

§ 115. *Peduncular Sulcus* ("great horizontal fissure").—When the flocculus and paraflocculus are removed, or the overlapping foliums of the cerebellum are separated from them and from one another by the removal of the pia, the non-foliated lateral surface of the medipeduncle is easily seen to continue laterad and dorsad for about 1 cm. between the tiers of foliums on the cephalic and the caudal aspects. This interval is the beginning or stem of what is commonly called the "great horizontal fissure," but which, from its obvious relation to the medipeduncle, I have called peduncular. By most writers it is represented as continuing along the dorsal ("posterior") margin of the cerebellum and as demarcating the cephalic and caudal aspects of the entire organ. In particular it is regarded as meeting its opposite at the meson just caudad of the cacumen, a single thin folium which, at either side of the meson, enlarges and becomes a subdivided cacuminal ("presemilunar") lobe.

§ 116. *The Peduncular Sulcus Incomplete as a Landmark*.—But, while it is perfectly possible, with most

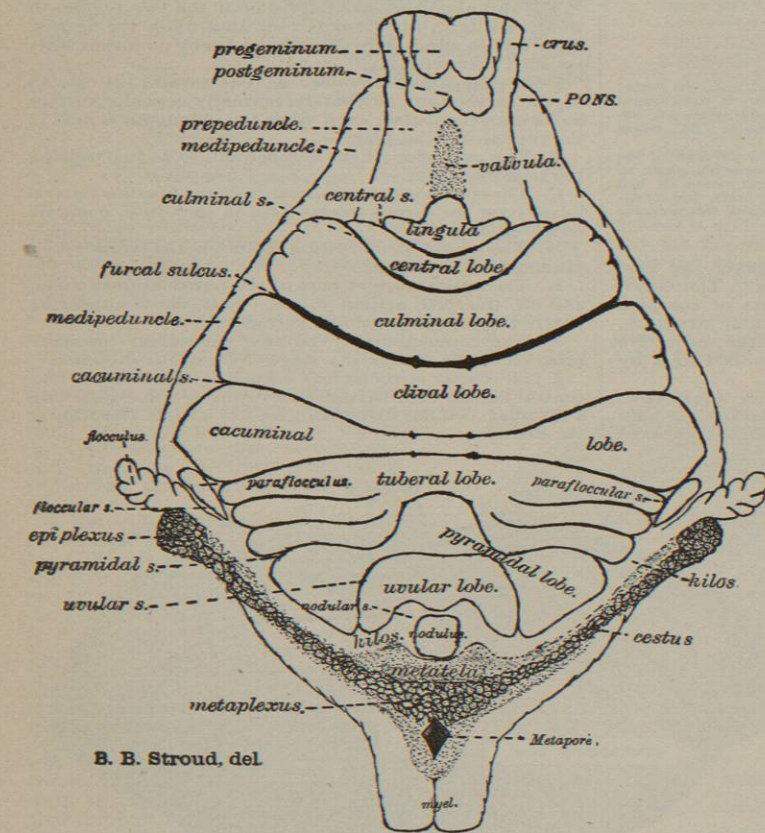


FIG. 701.—Diagram Showing the Divisions of the Human Cerebellum as if Extended in One Plane. (From Stroud, 1897, b, 108.) The line between the cacuminal lobe and the tuberal lobe should be designated *peduncular sulcus* ("horizontalis magnus").

specimens, to recognize a deep sulcus of the pileum which passes caudad of the cacumen and trends laterad in the direction of the medipeduncle, an inspection of the depths arouses doubts of its essential continuity and morphological significance.

§ 117. *Furcal Sulcus*.—On various grounds, especially comparative anatomy and development, Stroud has con-

cluded (1897, a, 6) that the primary and most constant sulcus, and the one which should be held to demarcate the two main regions of the cerebellum, is one which leaves the stem of the peduncular sulcus opposite the attachment of the paraflocculus and passes at right angles across the cephalic surface, dipping between the adjacent foliums so deeply as to more nearly reach the cavity than any other of the sulci. As seen in Table III, the furcal is the preclival sulcus of Schäfer.

§ 118. The region cephalad of the furcal sulcus is divided by the culminal sulcus (postcentral of Schäfer) into the culminal lobe and the central lobe.

§ 119. *Lingula*.—When the central lobe is lifted or removed there will be exposed the valvula, the thin zone of the mesocelium roof, and caudad of it, completely overhung and concealed by the adjacent parts of the cerebellum, a series of three, four, or five transverse diminutive foliums; see the medisection (Fig. 702). At birth the lingular folia are rounded and distinct, but in the adult they are relatively smaller, often flattened as if by pressure of the overhanging cerebellum, and sometimes (at least in certain negro and insane brains) nearly or completely absent.* The cephalic folium is narrowest and has a rounded outline (Fig. 700); the pia adheres quite firmly to these folia, so that they are liable to be torn off.

§ 120. Fig. 702 illustrates: A. The mesal topography of the cerebellum and adjacent parts when brought into nearly their "normal position," i.e., when the metepencephalic floor is nearly horizontal (cephalo-caudal) and when the longer axis of the cerebellum is nearly dorso-ventral; this is nearly their condition in a body lying prone, with the axon and longer portion of the neuron (myel) approximately horizontal, as with most quadrupeds and the majority of walking and swimming vertebrates (see § 9, and the article on *Terminology, Anatomical*). For comparison with Figs. 670, 687, and 756, this or they must be regarded as turned about one-fourth of a circle.

B. The exact number and form of the cerebellar folia and subfolia at birth, so far as they appear upon an approximate medisection.

C. The combination of the folia to form lobes, more or less well defined.

D. The arboriform arrangement, whence the name *arbor vitae* (herein mononymized to *arbor*).

E. The topographical relations of the mesal lobe (vermis) to the lateral lobes; caudad, dorsad, and at the ventro-cephalic region the lateral lobes project beyond the vermis, but the latter is the more prominent with the culmen at the cephalic side and with the nodulus at the caudo-ventral angle. The interval between the lateral lobes on the caudal aspect constitutes the vallis.

F. The enormous size of the cerebellum as compared with its cavity, even had the dorsal part of the latter been maintained at its natural size by alinjection.

G. The projection of the cerebellum beyond its attachments and proper cavity. Cephalad, it overhangs not only the valvula, but the postgeminum, these being parts of the mesencephalic; caudad, whatever exact limit be as-

* The lingula has not been recognized in the apes, but Stroud is inclined to regard as its homologue what he described (1897, b, 120) as a "cephalic" lobe in apes and in certain human brains, e.g., Fig. 698.

signed to the epicele, the vermis covers the entire "fourth ventricle."

H. The distinctness of the four lingular folia, constituting the transition from the massive cerebellum to the atrophic (?) valvula.

I. The prominence of the cephalic and caudal margins of the pons, and the concomitant depth of the prepontile and postpontile recesses.

