C. The presence of an oblique independent fissure caudad of the paroccipital suggesting the persistence of the lambdoidal of the fetus (§ 234 and Fig. 750).

D. The separation of the postcentral from the subcentral by an isthmus, 2.

E. The depth, simplicity, and cephalic trend of the occipital.

§ 312. *Continuity of the Paroccipital with the Parietal Occurs More Frequently on the Left.*—This has been noted by Ecker, Cunningham, and myself. In a recent paper (1900, *a*) I reported the results of the tabulation of 200 mated hemicerebrums, *i.e.*, from 100 individuals; all but 5 were adults, the 5 infants ranging from term to three years.

(*a*) Of the 100 left, 77 present continuity of the paroccipital with the parietal; in 23 the two fissures are separated. Of the 100 right there is continuity in only 39 and separation in 61.

(*b*) Of the 116 cases of continuity, 77 (66 per cent.) occur on left hemicerebrums, and only 39 (34 per cent.) on the right. Of the 84 cases of separation, 23 (28 per cent.) occur on the left and 61 (72 per cent.) on the right.*

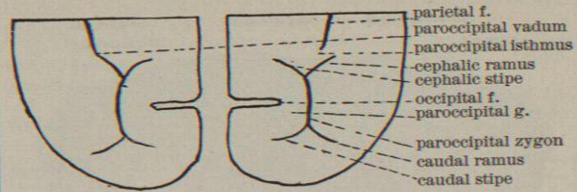
§ 313. *Have the Combinations Any Significance with Respect to Age, Sex, Race, Character, or Mental Condition?*—For the purpose of testing this, the 100 individuals were grouped as in the appended Table; but the grouping is obviously unsatisfactory.

§ 314. TABLE V.—PROVISIONAL AND UNSATISFACTORY GROUPING OF ONE HUNDRED INDIVIDUALS WHOSE PAROCCIPITAL FISSURES ARE KNOWN ON BOTH SIDES.

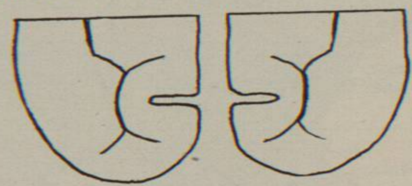
Group.	Characterization.	Number.
A	Educated and orderly	10
B	Ignorant or unknown	50
C	Insane—various degrees	25
D	Murderers	5
E	Africans, various grades	5
F	Infants under three years	5

§ 315. In Table V. the ten members of Group A are as follows: Chauncey Wright; Prof. James Edward Oliver (3,334); a lawyer (2,870) and his wife (3,065); a teacher of mathematics (3,091); an educated farmer (3,350); a physician (3,531); a woman physician and advocate of social reforms (3,430); a woman college student (3,416); and a dentist (3,129).*

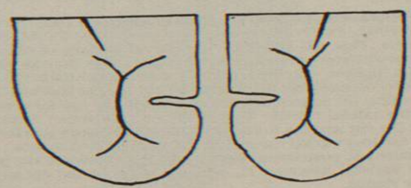
§ 318. *Commentaries on Fig. 778 and Table VI.*—Although I believe the number of mated hemicerebrums is larger than in any previous tabulation it is still too



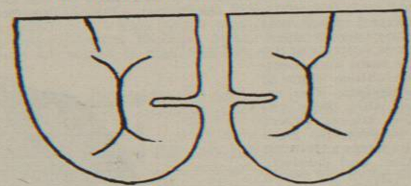
I. Left Continuity and Right Separation; 44 per cent.



II. Bilateral Continuity; 33 per cent.



III. Bilateral Separation; 17 per cent.



IV. Left Separation and Right Continuity; 6 per cent.

FIG. 778.—Diagrams of the Paroccipital Fissure.

§ 316. TABLE VI.—PERCENTAGES OF OCCURRENCE OF THE FOUR PARIETO-PAROCCIPITAL COMBINATIONS IN THE SIX GROUPS OF INDIVIDUALS.

