

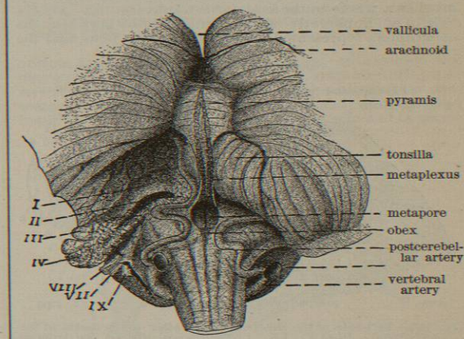

FIG. 691.—The Metapore (Foramen of Magendie) and Adjacent Parts Nearly as Represented by Henle ("Anatomie," iii., Fig. 232).

Preparation.—In the absence of statement by the author, it may be said that the brain was probably removed in the usual way, and the cerebellum tilted cephalad so as to expose its caudal aspect and the dorsum of the oblongata. The left tonsilla was then cut out, exposing on that side the parts marked I, IX, and a continuation of the postcerebellar artery.

I, metatela (*velum medullare posterius*), its lateral portion; II, lateral recess of the metepicele (fourth ventricle) opened by the removal of part of the metatela; III, flocculus; IV, epiplexus (*plexus choroideus lateralis*).

Changes.—The boundary line of the tonsilla has been made more distinct than in the original. In the upper part has been introduced a line to represent approximately the line of attachment of the arachnoid, constituting the dorsal boundary of the postcisterna (see Fig. 806).

Defects.—The margins of the metapore are too sharply defined; this is, perhaps, unavoidable when the parts are upon so small a scale; it cannot be said to bear either way upon the question of the naturalness of the orifice, for the effect of tearing a tough membrane like the metatela would be to leave ragged edges. The relations of the plexuses and accompanying strip of metatela are inadequately indicated, and the writer regrets his present inability to elucidate them. The postcerebellar arteries are represented as if distributed only between the oblongata and cerebellum, and between the lobes of the latter (compare Fig. 806).

me to publish in my paper (1893, *d*), Minot made the important suggestion that the metapore represented the mouth (proximal orifice) of an evagination of the endyma. Mrs. Gage found (1893) an evagination in *Amia*, and in *Diemyctylus* a distal orifice. Recently J. A. Blake has gone over the whole subject and shown (1898, 1900) by an admirable series of sections that in cats and dogs and other mammals there is a caudal protrusion of the metatela in the form of a closed sac, but that in man and apes, and (with modifications) in other primates, the larger part of the sac disappears so as to leave a free communication between the "fourth ventricle" and the postcisterna, a subarachnoid space. Blake's paper is accessible to American anatomists, and the bibliography is very complete; much, however, remains to be done.

§ 84. The increased cinerea of the postoblongata consists of (1) the continuous expanded masses of the ventral and dorsal cornua, especially the latter, which, with the modified ventral commissures, constitute the metacelian floor; (2) special masses of cinerea, more or less completely separate, the *nidi* of Spitzka, the niduli of Herrick, the "nuclei" of most writers, constituting the ental or deep origin of certain cranial nerves, and presumably representing detachments of the cornua; (3) the *dentatum oliveæ*, or olivary nucleus, a capsule of cinerea within the oliva, resembling the cerebellar dentatum.

§ 85. *Fig. 692 illustrates:* A. The insensible transition from the myel to the postoblongata, and thus from the myel as a whole to the brain as a whole.