J. The merging of the dorsal commissure of the myel and post-oblongata into the obex, and of this into the ligula; in the adult this latter seems to be hardly more than the combined pia and endyma (see Fig. 692), but in the child's brain from which this feature was derived, although the meninges had been removed, there was, nevertheless, a distinct lamina of nervous substance.

§ 121. The divisions of the caudal region of the cerebellum cannot be seen completely unless the post-oblongata is forcibly bent ventrad or cut away; indeed the entire oblongata and pons may advantageously be removed by transection of the peduncles ventrad of the flocculi as in Fig. 697.

§ 122. When the pileums are divaricated the postvermis caudad of the cacumen is seen to be at first narrow, then wider, and then decidedly compressed. The wide portion is the pyramis; the short region between it and the cacumen, the tuber; the longer portion of the remainder is the uvula crowded between subglobular divisions of the pileums, the tonsils. Finally, and seen with some difficulty, is the nodulus, a group of three or four foliums, connected at either side by the kilos with the flocculus. The relations of these parts to one another and to the lateral masses and to the sulci are indicated upon Table IV.

TABLE III.—SYNONYMS OF THE PRINCIPAL SULCI OF THE CEREBELLUM; STROUD, 1897, a.

Preferred.	Schäfer.
1. Central sulcus.	1. Sulcus precentralis.
2. Culminal sulcus.	2. Sulcus postcentralis.
3. Furcal sulcus.	3. Sulcus preclivalis.
4. Cacuminal sulcus.	4. Sulcus postclivalis.
5. Peduncular sulcus.	5. Sulcus horizontalis magnus.
	a. Sulcus postgracilis.
	b. Sulcus intragracilis.
6. Pyramidal sulcus.	6. Sulcus pregracilis.
	s. postpyramidalis.
7. Uvular sulcus.	7. Sulcus prepyramidalis.
8. Nodular sulcus.	8. Sulcus postnodularis.

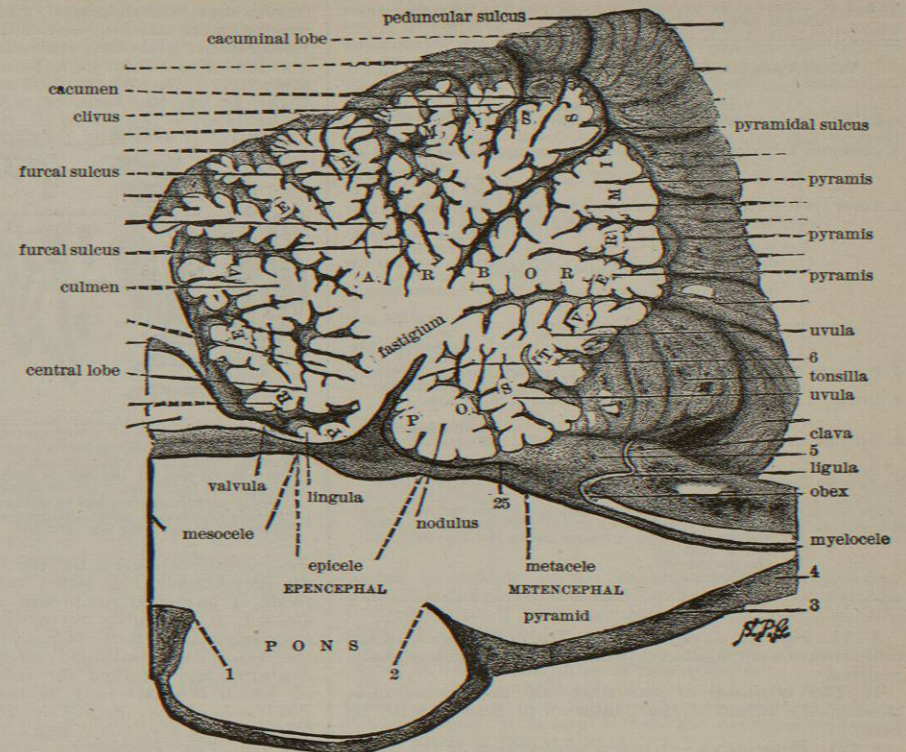


FIG. 702.—The Metepencephalon (Cerebellum, Oblongata, and Pons) of a Child at Term, Showing the Approximately Mesal Aspect of the Right Half; 478. $\times 3$. Traced from an enlarged photograph. (This is the same specimen that is shown in Fig. 756, where, however, no attempt was made to represent details, and the cerebellum is more nearly in its "natural attitude.") 1. Prepontile recess; 2. postpontile recess (*foramen caecum*); 3. presumed caudal end of the pyramid; between 3 and 4 there might be—but were not seen—indications of the pyramid decussation (Figs. 672 and 689); 5. slight elevation of the metacelium floor; the triangular darker area just ventro-cephalad represents the postfovea; 6. the dorsal extension of the epicele into the cerebellum; 25. metatela (diagrammatic).

Defects.—The plane of section passed slightly sinistrad of the meson; hence certain features are not exactly what would have appeared upon a precise medisection. On the cut (unshaded) surfaces the alba and cinerea are not distinguished, the latter having been bleached by the alcohol. The pons section does not show the fibres of the raphe. The cavities were not alinjected and hence are unnaturally small. The meninges were removed; so there is no indication of the dorsal attachment of the arachnoid to limit the subarachnoid space, and the obex, ligula, and metatela are supplied from other specimens, but the extent of the metapore (foramen of Magendie) is not shown.

When the drawing was made, the significance of the furcal sulcus had not been recognized. Dr. Stroud has kindly revised the identifications. He would limit the prevermis to so much as is cephalad of the furcal sulcus; but for the present I retain the original designations of the two regions of the vermis. The sulcus just cephalad of the cacumen is the cacuminal; that just caudad is the peduncular, deep in the pileum (lateral lobe) but shallow at the meson. The tuber is the part between the peduncular and tuberal sulci. See § 120.

TABLE IV.—SYNONYMS OF THE LOBES OF THE CEREBELLUM; FROM STROUD, 1897, a, SLIGHTLY MODIFIED.

TERMS PREFERRED.		SCHÄFER.	VARIOUS AUTHORS.
Vermis.	Vermis and pileum.	Worm and hemisphere.	Hemisphere.
1. (Lingular?) Cephalic lobe, variable.	1. Lingular lobe.	1. Lobus centralis.	Frænulum lingulae. Ala lobuli centralis.
2. Central lobe.	2. Central lobe.	2. <i>Not recognized as a distinct lobe.</i>	
3. Culmen.	3. Culminal lobe.	3. Lobus culminis.	Lobus lunatus anterior.
Furcal sulcus.			
4. Clivus.	4. Clival lobe.	4. Lobus clivi.	Lobus lunatus posterior.