Group.	Character.	Number.	I. L. Continuity. R. Separation.	II. R. and L. Continuity.	III. R. and L. Separation.	IV. L. Separation. R. Continuity.
A	Educated and orderly	10	60%	20%	20%	0%
B	Ignorant or unknown	50	48	34	12	6
C	Insane	25	40	28	24	8
D	Murderers	5	20	60	20	0
E	Africans	5	20	60	0	20
F	Infants	5	40	20	40	0

§ 317. *Fig. 779 illustrates:* A. The complexity of this paroccipital region (compare Figs. 774 and 777).

B. The narrowness of the isthmus between the paroccipital and the parietal.

C. The extension of the fissure marked 36′, over the margin of the hemicerebrum, a feature not distinctly apparent in Fig. 770.

small for final results; especially is this the case with groups, A, D, E and F. Hence the following remarks must be regarded as suggestive rather than conclusive.

§ 319. *Paroccipital Integrality.*—Superficially there are more cases of continuity (116) than of separation (84). But when the known or presumptive vadums are taken into account the balance of evidence seems to be the other way. It is certainly more convenient to speak of the paroccipital fissure than of the "occipital" or "posterior portion of the intraparietal complex."

§ 320. *Symmetry and Asymmetry.*—In 33 brains there is double continuity; in 17, double separation. In 44 there is right separation and left continuity; in 6, left separation and right continuity. In 50, therefore, the conditions are symmetrical and in the other 50 unsymmetrical.

§ 321. *Postpartum Changes.*—Condition III., bilateral separation, occurs in only 17 per cent. of the total, but in 40 per cent. of the five infants. So far as this small number goes there is borne out the conclusion of Cunningham that in many cases the union is delayed until after birth.

* A somewhat different ratio existed among twenty unmated hemicerebrums.

† This was the educated suicide mentioned in § 285; he was, however, highly esteemed by others besides myself.

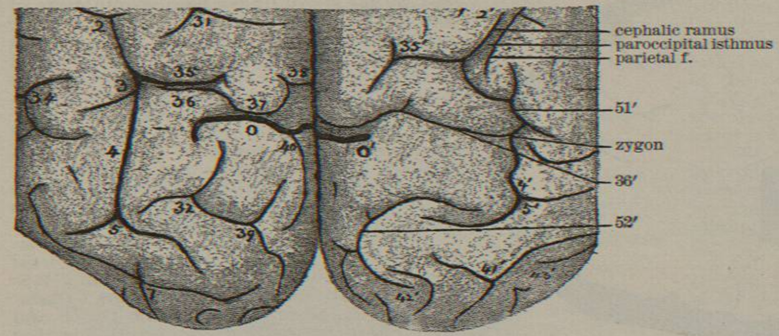


FIG. 779.—The Paroccipital Region of Chauncey Wright. On the left, the numbers correspond to those on Figs. 770 and 788. On the right, homologous parts have the same numbers with the addition of prime. O and O′, the occipital fissures. The left parietal fissure joins the cephalic ramus of the paroccipital at 2, where there is a vadum; on the right the isthmus is narrow and slightly depressed. The fissure marked 36, 37, and 38 is somewhat deep and separated from the occipital by a visible vadum; on the right (36′) it enters the paroccipital fissure.

§ 322. *Fig. 780 illustrates:* A. The least common of the four possible combinations of the paroccipital and parietal fissures of the two sides, viz., right continuity and left separation.

B. The continuity of the parietal and postcentral fissures on both sides, but with differences that are unusual and somewhat perplexing.

C. The existence, on the right, of a clearly defined triangular fissure, 3.

D. The unusual extension of the caudal ramus of the paroccipital, 4.

E. The appearance of the trench (6) due to the pressure of an artery.

§ 323. *Parieto-Paroccipital Combinations in Individuals.*—Four different combinations are possible (Fig. 778), viz.: I. Left continuity and right separation; II. Continuity on both sides; III. Separation on both sides; IV. Left separation and right continuity. Amongst the 100 individuals tabulated (all that were accessible to me at the time), combination I. existed in 44; II. in 33; III. in 17; and IV. in only 6.*

§ 324. *May Combination I. (Right Separation and Left Continuity) be Regarded as Normal?*—Among the ten educated and moral whites (Group A) combination IV. does not occur (but neither does it among the five murderers). Combination I. occurs in 60 per cent. of Group A, in 48 per cent. of Group B (ignorant or unknown); in 40 per cent. of C (insane), and in 20 per cent. each of D (murderers) and E (Africans).