B. The apparently sharp demarcation between the epencephal, represented here mainly by the pons, and the

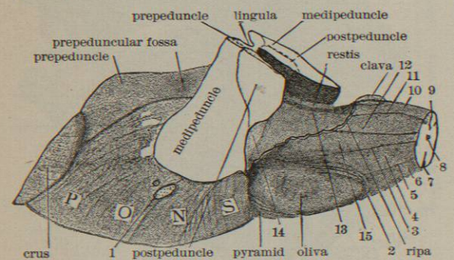

FIG. 692.—Left Side of the Metepencephal (After the Removal of the Cerebellum); 2,136. × 1.5. 1, Emergence area of the trifacial nerve, the larger the sensory root, the smaller the motor; 2, the *fibræ arciformæ* partly encircling the oliva; 3, line of emergence of the accessorius and of the dorsal roots of the spinal nerves; 4, continuation of the lateral column of the myel; 5, line of emergence of the ventral roots of the spinal nerves; 6, ventral column; 7, ventral (mesal) fissure; 8, myelocele; 9, dorsal (mesal) fissure; 10, *funiculus gracilis*, the oblongatal continuation of the myelic dorso-mesal ("posterior median") column, enlarging cephalad into the clava; the clava and funiculus together are sometimes called "posterior pyramid"; 11, "posterior median fissure"; 12, *funiculus cuneatus;* 13, the shaded band represents the mesal portion of the metacele (caudal part of the "fourth ventricle") between the restes ("restiform bodies") of the two sides; 14, acoustic tubercle, over which run the acoustic striæ, which are not shown; 15, tubercle of Rolando, the continuation of the unspecified funiculus of Rolando, interpolated between the *funiculus cuneatus* and the emergence line of the dorsal roots.

Defects.—Although good in general form and showing the oliva and its arciform fibres (2) with unusual distinctness, the specimen does not exhibit the several columns very clearly, and the lines of demarcation, excepting the "posterior median fissure," are taken from other preparations and from figures; this applies also to the lines upon the pons indicating the passage of the caudal fasciculi entad of the cephalic. The dotted lines demarcating the sectional areas of the peduncles are only approximately accurate. The facial and acoustic nerves are not shown, or the acoustic striæ (see Fig. 693).

adjoining segment. In reality, however, not only do the cephalic and caudal margins overhang the adjoining surfaces to a certain extent (see Fig. 702, 1 and 2), but it is by no means certain that the pons covers no more and no less than the epencephalic portion of the oblongata. In the sheep and cat, for example, the trapezium, here invisible, is exposed (Fig. 794), while with many lower vertebrates the pons is rudimentary or absent altogether, and the boundaries between metencephal and epencephal must be otherwise determined; *e.g.*, the turtle, Fig. 680.

C. The lapping of the cephalic portion of the pons over the caudal, giving the appearance of a twist or rotation of the medipeduncle upon its own axis to the extent of the fourth of a circle.

D. The relation to the oliva of the arciform fibres (2), which appear to be derived from the pyramid and to pass around the caudal end of the oliva to enter into the composition of the restis and postpeduncle.

E. The projection of the right clava beyond the left, a marked lack of symmetry in this specimen.

F. The ripa, or line of demarcation between the general, pial surface of the myel and oblongata, and the endymal, metacelian surface. The ripa consists of the pia and endyma with, in some specimens (Fig. 702), a thin intervening lamina of nervous substance.

G. The prepeduncular fossa, a shallow depression on the dorso-lateral surface of the prepeduncle, near the medipeduncle.

§ 86. The visible longitudinal divisions of the postoblongata do not correspond altogether with the myelic columns. The ventral column (Fig. 672, *i*, Fig. 689, *ca*, Fig. 692, 6) continues cephalad partly in the pyramid of the same side, as would naturally be expected, but mostly dips entad of the pyramid and oliva and forms longitudinal fasciculi near the meson farther dorsad.

§ 87. Of the lateral column (Fig. 689, *cl*, and Fig. 692, I) a large part crosses at the decussation (shown in Fig. 689, but not always visible) to constitute mainly the pyramid of the opposite side. Some of the fibres join the restis of the same side, constituting the "direct lateral cerebellar tract." The rest of the lateral column dips entad of the oliva and "forms the longitudinal fibres of the *substantia reticularis grisea*."