TABLE IV.—SYNONYMS OF THE LOBES OF THE CEREBELLUM; FROM STROUD, 1897, *a.* SLIGHTLY MODIFIED.—Continued.

TERMS PREFERRED.	SCHAFFER.	VARIOUS AUTHORS.
Vermis.	Vermis and pileum.	Worm and hemisphere.
5. Cacumen	5. Cacuminal lobe	5. Lobus cacuminis.
6. Tuber ...	6. Tuberal lobe ...	6. Lobus tuberis ...
	a. pre-tuberal lobe.	a. L. semilunaris inferior.
	b. mediotuberal lobe.	b. Slender lobe.
	c. posttuberal lobe.	c. L. gracilis anterior.
7. Pyramis...	7. Pyramidal lobe.	7. Lobus pyramidis.
8. Uvula...	8. Uvular lobe...	8. Lobus uvulae ...
9. Nodulus.	9. The nodulus does not extend laterad into the pileum. The flocculus is a separate division. It is not a part of the pileum (or hemisphere).	9. Lobus noduli....
		Amygdala. Flocculus.

§ 123. *Fig. 703 illustrates:* A. The constitution of the dentatum as a corrugated capsule of cinerea, open cephalo-ventrad.
B. The entrance of the fibres of the prepuduncle through the hilum of the dentatum to connect with its cells.
§ 124. *Entocinerea.*—Upon a medisection of the organ there would appear to be only alba and ectocinerea, the

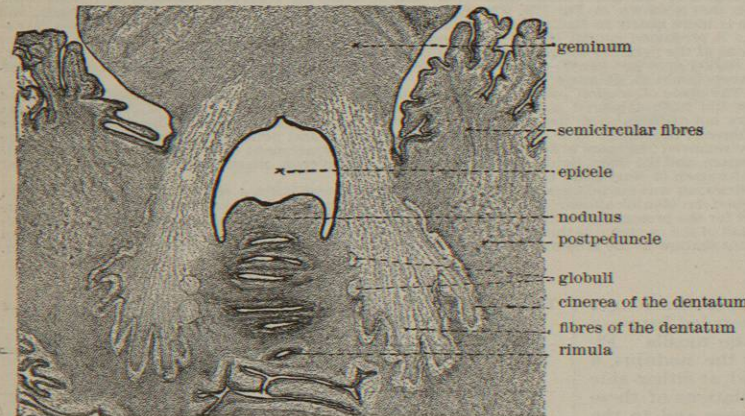


FIG. 703.—The Dentatum and Prepuduncle. (From Stilling, somewhat modified.) × 2.—
Preparation.—The plane of section was oblique, so as to coincide with the general direction of the prepuduncles as shown in Figs. 692 and 693.
Defects.—By an inexcusable oversight the prepuduncles are not indicated by a line and the name; but they are readily recognized as the fibrous tracts at the sides of the epicele, converging from the dentatum to the geminum. There is no representation of the "fleece," the layer of fibres radiating from the ectal surface of the dentatum.

former branching in a tree-like manner, whence the name *arbor (vita)*. But in the central part of the cerebellum, near the apex of the epicele, are four pairs of masses of cinerea sometimes called roof-nuclei or tectal nidi. There are reasons for thinking that the primitive cerebellar ento-

cinerea has been displaced, and is represented by these masses enumerated in their order from the meson laterad: Fastigium; globulus; embolus; dentatum.
§ 125. *The Dentatum.*—This is the largest and most easily recognized of the four masses; (see Figs. 703 and 704). It has the form of a corrugated capsule, open



FIG. 704.—The Dentatum and Other Masses of Cinerea in the Central Part of the Cerebellum. From Stilling, somewhat modified. × 2.—
Preparation.—This is commonly designated as a "horizontal" section. Really, the plane cannot be indicated in such simple terms. The central part of the figure, including the cinereal masses, is through the fastigium, the roof of the apex of the epicele.
Defects.—No attempt has been made to represent the fibrous constitution beyond the purely diagrammatic indication of the cephalic (anterior) decussating commissure.

meso-ventro-cephalad, for the reception of the fibres of the prepuduncle (Fig. 703). In any cerebellum, whether fresh, or hardened in chromic acid compounds, or even alcohol, it is readily recognized upon transsections or upon sagittal sections begun about 1 cm. either side of the meson and continued laterad for 2 or 3 cm. The dentatum has received the following additional names, of which the last only is used with any frequency: *Nucleus dentatus*; *corpus denticulatum*, *s. fimbriatum*, *s. lenticulatum*, *s. ciliare*; Eng., ciliary body.

§ 126. *The Fastigium.*—This, more often called "fastigial nucleus," is close to the meson, directly in the roof (fastigium) of the epicele; Fig. 703. It is rounded cephalad, but the caudal end presents two or three projections.

§ 127. *The Embolus and Globulus.*—These smaller masses of cinerea lie between the dentatum and the fastigium, and somewhat dorsad of the latter. Their forms are indicated by their names, and are well shown in Stilling's figure as reproduced in Fig. 704. More common (and cumbersome) titles are *nucleus globosus* or *globuliformis*, and *nucleus emboliformis*.

§ 128. *Fig. 704 illustrates:* A. The existence, near the apex of the epicele, of four pair of cinereal masses, representing, perhaps, dislocated portions of the cerebellar entocinerea.
B. The lack of precise symmetry in the forms of these masses; of the globuli there are three on the left and two on the right, the more cephalic probably representing two.

V. MESENCEPHAL.—§ 129. Synonyms: Mesencephalon; midbrain. Tabular arrangement of parts: Chief parts: quadrigeminum and crura. Cavity: mesocele (aqueduct or iter.) Floor: crura. Sides: gemina. Roof: gemina and valvula. Ectocinerea: cappa. Entocinerea ("central tubular gray"). Commissures: postcommissure, trochlear decussation.
§ 130. In early embryonic stages the mesencephal is the most conspicuous region of the entire brain, but con-

sists of a single, thin-walled vesicle, with a relatively large cavity (Figs. 671 and 677). As the parietes thicken, two furrows appear upon the dorsal aspect; a mesal, demarcating the left elevation from the right, and a transverse, subdividing each of these into a cephalic and a caudal portion (Fig. 673); there results, in the adult mammalian brain, the formation of four approximately similar elevations, whence the names, *corpus quadrigeminum*, *corpora quadrigemina*, *optic lobes*, etc. In the present article they are called *gemina* (twin bodies), *pregeminum* and *postgeminum* (Figs. 693 and 707). They constitute the larger part of the mesocelium roof.
§ 131. *Valvula.*—A caudal portion of the mesocelium roof retains nearly its primitive tenacity as a transparent lamina, the valvula, between the gemina and the lingula (Fig. 702). Its cephalic part presents some slight corrugations, either a mesal furrow and a pair of lateral ridges, the frenulums (Fig. 706), or a mesal ridge in addition.
§ 132. The fibres of the trochlear nerve decussate in the valvula. It is practically convenient, although not perhaps quite correct, to regard the trochlear decussation as the boundary between the mesocelium valvula and the epicele lingula (see Fig. 675).