§ 325. There are many questions, general and special, that arise in connection with the paroccipital, but space permits mention of only two which were briefly discussed in my paper (1900, *a*): (1) In tabulating should not the cases in which the vadum equals in height more than one-half the greatest depth of the "parieto-paroccipital combination" be included under "separation"? (2) What weight is to be assigned to the condition in apes and monkeys where continuity is the rule, perhaps without exception? The developmental conditions in other primates than man are not known.

§ 326. *Fig. 781 illustrates:* A. The location and common form of the insula.

B. The existence of fissures and intervening gyres, radiating in general from its summit.

C. The division of the whole by a somewhat deep fissure, the transinsular (2), into a cephalic region, *preinsula* and a caudal, *postinsula*.

§ 327. *Supergyres and Subgyres.*—The ectal surfaces of two adjoining gyres are commonly at about the same level, excepting for a marked change in the general contour of the cerebrum, as, *e.g.*, at its several margins. But sometimes one gyre may be developed much more than its neighbor, and encroach upon it so as to conceal it more or less completely. The covering gyre is here called a *supergyre*, and the covered a *subgyre*.

§ 328. *Superfissures and Subfissures.*—These terms are employed herein to designate the fissures which result from the formation of supergyres and subgyres. The line of overlapping of a supergyre is a *superfissure*, as also is the line of junction of two supergyres meeting from opposite directions. A *subfissure* is one which is concealed by a supergyre, and invisible until the lips of the superfissure are divaricated.

FIG. 780.—Dorsum of the Occipital Half of the Cerebrum of an Insane Swiss Woman, Fifty-Three Years Old; 2,964. × 0.6. Her mother was also insane. 1, A fissure apparently, but not really, connected with the paroccipital; 2, the cephalic stipe of the paroccipital; 3, a triangular depression; 4, an unusual and deep extension of the paroccipital; 5, undetermined fissure. On the left, 6, a vascular trench between the parietal and occipital; C., central fissure; Pac., paracentral; P., parietal; O., occipital; Pao., paroccipital.

§ 329. *Normal, human subfissures* are the circuminsular, which encircles the insula (Fig. 782), the transinsular and others crossing the surface of the insula (Fig. 781), and those which indent the ental or insular surfaces of the operculums (Fig. 783). Unusual subfissures ap-

* Mr. E. A. Spitzka informs me that this combination exists in the brain of Dr. Edouard Seguin. (See his papers, 1900, *a*, *b*.)

pear in Fig. 786, after the removal of the unusual supergyre; superfissures are shown also in Fig. 787.

§ 330. The *insula* ("island of Reil") and the operculum

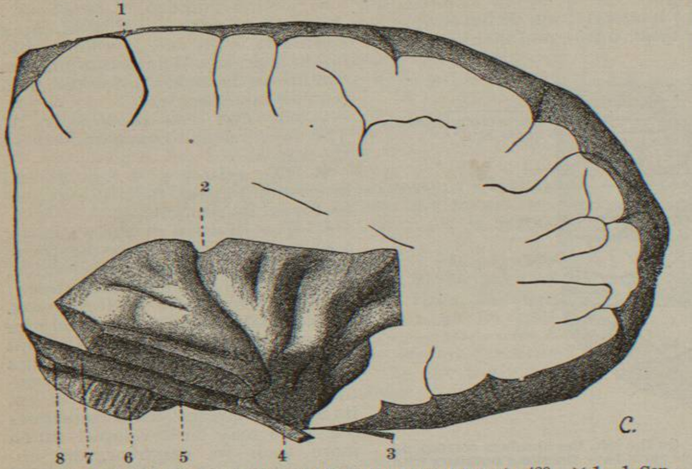


FIG. 781.—Right Adult Insula, Exposed from the Lateral Aspect; 480. × 1. 1, Central fissure; 2, transinsular fissure; 3, olfactory tract; 4, optic nerve; 5, optic tract; 6, crus; 7, pregeniculum; 8, postgeniculum.

constitute normal and typical examples of subgyres and supergyres. As may be seen in Figs. 663, 667, 752, and 782, and in the diagram, Fig. 759 (B), the insula is a part of the cortex, which, at one period wholly superficial, is gradually covered, more or less completely, by converging folds of the adjacent regions. The insula thus becomes a subgyre, while the operculum, preoperculum, suboperculum, and postoperculum are supergyres. For other supergyres see §§ 336 and 342.