§ 88. The dorsal column of the larger portion of the myel is displaced in the cervical region by the dorso-mesal ("posterior median") column (Fig. 692, 10); this, in the postoblongata, is called *funiculus gracilis*. Near the apex of the metacele it presents a distinct enlargement, the clava (Fig. 692), cephalad of which the funiculus is no longer distinct. Between the *funiculus gracilis* and the lateral column (Fig. 692, 4) there intervene, in the postoblongata, two funiculi, of which the more lateral (15) is regarded as the direct continuation of the dorsal column of the myel, but is commonly called funiculus of Rolando, sometimes "lateral cuneate"; between it and the dorso-mesal column (*funiculus gracilis*) intervenes another interpolated funiculus, the cuneate (12); this and the funiculus of Rolando appear to enter into the composition of the restis ("restiform body") which is continued as the postpeduncle into the cerebellum; but, according to *Quain*, this relation is rather apparent than real, the components of the restis and postpeduncle being (*a*) the arciform fibres (Fig. 692, 2) from the ventral column, and (*b*) the "direct cerebellar tract" of the lateral column.

§ 89. The increased bulk of the postoblongata is due also in part to the entrance (or exit) of the roots of the accessory, hypoglossal, vagus, and glosso-pharyngeal nerves, which are more numerous than the spinal nerve roots upon a similar length of the myel (see Figs. 672 and 689).

§ 90. *Fig. 693 illustrates:* A. The general topographic relation of the cerebellum to the segments just cephalad and caudad, and to the ventral portion of its own segment, through the three pairs of peduncles, prepedunclе (5), postpeduncle (3), and medipeduncle (the cut area crossed by line 5 on the right and by lines 3, 4, and 5 on the left).

B. The tendency of anatomical writers to ignore the existence or traces or morphological significance of the thin or membranous portions of the encephalic parietes (see my paper, 1891, *b*).

IV. EPENCEPHAL.—§ 91. *Synonyms.*—Epencephalon; metencephalon; cerebellar segment; hindbrain.

§ 92. *Principal Parts.*—Floor: preoblongata and pons. Roof: cerebellum and lingula. Sides: peduncles. Cavity: epicele with lateral recesses. Ectocinerea: cortex. Entocinerea: dentatum, fastigatum, embolus, globulus. Chief cerebellar divisions: (mesal) vermis; (lateral) pileums ("hemispheres"). Flocculus and paraflocculus.

§ 93. *Boundaries.*—The epencephal may be defined as including as much of the brain tube as intervenes be-

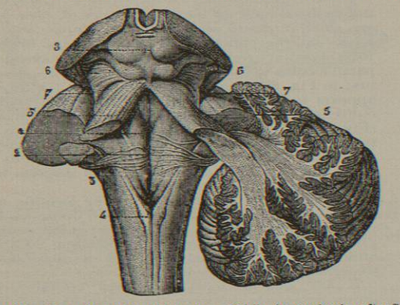

FIG. 693.—Dissection of the Peduncles. × 0.5. (From Quain, after Sappey, and Hirschfeld and Leveillé.) 1, Mesal sulcus; the line crosses the middle of the wide cut surface of the medipeduncle; 2, mesal sulcus at the place of emergence of the acoustic striæ; 3, postpeduncle, continuous with the restis; the cut end of the postpeduncle is crossed by the line, 2; 4, the clava, the swollen portion of the funiculus gracilis; 5, prepeduncle; 6, lemniscus; 7, lateral sulcus of the crus; 8, pregeminum, the postgeminum just caudad.

Preparation.—On the left, the three peduncles are cut short; the right half of the cerebellum is cut obliquely, and tilted laterad, so as to show the connections of the prepeduncle and postpeduncle.

Defects.—There is no evidence of the lines of division, ripas, of the endyma in exposing the metepicele ("fourth ventricle"), or of the existence of the valvula and lingula between the prepeduncles.

tween the membranous portion of the roof (metatela) and the decussation of the trochlearis nerve, together with the corresponding regions of the floor and sides and the encompassed cavity, the epicele.