§ 133. *Mesocele.*—In all mammals what Tiedemann picturesquely described as a "vast and spacious cavity" becomes relatively an insignificant tubular passage, which has been called "aqueduct" and *iter a tertio ad quartum ventriculum*. As may be seen from Figs. 670, 687 and 756, it is expanded or trumpet-shaped at the cephalic end, and irregular in form at the caudal; the intermediate, longer part varies considerably in different individuals, being sometimes nearly cylindrical, but usually a transection presents points in two, three, or four directions, lateral, ventral, dorsal; the departures from the cylindrical shape are more frequent and distinct in the postgeminum and valvular portion (see Figs. 687, 706, and 708), and may be regarded as vestiges or suggestions of the potentially tripartite condition which is actually present with birds and frogs (Fig. 685).

§ 134. *Lemniscus and Brachia.*—The lateral slope of the mesencephal presents three megascopic features, the lemniscus, postbrachium, and prebrachium, shown in Fig. 706; in the former the fibres run approximately cephalo-dorsad, in the latter obliquely dorso-ventrad; their course and connections are considered in the article *Brain, Histology of the*, as is also the extent of the ectocinereal lamina called *cappa*. The lemniscus and its connections have been discussed at considerable length by E. C. Spitzka, 1884, *c.*
§ 135. *Entocinerea.*—This is the least modified of all portions of the encephalic "central tubular gray"; it forms a layer 2 to 3 mm. thick surrounding the mesocele.

§ 136. *The Crura (crura or pedunculi cerebri).*—Excepting the parts already named, the mesencephal consists mainly of a pair of fibrous masses (Figs. 672 and 689) containing the compacted motor and sensory conductors between the regions caudad, whose relations are mainly with the body, and the regions cephalad, which are the organs of the mind. Each crus consists of two regions, a ventral, the crura, and a dorsal, the tegmentum (Figs. 706 and 708).
§ 137. *Intercalatum (substantia nigra, locus niger).*—A transection through the crus at almost any level reveals a dark mass (Figs. 706 and 708) of crescentic outline, approximately dividing the section into a ventral third and a dorsal two-thirds. Its lateral and mesal borders correspond to the furrows called *sulcus lateralis* and *s. oculomotorius*. The name commonly employed refers to the distinctly dark color (due to pigment in the cells) of the mass in man and

some apes; but the absence of color in other mammals has led E. C. Spitzka to propose a name referring to its more constant character of *intercalation* between the ventral crura and the dorsal tegmentum; the locative mononym was adopted by the Association of American Anatomists in 1897.

§ 138. *Postcommissure.*—The cephalic margin of the mesocelium roof is of moderate thickness, and curved

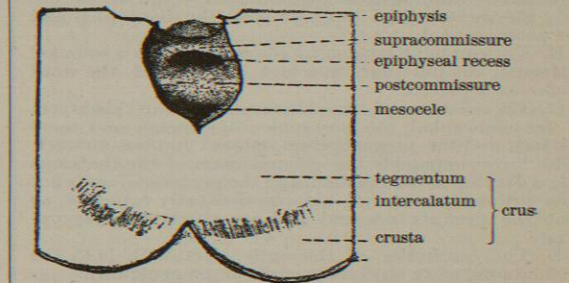


FIG. 705.—The Postcommissure and Adjacent Parts; 2,239. × 1.5.
Preparation.—The diencephal was transected just cephalad of the postcommissure; the diatela was torn away to admit more light; the space just above the epiphysis was occupied by the dorsal sack. The figure should be compared with the medisections (Figs. 670 and 687), and with the dorsal aspect of the region (Figs. 707 and 708).

dorsad so sharply as to present a cephalic convexity (Fig. 705) and a caudal concavity (Fig. 687). Osborn has suggested that it is intersegmental like the trochlear decussation (Fig. 675).

§ 139. *Fig. 705 illustrates:* A. The appearance of this aspect of the postcommissure as a cylinder.
B. The considerable size of the epiphysal recess; although a mere diverticulum within an apparently functionless organ, it is larger than the cephalic orifice of the mesocele in this specimen.
C. The distinctness of the supracommissure (*commissura habenarum*).

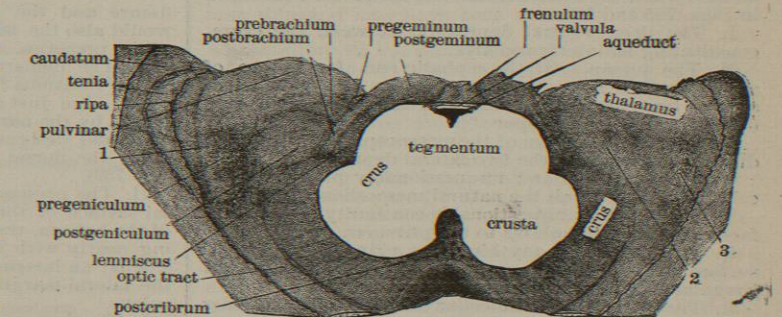


FIG. 706.—Caudal Aspect of the Mesencephal and Part of the Diencephal; 2,300. × 1.5. 1, Tenuis sulcus; 2, right postgeniculum; 3, right pregeniculum.
Preparation.—A well-hardened, alcoholic, adult brain was transected just cephalad of the pons, at a level indicated nearly by the line from *crura* in Fig. 707. A block containing the thalami and adjacent parts was then cut out by incisions in various directions, the fornix peeled off, and the velum and other parts of the pia removed; the ink lines near the sides marked *ripa* indicate the lines along which the lateral margins of the velum, the paraplexuses, were torn away.
Defects.—More should have been left at the sides and ventrad. On the left, the roughly indicated curved line just laterad of the tenia was due to inadvertence, and may be disregarded. See § 140.

D. The location of the dorsal sac upon (morphologically, cephalad of) the epiphysis; see Fig. 687.
E. The modified relative position of these parts. In a less modified condition of things, the two commissures and the epiphysis should all lie nearly in one plane; but the pressure of the superincumbent cerebrum has made

the long axis of the epiphysis cephalo-caudal instead of dorso-ventral, and left the two commissures and the two orifices in a dorso-ventral series instead of a cephalo-caudal.

§ 140. *Fig. 706 illustrates*: A. Segmental overlapping. The thalami and geniculi project caudad beyond the intersegmental line, and the caudatum is here directly laterad of the thalamus instead of cephalad; consequently a transection through the pregeminum would divide not only the mesencephal, but also both the diencephal and the prosencephal.