§ 331. *Fig. 782 illustrates:* A. The existence of two zones of the lenticula, an ectal, the putamen, and a second, entad of the first, as seen in Fig. 739. There is still a third, but it does not extend sufficiently far dorsad to appear in this or Fig. 738.

B. The constitution of the insula as an elevation of the lateral region of the hemicerebrum, its cortex and medulla being continuous with the rest and with the overlapping operculums.

C. The peculiar form and location of the claustrum, a thin, subcircular disc of cinerea, between the putamen and the insular cortex, of which it is probably a dismemberment.

§ 332. The insula has notable topographical relations with (*a*) the several operculums, (*b*) the claustrum and lenticula. Although perhaps, upon the whole, most developed in man, relatively to the size of the entire brain, it is perfectly distinct in apes and monkeys, in dogs, the porpoise, and many other mammals; its comparative anatomy and its human variations are fruitful and important subjects for further observation; see especially the papers of E. C. Spitzka (1879, *a*) and (Clark, 1896).

§ 333. *The Insula in Apes.*—According to Cunningham (1897, *b*, II., 22), he and Marchand have reached independently the conclusion that in apes (orang, chimpanzee, gorilla, and gibbon) only the caudal portion of the insula is covered by the operculum and postoperculum (parietal and temporal operculums). Owing to the non-development of the other two operculums the cephalic portion of the insula is exposed like the rest of the cortex, and the "*sulcus limitans*" of Reil (part of my circuminsular fissure) is represented by a "fronto-orbital sulcus."

I regret that this interpretation is not borne out by the study I have been able to make of the material at Cornell University. There are more than fifty brains of monkeys and lemurs, and during the past sixteen years I have prepared with special care ten fresh ape brains (one gorilla, three chimpanzee, and six orang); all have been photographed; some have been sectioned or partly dissected, and one (chimpanzee) has been drawn. Still I hesitate, and am not sure that it will be possible for me to decide until there is available a fetal ape brain displaying the region in question in process of formation.

§ 334. The *operculum* is not strictly a single gyre but includes portions of at least two, the precentral and the subfrontal. It is as if the eastern half of the southern extremity of Africa were owned by the Dutch and the western by the English, each half having its own territorial designation; we might still speak of the Cape of Good Hope composed by the two countries. In general the same may be said of the postoperculum, suboperculum, and preoperculum.

§ 335. *Fig. 783 illustrates:* A. The extent to which the several operculums lap over the insula, constituting so many supergyres.