§ 94. *Fig. 694 illustrates:* A. The general aspect of the adult cerebellum from the side.

B. The location of three main sulci, furcal, cacuminal, and peduncular.

§ 95. *Epicele.*—The epencephalic cavity includes the cephalic ("anterior") portion of the "fourth ventricle" together with its dorsal extension (fastigium) into the cerebellum, more or less triangular in form. According to Blake (1898–1900, 89–90) the cavity of the cerebellum has at first a greater dorso-ventral extension which is reduced by the fusion of the opposed walls.

§ 96. *Lateral Recesses.*—By this name are commonly known the pair of extensions of the "fourth ventricle" laterad and ventrad (Figs. 684, 695, and 698). Their walls are partly membranous (metatela) and partly substantial (sides of oblongata, peduncles of flocculus, and certain nerve roots). They might with equal appropriateness, perhaps, be described under the metencephal, and the difficulty in determining the segmental assignment is very naturally included by Blake (1898, 104) among the reasons for the non-recognition of two segments in this region.

§ 97. *Fig. 695 illustrates:* A. The embryonic continuity of the endyma and more substantial elements of the parietes around the lateral recesses at this stage (see § 98).

B. The corrugation of the thin portion of the parepicelian parietes preparatory to the formation of the epiplexus.

§ 98. *Outlets of the Lateral Recesses.*—Although closed in the embryo (Fig. 695) the ventral ends of the recesses are commonly described as open, constituting communications with the subarachnoid space even when the metapore does not exist. I have been disposed to regard these

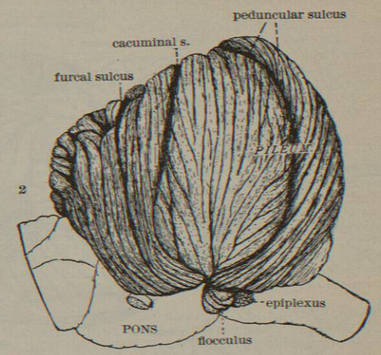

FIG. 694.—Left Side of the Cerebellum of an Aged White Man; 3,434. × 1. (From Stroud, 1897, *a*.) The outlines were drawn with the camera lucida.

orifices as artifacts from the readiness with which the membranous adhesions of that region are torn during the removal and examination of the brain according to customary methods. But the histological and embryological researches of Blake seem to show that in man and in mammals generally the ends of the recesses are opened by the more or less extensive disappearance of the membranous parietes.

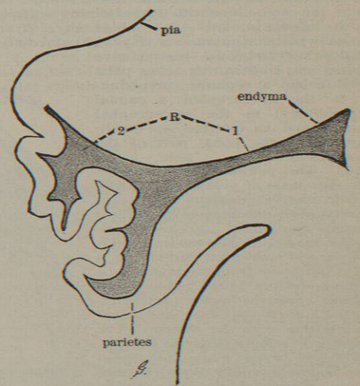

FIG. 695.—Transection of the Brain of an Embryo Rabbit, Sixteen Days Old. (From Kölliker.) × 65; enlargement of part of Fig. 669.

§ 99. *Fig. 696 illustrates, in addition to points also shown in Fig. 694:* A. The great depth of the furcal sulcus.

B. The absence of the lingular foliums (§ 119).

§ 100. *Preoblongata.*—The floor of the epicele is the preoblongata, continuous with the postoblongata and with the crura. In the turtle (Fig. 680) and other non-mammals there is no obvious line of demarcation.

§ 101. *Pons.*—In mammals the preoblongata is so markedly reinforced by a transverse fibrous mass, the pons, that it is easily recognized; but the width of the pons varies so greatly that its margins can hardly be accepted as the boundaries of the entire segment. Compare the turtle (Fig. 680) with the sheep (Fig. 794) and man (Figs. 672 and 689).