B. The caudal extension of the thalamus as a rounded eminence, the pulvinar, on which, at the right, the word *thalamus* is placed.

C. The existence of two other eminences on this aspect of the diencephal, the postgeniculum, mesad and more distinct, and the pregeniculum, laterad and less distinct. With lower mammals the general mass of the thalamus is less developed than in man, and the pregeniculum is not only still less prominent, but also decidedly cephalad, so that the prefixes *pre* and *post* are much more appropriate.

D. The continuity of the optic tract with both the geniculi, more obviously with the pregeniculum.

E. The nearly complete concealment of the pregeminum, in this view of the parts, by the postgeniculum; the former is seen at the left to project slightly.

F. The location and forms of the postbrachium and prebrachium; the former is between the two geminums, the latter just cephalad of the pregeminum; as they pass ventrad they embrace, as it were, the postgeniculum.

G. The location of the lemniscus, just caudad of the postbrachium.

H. The T-shape of the mesocele in this specimen.

I. The thinness of the mesocelium roof, here constituted by the valvula, with a mesal furrow and lateral ridges, the frenulums.

J. The relatively extreme thickness of the mesocelium floor, constituted by the crura.

K. The division of each crus into a ventral crista and a dorsal tegmentum, the boundary between these two regions being defined partly by the lateral furrow, opposite the word *crus*, on the left, and partly by a pigmented tract, the intercalatum, not here seen, but shown in Figs. 705 and 708.

L. The deep ventral depression between the crura, constituting an intercrural area.

M. The presence, at the cephalic end of this area, of several rather large foramina for the transmission of arterial branches, whence this part is called postcribrum ("posterior perforated space").

N. The trefoil outline of the mesencephalic transection due to the mesal and the two lateral depressions.

O. The obviously and unquestionably pial and ectocelium character of all the natural mesocelium surfaces.

P. The equally unquestionable continuity of these surfaces over the geniculi to the pulvinar.

Q. The absence of anything like a ripa on the visible surface of the thalamus until we reach the sharp and irregular line so marked at the left.

R. The endymal and entocelium character of the slender natural surface of the caudatum.

S. The continuation of this endymal surface upon the visible length of the tenia.

T. The significance of the ripa as not only a boundary between contiguous pial and endymal surfaces, but as indicating where the margin of the paraplexus or some membranous continuation of it has been torn away.

§ 141. *Fig. 707 illustrates*: A. The segmental overlapping of the diencephal at the side of the mesencephal and of the prosencephal at the side of that (see § 55).

B. The division of the caudatum (the entocelium portion of the striatum) into a cephalic, enlarged *caput* and a caudal, slender *cauda*.

C. The unlike topographical relations of these two parts, in that the *caput* is uncomplicated, while the *cauda* has a slender, marginal (riparian) band at its mesal side, the tenia, having peculiar relations with other parts.

D. The location of the diacele between the two thalami and its continuity with the aula.

E. The presence of the medicommissure (seen somewhat better in Fig. 709).

F. The relation of the callosal genu to the intercerebral fissure and the pseudocele; but for the callosum the

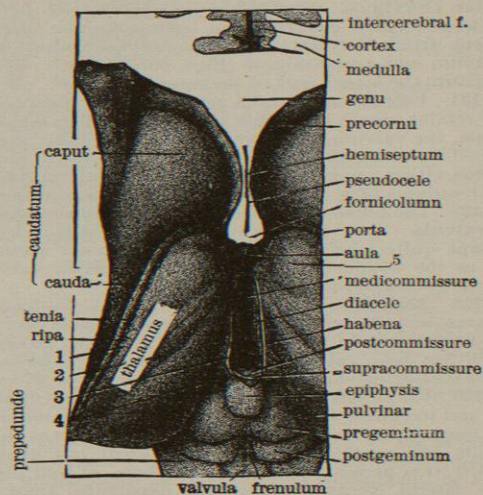


FIG. 707.—Dorsal Surfaces of the Caudatum, Thalamus, and Gemina. (From Henle, reduced and slightly modified.) 1, Tenial sulcus; 2, fimbrial sulcus; 3, habenal sulcus; 4, trigonum; 5, "anterior tubercle" of the thalamus.

Preparation.—The dorsal portion of the cerebrum has been removed, including the callosum, fornix, velum, paraplexuses, and diatela; also the pia covering the epiphysis and mesencephal.

Defects.—The shading is too deep and does not indicate the distinction between the pial and the endymal surfaces. The caudal parts of the thalami are crowded mesad, and the gemina are not well shaped.

fissure and the pseudocele would be continuous, as would also the hemiseptum with the general mesal wall of the precornu.

G. The demarcation of the mesal, entocelium surface of the thalamus from the dorsal, entocelium surface by a rough edge just dorsad of the habena; here it is represented by the narrow, white line between the two black ones, and designated as the habena; it is really a ripa along the dorsal side of the habena (see also Figs. 687 and 739).

H. The presence of three shallow furrows on the dorsal surface of the thalamus; a dorso-mesal, just dorsad of the habena, the habenal sulcus; a lateral, corresponding nearly with the mesal edge of the tenia, the tenial sulcus; an intermediate and oblique, corresponding with the lateral margin of the fimbria (removed), the fimbrial sulcus.

I. The demarcation of the dorsal surface of the thalamus, which is pial and ectocelium, from the adjoining surface of the caudatum and tenia, which is endymal and entocelium, by a sharp, irregular line at the mesal edge of the tenia, constituting a ripa. This line was introduced into the figure; it is absent in the original, as in all similar figures known to the writer, excepting Fig. 16, in Meynert's "Psychiatry," where it is called "linea aspera," without, however, any reference to its morphological significance.

J. The vague and unsatisfactory representation of the parts at the porta. This region has yet to be cleared up in respect to the relation of the pial and endymal surfaces; it was my inability to show these relations clearly upon original preparations that led me to employ the present figure provisionally.

K. Incidentally it may be remarked that both this and

the previous figure exemplify the advantages of that feature of the simplified nomenclature which consists in the designation of members of natural or artificial groups of parts by words compounded of the generic terms and prefixes indicating relative position; e.g., pregeminum and postgeniculum; pregeniculum and postgeniculum; commissure, medicommissure, postcommissure, and supracommissure.

V. DIENCEPHAL.—§ 142.—Synonyms: Diencephalon, deutencephalon, thalamencephalon, interbrain, tween-brain. Tabular arrangement of parts: Chief parts: thalami. Cavity: diacele. Floor: tuber, chiasma, and diaterma. Sides: thalami. Roof: diatela (practically the velum). Plexuses: diaplexuses. Commissures and decussations: medicommissure, supracommissure, chiasma. Ectal elevations: albicantia, pregeniculum, and postgeniculum. Perforated areas: precribra and postcribrum. Ental elevations: habena. Ectal depressions: trigonum, habenal, tenial, and fimbrial sulci. Ental depression: aulix ("sulcus of Monro"). Appendages: hypophysis, epiphysis, and dorsal sac.