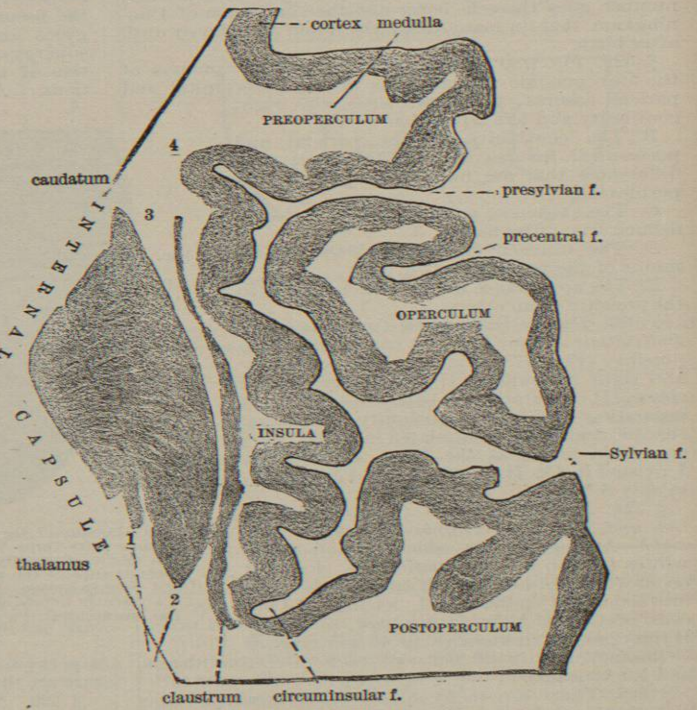


FIG. 782.—Longisection of the Right Insula and Adjacent Parts; 2,397. Enlargement of the corresponding region of Fig. 738. 1, 2, Zones of the lenticula, the lateral and larger the putamen; 3, the stratum of alba between the putamen and claustrum, sometimes (most undesirably) called "external capsule"; 4, opposite the circuminsular fissure. *Internal capsule* should be simply *capsula*.

B. The fissuration of the ental surface of the operculums.

C. The distinctness of the supercallosal fissure, and the absence of a fronto-marginal between it and the dorsal margin of the hemicerebrum.

D. The length of the postrhinal fissure, partly concealed by the optic nerve.

§ 336. *Subfrontal Fissure and Gyre* ("*Broca's convolution*").—From every point of view, anatomical, histo-

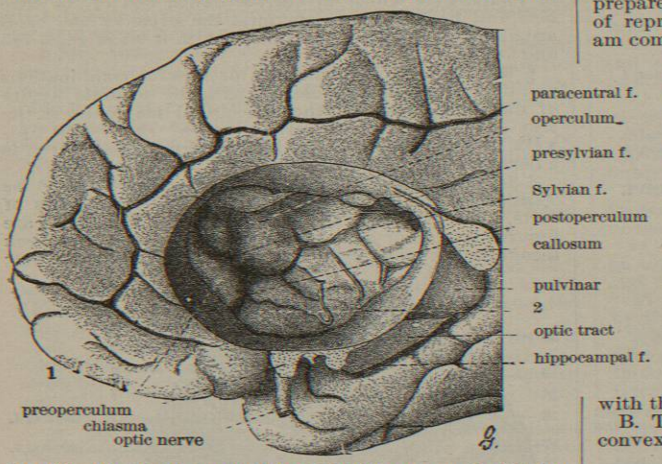


FIG. 783.—The Mesal Aspect of the Right Operculums of a Child at Term; 1,823. × 1.

Preparation.—The hemicerebrum had been hardened in alcohol while resting on the meson, and hence is a little thinner and wider than natural, but thereby better suited to the desired object. A probe was pushed through from the lateral aspect at the triangular place of divergence of the Sylvian, basisylvian, and presylvian fissures; from the hole so made upon the mesal aspect, cuts were carried in various directions, cautiously, until most of the thalamus, caudatum, lenticula, and insula were removed, thus exposing the ental or mesal surfaces of the operculum, postoperculum, and preoperculum, with the intervening Sylvian and presylvian fissures.

Defects.—The inclusion of the occipital region would have rendered the figure somewhat more intelligible. The suboperculum and subsylvian fissure are not exposed; the cut surface at the ventral side should be traversed by a line starting from just cephalad of the chiasma to represent that part of the basisylvian fissure.

logical, physiological, psychological, anthropological, and zoological, a most interesting and important cortical region is that which Broca first showed to be related to the faculty of articulate speech. Although the conditions are often, perhaps usually, complex and perplexing, there seem to me to be a sufficiently large number of cases like those represented in Figs. 663 and 784 to warrant describing the gyre as curving about the presylvian fissure, and the fissure as zygal and U-shaped; the topography is much like that of the paroccipital fissure and gyre.

§ 337. *Fig. 784 illustrates:* A. An unusually simple condition of the subfrontal gyre as a U-shaped region about the presylvian fissure.