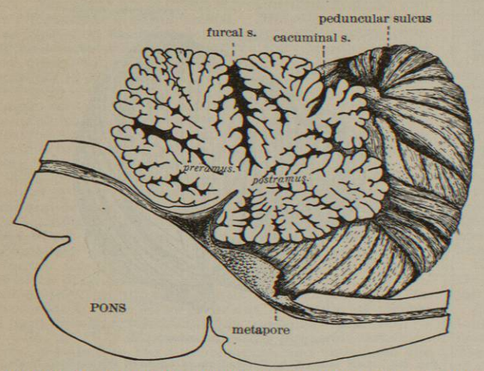

FIG. 696.—Mesal Aspect of the Cerebellum of an Adult Male Negro; 3,118. × 1. Traced from a photograph. (From Stroud, 1897, *a*.)

§ 102. *Peduncles.*—At and near the meson the connections of the cerebellum with the adjoining segments are thin; the lingula is relatively atrophied (Fig. 702) and the metatela wholly membranous (Figs. 670 and 687); but laterally the cerebellum has massive continuations, constituting three pairs of peduncles: a cephalic (prepeduncles) to the mesencephal; a caudal (postpeduncles) to the metencephal and myel, and an intermediate (medipeduncles) to the pons, part of the same segment.

§ 103. The peduncles constitute a continuous mass of alba at either side, but their relative positions and extent are pretty well determined by various methods, anatomical, microscopical, and experimental. The medipeduncle is the largest and most lateral; it is mainly continued from the lateral lobe of the cerebellum to the pons, where the fibres cross the meson, interdigitating with their opposites, and forming a relation with the cinerea. The postpeduncle mainly connects the vermis with the restis, while the prepeduncle connects chiefly the dentatum with the mesencephal and parts farther cephalad. The dorso-lateral aspect of the prepeduncle presents a distinct shallow depression, the prepeduncular fossa (Fig. 692).

§ 104. The relative location and direction of the three peduncles on the right side may be illustrated by the digits of the right hand. Hold the hand with the fingers down, the thumb pointing backward, the index forward, and the other three fingers, slightly overlapping, outward between them. The palm may then represent the cerebellum, the pollex the short and sharply curved postpeduncle, the index the longer and less curved prepeduncle, and the other three fingers the intermediate and thickest medipeduncle, continuous with its opposite through the pons.

§ 105. *Fig. 697 illustrates:* A. The lapping of the tonsillæ over the uvula.

B. The location of the flocculus and the commencement of the peduncular sulcus.

C. The relative position and size of the three peduncles.

§ 106. *Flocculus and Paraflocculus.*—Attached to the medipeduncle by short peduncles of their own are small foliated masses, the flocculus (in two lobes) and the paraflocculus (in one) (Figs. 698 and 701). Contrary to the implication of the names, the paraflocculus is really attached mesad of the flocculus; in Fig. 698 they are twisted so that the reverse appears to be the case. The peduncle of the flocculus forms part of the wall of the "lateral recess" (Fig. 698). Little is known of the functions of these parts or of their homologues in other animals. According to Stroud (p. 96) the paraflocculus is much larger in the cat and capable of division into a supraflocculus and mediflocculus.

§ 107. *Fig. 698 illustrates:* A. The location and form of the flocculus, with its two divisions and rounded folia, and of the smaller paraflocculus, presenting but slight traces of foliation. All are attached to the medipeduncle, and the flocculus is sometimes called the peduncular lobe.

B. The general location of the lateral recess (2), or parepicele, between the peduncles cephalad, the restis and other parts of the postoblongata mesad, and the flocculus stem laterad; its peculiar relations with the glosso-pharyngeal and vagus nerves are inadequately shown and need special preparation and study.