With the adult of man and all other mammals the primitively thin sides of the diencephal are greatly thickened and become the *thalami*, with the *geniculi* (pre- and post-) as latero-caudal elevations. The relations of the diencephal to the entire brain are well indicated in the young rabbit (Fig. 681).

§ 143. The *pregeniculum* and *postgeniculum* are represented in Figs. 706 and 707, and described in connection therewith; the *optic tract* and the *chiasma* are shown in Figs. 689 and 711, and considered in connection with the optic nerves in the article, *Cranial Nerves*.

§ 144. *Fig. 708 illustrates*: A. The form, direction,

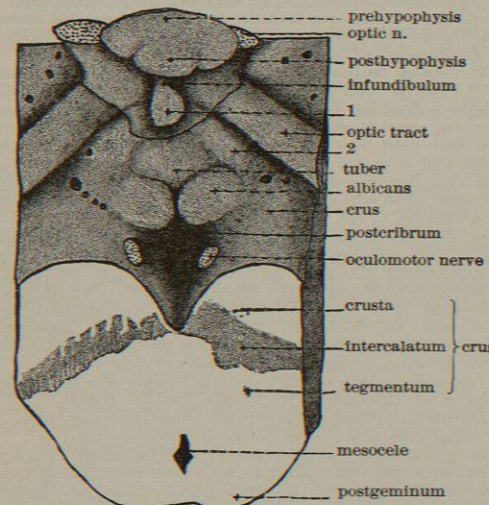


FIG. 708.—The Tuber (*tuber cinereum*) and Adjoining Parts; 706. × 1.5. (The same region is shown in Figs. 672 and 689, upon a smaller scale.) 1, Expanded proximal end of the infundibulum, covering the lura, which is exposed in Fig. 672; 2, a slight elevation between the tuber and the optic tract. The irregular line across the tuber and optic tracts represents the cut or torn edge of the pia, which adheres quite firmly to the chiasma. The black spots represent the foramina in the postcribrum and elsewhere through which vessels passed; the triangular region laterad of the chiasma is a part of the precribra ("anterior perforated space").

Preparation.—The brain was removed with great care, the hypophysis being extricated from its fossa by dividing the dural folds in several directions with the sharp point of a scalpel, and then introducing the blunt-pointed syringotome.

Defects.—The natural surfaces of the crura should have presented a more fibrous appearance (somewhat as in Fig. 689), and another preservative than alcohol would have differentiated the cinerea on the cut surface. The albicantia have perhaps the appearance of overhanging the postcribrum too far, but this is more nearly correct than the usual representation, as, for example, in Figs. 672 and 689. The left intercalatum should be shown more nearly like the right.

and complete separation of the albicantia; they are usually represented (as in Figs. 672 and 689) as hemispherical elevations; here they are seen to be elliptical in outline, their longer axes converging caudad, and the caudal ends overhanging the postcribrum; in the sheep (Fig. 794) and in mammals generally the albicantial sulcus is a shallow depression or wholly absent.

B. That the hypophysis is wider than long, and consists of two parts, conveniently called *prehypophysis* and *posthypophysis*; the latter is the smaller and partly as it were let into an emargination of the former.

C. The expanded base of the infundibulum (1).

D. The raised, unnamed area (2) at either side of the tuber.

E. The demarcation of the crista from the tegmentum by the intercalatum.

F. The slight, angular extensions of the mesocele, which sometimes is almost circular in outline.

§ 145. The diacelium floor is various in direction and composition. Beginning with the mesencephalic floor, the crura (Fig. 687), there is a marked decrease in thickness in the region of the postcribrum (which may really be common to the two segments), as well as a deflection of the floor ventrad; the albicantia (Figs. 672, 689, and 708) constitute lateral thickenings, and then the floor is reduced to an atrophied lamina comparable with the valvula; this, with the shorter, thin part just cephalad of the intervening and dependent hypophysis, constitutes the tuber (*tuber cinereum*) and infundibulum.

The fusion of the stems of the primitive optic vesicles to form the chiasma, and the fusion of this with the otherwise thin diacelium floor, confers upon the latter in this region considerable thickness and firmness, but this part is again succeeded by the atrophied terma (Figs. 687 and 711), strictly the diaterma, in distinction from the prosotermia dorsad of the precommissure. Although the diaterma has a nearly dorso-ventral direction, it should properly be regarded as part of the floor, since the aula, the mesal division of the prosocelium, is constructively cephalad of the diacele, although actually more nearly dorsad.

§ 146. *Hypophysis* (pituitary body or gland, Figs. 670, 687, and 708).—This has a twofold origin, viz., from the neuron (posthypophysis) and from the enteron (prehypophysis); see the article *Brain, Development of*. Herdman thinks it may have been an ancestral sense organ (*American Naturalist*, 1888, p. 1127). At present, notwithstanding its constancy throughout the vertebrates, its function is still in doubt, but the not infrequent co-existence of acromegaly with lesion of the hypophysis merits careful consideration.*

§ 147. In marked contrast with the massive sides the diacelium roof is, for the most part, very thin, consisting apparently of the endyma only, closely attached to the ventral or diencephalic layer of the velum, from which are developed the parallel diaplexuses (Figs. 716 and 732) dependent at either side. Cephalad, the diatela is continuous with the aulata, or perhaps directly with the fornix dorsad of the aula and portas; caudad, it extends for some distance beyond the proper diencephalic boundary, is reflected ventrad upon the dorsal (properly cephalic) aspect of the epiphysis to constitute the dorsal sac, and is then continuous with the supracommissure, and the epiphysis itself (Fig. 687).

§ 148. *Fig. 709 illustrates*: A. The size, form, and connections of the medicommissure; it is relatively smaller than in other mammals (Fig. 688), and slightly constricted about its middle; if isolated it would have the form of a pulley-wheel with a shallow groove.

B. The relations of the mesal aula to the portas and to the diacele (see § 163).

C. The thinness of the lamina uniting the two halves (columns) of the fornix. This lamina must be regarded as the primitive prosocelium terma as high as the dorsal limits of the porta, and may, therefore, be called the *prosotermia*.

* On this subject articles have been published by Woods Hutchinson in the *New York Medical Journal* for July, 1900.

§ 149. *Habena* (habenula); (Fig. 687).—At the dorsal margin of the mesal surface is the *habena*, a slight ridge, with a dorsal convexity, extending from the porta to the supracommissure, which unites it with its opposite.

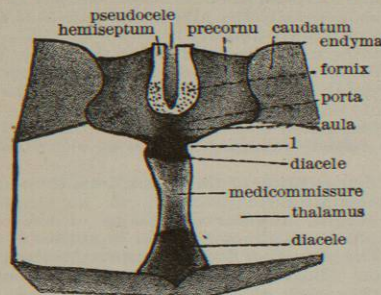


Fig. 709.—The Mediacommissure and Adjacent Parts; 2032. X 1.3. (Compare Fig. 707, where some of the same parts are shown on a smaller scale.)