B. An unusually simple zygal form of the subfrontal fissure, comparable with that in the infant brain shown in Fig. 663.

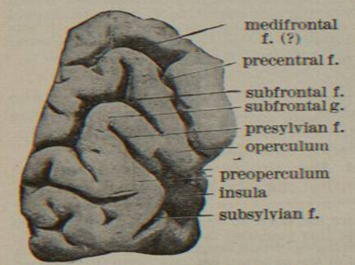


FIG. 784.—Left Subfrontal Gyre ("Broca's Convolution") and Adjacent Parts of a Man about Thirty-Three Years Old. × .5. He was the son of a clergyman, but was found dead after a drunken debauch.

C. The complete separation of the subfrontal fissure from the precentral and the bifurcation of the latter at the point reached by the line from the name.

D. The relatively large size of the preoperculum as compared with the suboperculum; these proportions also are as in Fig. 663, and the reverse of those in Fig. 752.

E. The (probable) partial exposure of the insula in the adult brain.

§ 338. *The Subfrontal Gyre in Apes.*—A paper on this subject has been published by Hervé (1888). I am not prepared to discuss Hervé's conclusions as to the degree of representation of the subfrontal gyre in apes; but I am compelled to dissent from the statement (p. 22) that of the two branches of the Sylvian fissure "ascending" and "horizontal" (corresponding respectively to my presylvian and subsylvian) the latter is the more constant.

§ 339. Recalling my own earlier erroneous interpretation of the parts, I am compelled to insist upon the necessity of exposing them fully by removing the postoperculum, and of determining whether or not a given fissure cuts through the entire thickness of the operculum.

§ 340. Supergyres and subgyres occur by exception in other parts of the cerebrum, especially the occipital (see Figs. 785 and 786), and normally in many monkeys, the *poma*, § 351, Fig. 787.

§ 341. *Figs. 785 and 786 illustrate:* A. The presence of a postcuneal fissure along the caudal margin of the cuneus; its dorsal end is free, but ventrad it has a very shallow connection with the calcarine.

B. The concealment, in the undissected brain, of the convexities of the paroccipital fissure and gyre and part

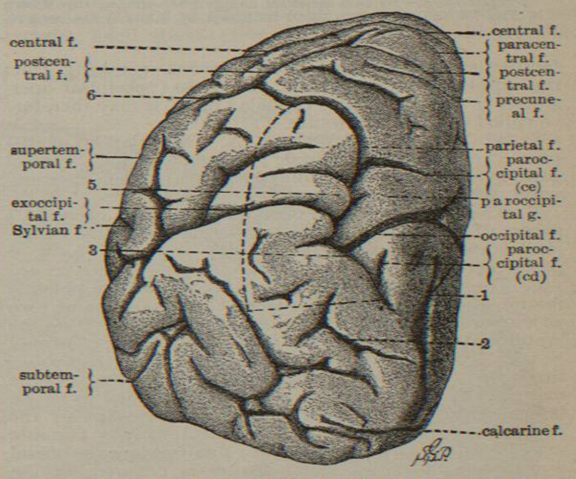


FIG. 785.—Dorso-Caudal Aspect of the Left Hemicerebrum of an Adult Male Mulatto; 322. × .8. 1, Nearly straight fissure along the caudal margin of the cuneus, the postcuneal f. (?); 2, unidentified occipital f.; 3, margin of a supergyre overlapping the paroccipital fissure, part of the paroccipital gyre, and the lateral end of the occipital fissure; 5, near the margin of the same supergyre; 6, ventral part of the postcentral f. The interrupted L-shaped line from opposite 1 to the middle of the length of the parietal fissure indicates the lines of incision by which the supergyre was removed, as seen in Fig. 786, where the two fissures are commented upon (see § 341).

For the *preparation*, see Fig. 757.

of the occipital fissure by an extensive supergyre, analagous to, though probably not homologous with, the poma (occipital operculum) of monkey brains (Fig. 787).

C. The conversion of the paroccipital fissure and gyre into a subfissure and subgyre.

D. The apparent continuity of the exoccipital with the occipital in the undissected brain.

E. In general, the desirability of checking all conclusions based upon the obvious features of the cerebrum, by an examination of the concealed conditions.