C. The twisting of the peduncles of the flocculus and paraflocculus whereby their real attachments are apparently reversed. The paraflocculus, although its name suggests a lateral position, really is attached mesad of the flocculus; see Fig. 701.

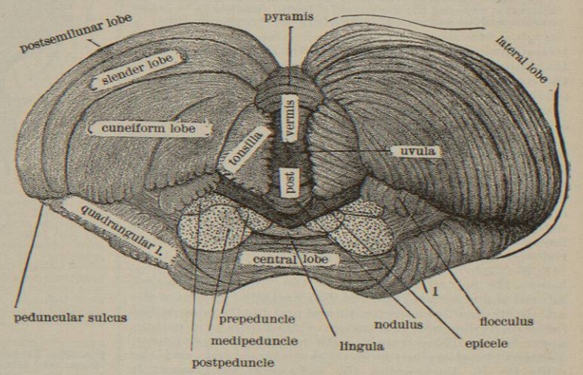

FIG. 697.—Caudal ("Lower" or "Posterior") Aspect of the Adult Cerebellum. A little less than natural size. (From Edinger, inverted and slightly modified.) 1, Part of the right quadrangular lobe. The cut ends of the peduncles are dotted; the large medipeduncles extend latero-dorsad into the lateral lobes; the flocculi are attached to the medipeduncles. The continuity of the vermian divisions with those of the lateral lobes is not apparent upon this aspect.

Defects.—In addition to the general remark made under Fig. 700 the following special deficiencies are to be noted: (1), There is no line to represent the divided endyma of the metatela along the caudal (here upper) side of the cavity (epicele); all this region requires elucidation in respect to celian circumscription; (2), the omission of the plexuses and nerve roots; (3), the postvermis should be more deeply shaded to indicate its depth below the level of the tonsillæ, which also are really almost in contact; (4), on this, or on Fig. 700, the vermis should present a line indicating the reflexion of the arachnoid.

§ 108. The *cerebellum* is essentially an arch over the epicele (cephalic part of the "fourth ventricle") (Fig. 699). This condition exists in the embryo, and persists in many of the lower vertebrates. The adult human organ, however, is a foliated mass of complex fibrous and cellular structure, well meriting the adjective *hypertrophied*, applied to it by E. C. Spitzka.

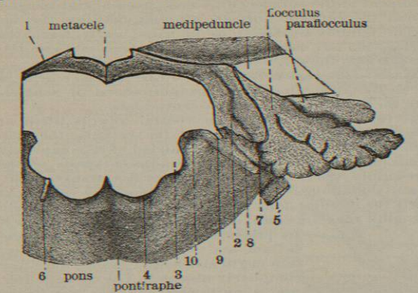

FIG. 698.—Caudal Aspect of the Right Flocculus and Adjacent Parts; 2,238. × 2. 1, Endyma at the left side of the epicele; 2, right lateral recess, laid open; 3, oliva; 4, pyramid; 5, trifacial nerve; 6, abducens; 7, facial; 8, acoustic; 9, glosso-pharyngeal; 10, recess latero-dorsad of oliva.

Preparation.—The cerebellum was removed by division of the peduncles to near the floor of the epicele, and the postoblongata by a transection just caudad of the pons; the lateral recess (2) had already been torn open, as usual, in removing the brain, and its entire extent and exact form are not determinable from this preparation (see Fig. 684).

FIG. 699.—Caudal Aspect of the Cerebellum and Oblongata of a Fetus. (Size and age and magnification uncertain, specimen and notes having been lost; it probably resembled quite nearly the specimen shown in Fig. 373.) *a*, The kilos.

§ 109. *Fig. 699 illustrates:* A. The large size of the epicele at this period, as compared with the thickness of the parietes.

B. The extensions latero-ventrad constituting the parepicele or "lateral recesses" (compare Figs. 384 and 395).

C. The non-appearance of the mesal lobe, vermis, at this period and the absence of sulci upon the lateral masses, pileums.