Preparation.—The brain was removed with care so as not to tear the mediacommissure, and alcohol was injected *per turam* so as to harden the parietes and keep them apart. The prefrontal lobes were then removed, thus opening the precornua and exposing the caudatums; with these as guides the block containing the mediacommissure was safely isolated; the thalami are cut away almost to the level of the commissure. See § 148.

Along the dorsal side of the habena is the habenal sulcus, and the two represent nearly the line of reflection of the endyma from the mesal surface of the thalamus upon the roof of the diacele (see Figs. 681, 687, 707, and 732).

§ 150. *Fig. 710 illustrates:* A. The overlapping of the cerebrum upon the diencephal, so that the transection of one includes the other.

B. The folding of the pia covering the now apposed dorsal surface of the thalami and the ventral surface of

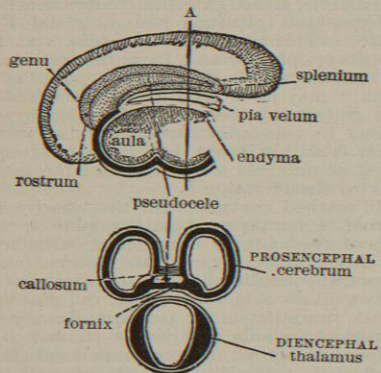


Fig. 710.—Diagrams Illustrating the Relations of the Callosum, Fornix, and the Pseudocele, the Constitution of the Velum, and the Superposition of the Prosencephal. The upper figure represents the mesal aspect of the right half of the schematic brain; the lower, a transection of both right and left halves at the level indicated by the line A in the upper. In the lower figure the thickening of the black line representing the fornix may indicate the hippocamp, but strictly it should be corrugated, presenting an ectal furrow—the hippocampal fissure. The relations of the fornix to the rest of the parietes would also be more completely shown had the black line been interrupted a little laterad of the hippocamp.

Defects.—The aula, the mesal part of the pseudocele, is shown of equal size with the diacele, and on the same level; this is not the case, so far as the writer is aware, with any vertebrate in which the callosum and fornix attain dimensions such as are indicated in the figure (see Fig. 725); but so far as concerns the special objects of this figure, the above inconsistency may be ignored. Unlike most of the figures, the substantial nervous parietes are represented by the heavy black line, the pia and endyma by lighter ones.

the cerebrum so as to constitute the velum (see Fig. 732); but since this figure does not represent the lapping of the prosencephal upon the diencephal at the *sides*, or the

formation of the rima and paraplexus, the pia of the two segments is continued independently around each.

C. The theoretical constitution of the diacelian roof by (1) the possible, though not always actual, continuation of the thicker nervous material at the sides, (2) the lining endyma, (3) the covering pia, one or both layers according to the closeness of their adhesion.

D. The relations of the callosum, fornix, and pseudocele; the two former represent two lines of extended junction between the apposed mesal surfaces of the hemispheres; they are continuous at the splenium and likewise in man at the cephalic end; the space thus circumscribed like the hollow of a partition is the pseudocele or "fifth ventricle"; it is really narrower, but the relations are as indicated.

E. The general constitution of the fornix is more fully described in § 197.

§ 151. *Mediacommissure* (commissura media, s. grisea, s. cinerea, s. mollis, s. thalamic fusion).—Primarily separate, the apposed, mesal surfaces of the thalami unite (at about the fifth month of gestation according to Mihalkovics), giving rise to what is commonly called the "middle commissure" (Figs. 670, 687, 707, and 709). It is in a direct line between the porta and the aqueduct, considerably nearer the former, and just dorsal of the aulix. The shorter, dorso-ventral, diameter, is 4–5 mm., the longer, cephalo-caudal, 6–7. It is relatively larger in all other mammals (*e.g.*, sheep, Fig. 688); it is present in turtles (Fig. 680) but absent in birds and other immammalia. Its functions are experimentally unknown, but in a man and a cat lacking the callosum, it was larger than usual.

§ 152. *Anomalies of the Mediacommissure.*—It is said to be sometimes double. Among sixty-six brains Wenzel found it absent in ten. It is wanting in at least half a dozen of the (about two hundred) brains prepared or examined by me with reference to it, amongst others in No. 3,334, Professor Oliver.*

§ 153. *Aulix* (sulcus of Monro; part of the interzonal sulcus?).—Most well-preserved brains present a more or less distinct furrow just ventrad of the mediacommissure terminating cephalad at the porta ("foramen of Monro") and caudad near the postcommissure, sometimes in the mesocele and sometimes in the epiphyseal recess. It was figured and described by Reichert under the title "sulcus Monroi," for which I proposed (1884, c) the mononym *aulix*, a furrow (Figs. 675, 687).†

§ 154. *Epiphysis* (conarium, pineal body or gland; Figs. 675, 687, 707).—Excepting the lancelet (*Branchiostoma*) every vertebrate likewise has this apparently useless or vestigial diverticulum of the diacelian roof. Max Flesch believes that it is associated with the temperature apparatus, but the number of forms in which has been traced a connection between it and a rudimentary mesal eye is so great as apparently to warrant the view that it is the remnant of a primitive mesal organ of vision; see the papers of Béraneck (1892), Heckscher, Ritter (1891), and Studnička (1899); Ritter also describes the relation of the epiphysis to a blood sinus in *Pterinosoma*.

§ 155. *Acervus* (*acervulus cerebri*).—The adult epiphysis frequently has embedded in follicular cavities calcareous particles known by the above names, and as "brain-sand"; in the brain shown in Fig. 687, it was so abundant as to leave a considerable cavity when removed, but this unusual feature is not represented.

* I venture to suggest that some of the reported cases may have been based upon inadequate evidence. Unless the brain is medicated while fresh, or prepared by the injection of a preservative into the arteries or the cavities, or both, the mediacommissure commonly fails to be reached; its peculiar softness causes it to break easily; and the imperfect preservation of the adjacent thalamic surfaces might lead to the non-recognition of the slight elevation indicating its existence. If the specimen is allowed to dry slightly, and is then held so that the light is reflected from the smooth endymal surface of the thalamus, then the presence of the remnant of the commissure will be indicated by the absence of such reflection from an area corresponding with its usual location. There are few other parts of the brain where errors of observation are more likely to occur.

† His and others have applied the name "sulcus Monroi" to an alleged sulcus extending from the mesocele to or toward the optic recess, and have interpreted it as a portion of the interzonal sulcus (*sulcus limitans ventriculorum*); the grounds for dissent from this interpretation are stated in my papers 1896, d, and 1897, a.

§ 156. *Peculiar Topographic Relations of the Epiphysis.*

—One of the striking results of the segmental overlapping and crowding is the embedding, as it were, of the epiphysis amongst four segments. Although directly connected with the thalami, the epiphysis leans caudad so as to rest upon the pregeminum; the cephalic aspect of the cerebellum rests upon the postgeminum and abuts against the epiphysis; finally the callosum, a cerebral commissure, has its splenic curvature upon the epiphysis. Between all these parts, of course, there are mem-

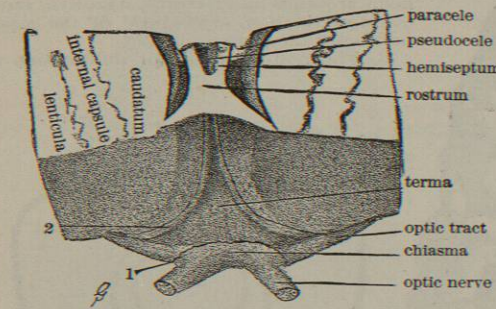


Fig. 711.—Cephalic Aspect of the Terma ("lamina terminalis") and Adjacent Parts of a Young Child; 213. X 1.5. 1. Torn margin of the pia on the chiasma; it has been removed from the adjacent surface; 2, gyrus subcallosus, continuous dorsad with the "peduncle of callosum."

Preparation.—The brain was exposed by removing the skull with nippers and scissors so as to avoid tearing the terma; the optic nerves were divided close to their foramina of exit. After hardening in alcohol, the parts adjacent to the terma were carved away; the surface at either side is concave, following the general direction of the terma. The block was strengthened by a long (shawl) pin passed from side to side, and a common pin was pushed into the striatum at either side so as to project beyond the optic nerves and keep the latter from striking the sides of the vial. The removal of the pia from the terma was the most difficult part of the preparation, and the utmost care did not prevent the tearing of a small slit in the left side, which is ignored in the figure.

branes and vessels, but if they are disregarded the epiphysis, a part of one segment, the diencephal, may be described as encompassed by three others, the mesencephal, the epencephal, and the prosencephal. With a brain hardened in its natural shape, a disc 2 cm. in diameter (*e.g.*, a "nickel") will cover parts of all four encephalic segments; see particularly specimens 885 and 2,268; in drawings, for the sake of clearness, the parts are sometimes represented as if less crowded; *e.g.*, Figs. 672 and 687.

§ 157. *Fig. 711 illustrates:* A. The existence and completeness of the terma (*lamina terminalis* or *l. cinerea*), constituting the cephalic boundary of the mesal encephalic cavities; in the embryo it is actually the most cephalic part of the brain, but is later concealed by the projecting hemispheres.

B. The continuity of the terma with the chiasma, leading to the rupture of the former during the removal of the brain unless the optic nerves are early divided.

C. The extreme thinness and delicacy of the terma which cannot be represented adequately in such a view, and is not always indicated in the medisections; Fig. 687.

D. The existence of a somewhat thicker extension of the terma at each side, forming the cephalic boundary of the optic recess.

E. The pair of slightly raised bands, commonly called the "peduncles of the corpus callosum," continuous ventrad with the gyri subcallosi.

F. The convexity of the entocellic surface of the caudatum (see also Fig. 707).

G. The relation of the callosal rostrum to the hemiseptums, the lateral halves of the septum lucidum.

H. The somewhat unusual thickness of the hemiseptums in this specimen.

VII. PROSENCEPHAL. — § 158. Synonyms: Prosen-

cephalon; telencephalon; forebrain; secondary forebrain; cerebrum; * pallium. The prosencephal is here regarded as composed of the cerebrum (cerebral hemispheres) less the olfactory bulbs and tracts, and the parts and cavities connecting them across the meson. See Table II., p. 153.

§ 159. *Peculiarities of the Prosencephal.*—From the other segments the prosencephal is distinguished by (a) the extraordinary range of variation among vertebrates, as seen in, *e.g.*, the hag (Fig. 791), the lamprey (Fig. 790), the salamander (Fig. 717), the frog (Fig. 685); the rabbit (Fig. 681); and cat (Fig. 682); (b) its preponderance in the human adult as contrasted with its primary insignificance (Fig. 676); (c) its (generally conceded) function as the organ of the "mind."

§ 160. *Prosocle.*—The prosencephalic cavity is primarily single and mesal, as indicated in the diagram, Fig. 674; it may remain so in cyclopean monsters (Fig. 712), and a nearly undivided adult cerebrum has been described by Turner (Fig. 713).

§ 161. *Fig. 712 illustrates:* A. The increase of the prosencephalic vesicle in size and in the thickness of its parietes. As shown in Fig. 2 of the original paper, the floor and cephalic wall of the mesal region are 7 to 11 mm. thick, supposing the parts to be of natural size.

B. The subordination of the lateral extensions to the mesal portion of the prosencephal; they do not, as in the normal brain, extend cephalad of the mesal boundary, but merely laterad, caudad, and to a certain extent ventrad, so as partly to overlap the mesal portion.

C. The partial formation of fissures, one of which may represent the Sylvian.

D. As stated in the text, the prosencephalic cavity is single, *i.e.*, not divided by constricted orifices (portas or

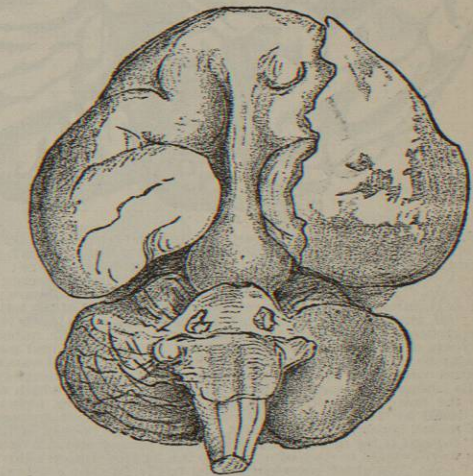


Fig. 712.—Ventral Aspect of the Brain of a Cyclops, at Term. (From Cleland, *Journal of Anatomy and Physiology*, xii., Pl. xvii., Fig. 1.) The size of the specimen is not stated. The arachnoid has been removed from the mesal region, and from the left. The original paper contains a figure of a medisection of the entire mass, a description of some animal cyclopians, and a brief discussion of the nature of the malformation.

"foramina of Monro" into a mesal aula and lateral paraceles. In this respect the cyclopean brain may be compared to the normal brain of "fishes" (Ganoids and Teleosts).

E. The morphological instructiveness of many malformations. Goethe well said, "In her mistakes Nature often reveals her secrets"; indeed it is scarcely possible to imagine any encephalic malformation that may not

* Cerebrum is sometimes employed loosely as embracing not only the olfactory region, but the thalami, quadrigeminum, and crura.