D. The continuity of the riparian part, *a*, the kilos ("posterior velum"), along the line of junction of the ectal pia and ental endyma, they not being represented distinctly; if their torn edges were distinct they would constitute the cestus. The cestus and kilos indicate the line of attachment of the metatela.

§ 110. *Aspects of the Cerebellum.*—In the natural condition of the adult brain the rounded margin of the cerebellum demarcates two surfaces looking respectively "upward" and "downward." But in accordance with the general principle of normalization (§ 38) and by analogy with the simpler case of the epiphysis (§ 154) the cerebellum is here regarded as if projecting dorsad at right angles with its supporting portion of the brain-axis, the oblongata (Fig. 702). The two main surfaces become therefore cephalic and caudal, but they are not sharply delimited.

§ 111. *Pileums and Vermis.*—The adult cerebellum comprises a mesal lobe, the *vermis*, and two *lateral* masses, the pileums, commonly called "hemispheres." On the cephalic aspect, the vermis (prevermis) is prominent (Fig. 700); but on the caudal the lateral lobes project decidedly beyond the postvermis, the surface of which is thus at the bottom of a deep mesal crevice, the vallis ("vallecula") (Fig. 697).

§ 112. *Foliums, Sulci, and Lobes.*—The entire surface of the adult cerebellum presents numerous lines, for the most part parallel and having a generally transverse direction. These lines represent crevices of greater or less depth, the sulci, and the intervening thin plates are the folia. Certain of the interfoliar crevices are so constant, deep, or distinct as to warrant the recognition of the intervening groups of folia as lobes.

The commonly received division of the two regions of the cerebellum into lobes is indicated upon the figures. I am free to admit, however, that I am by no means fully satisfied therewith.

§ 113. *Fig. 700 illustrates:* A. The natural tilt caudad of the cerebellum, so that its normally cephalic surface looks dorso-cephalad, even when the oblongata is held in the cephalo-caudal plane.

B. The extension of the cerebellum, so as to overhang the postoblongata.

C. The enormous preponderance of the pileums (lateral lobes) over the vermis (mesal lobe) in the adult; compare however, Fig. 699.

D. The slight demarcation between the vermis and pileums on this aspect.

E. The appearance of part of the postsemilunar lobes, and of the peduncular sulcus, both these appearing partly also upon the caudal surface.

F. The connection of the two cacuminal (presemilunar) lobes by means of a single folium, the cacumen.

§ 114. *Cortex* (ectocinerea).—Each folium consists of a central lamina of alba and a covering of cinerea having a peculiar cellular structure; see the article *Histology of the Brain*.

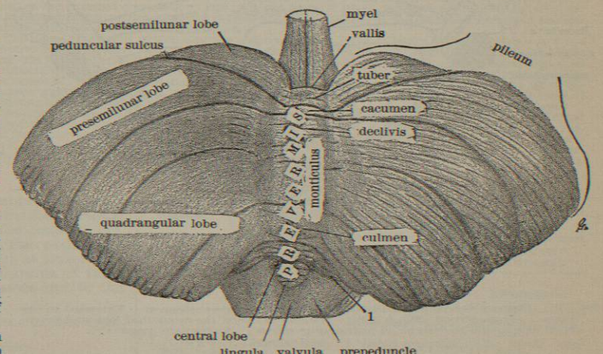

FIG. 700.—Cephalic ("Upper" or "Anterior") Aspect of the Adult Cerebellum. From Edinger, inverted and slightly modified; a little less than natural size. 1, The ala or lateral portion of the central lobe.

Defects.—The original figure is obviously diagrammatic; it was selected as more clear than usual, and as representing the general interpretation of the foliar arrangement on this aspect of the cerebellum; I am not, however, satisfied in all respects, and regret that I cannot determine certain points upon my own preparations, so as to base the figures upon them entirely. These remarks apply equally to Fig. 697.