§ 342. The so-called "external occipital," or "external perpendicular," fissure of monkeys is a superfissure,

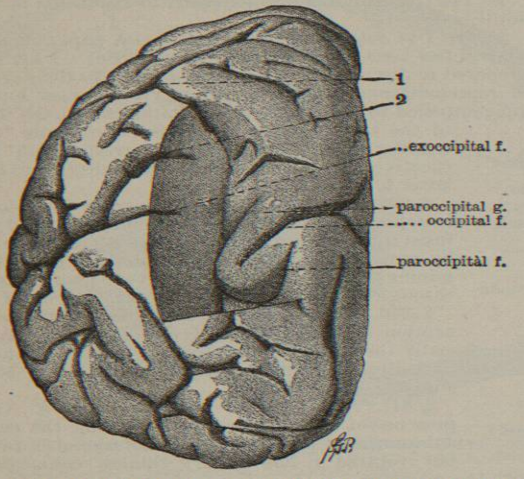


FIG. 786.—Dorso-Caudal Aspect of the Left Hemicerebrum of an Adult Male Mulatto, Partly Dissected; 322. × .8. 1, Junction of the parietal and postcentral fissures; 2, a fissure connected with the exoccipital.

Preparation.—By two incisions along the L-shaped line shown in Fig. 785 the supergyre there indicated by 3 and 5 has been removed.

factitious, variable, and heterogeneous, resulting from the lapping of a supergyre, the *poma* ("occipital operculum"), upon the parts cephalad of it; it may therefore be called the *pomatic* fissure.

§ 343. *Fig. 787 illustrates:* A. The relation of the poma ("occipital operculum") of monkeys, as a typical supergyre, to the paroccipital and part of the supertemporal, which are here subgyres.

B. The relation of the pomatic ("external occipital") fissure of monkeys, a typical superfissure, to the paroccipital and occipital fissures, which are here wholly or partly subfissures.

C. The, so to speak, factitious nature of the pomatic fissure, since it results, not from the opposition of two adjoining and approximately equal gyres, but from the lapping of one over the crests of those adjoining. As may be seen by comparing the two sides, it really comprises three distinct parts, viz., a lateral, between the pomatic margin and the ectal surface of the temporal gyre; an intermediate, coinciding with the cephalic stipe of the paroccipital fissure; a mesal, formed by the pomatic margin and the paroccipital gyre; finally, since the dorsal termination of the occipital fissure is covered by the poma, there results an apparent continuity of the pomatic and occipital fissures.

D. The continuity (depth not determined) of the paroccipital fissure with the parietal; see § 325.

E. The junction of the Sylvian and supertemporal fissures.

F. The distinctness of the "angular gyres."

G. The existence of peculiarities and complexities which, in my judgment, render monkey brains less serviceable than those of human fetuses for the elucidation of fissural problems.

§ 344. Under the various titles "external perpendicular," "external occipital," "temporo-occipital," "ape-fissure," "vordere occipital," etc., have been included several different human fissures or combinations of fissures, viz.: (A) The dorsal outcrop of an unusually deep occipital fissure; Marshall, "The Brain of a Bushwoman," *Philosophical Transactions*, cliv., p. 511, Figs. 1, 9, *h*; (B) a fissure on the lateral aspect caudad of the supertemporal, and having a general dorso-ventral direction; the *vordere occipital* of Wernicke ("Das Urwindungssystem des menschlichen Gehirns," *Arch. für Psychiatrie*, 1875, pl. v., Figs. 19 and 22, *k*); called *exoccipital* in the present article in order to avoid using the more natural mononym, *preoccipital*, already applied elsewhere by Meynert; (C) the combination of A and B,* on account of a supergyre which covers the dorsal end of the true occipital fissure (A) and permits the adjacent end of B apparently to become continuous with it, as in Figs. 785 and 786.

§ 345. No one of the fissures or fissural combinations mentioned in § 344 is identical with the pomatic fissure of most monkeys; but the exoccipital may exist in the true apes and in *Ateles* (Huxley, *Zool. Proc.*, 1861, pl. xxix.). It is doubtful whether the term "ape-fissure" is a desirable one to retain.†

§ 346. *What Significance Has the Arrangement of the Fissures?*—The query is warranted by two classes of facts, viz.: (1) with the mammals whose cerebrums are fissured a more or less definite fissural pattern has been recognized in most of the species studied in that respect;

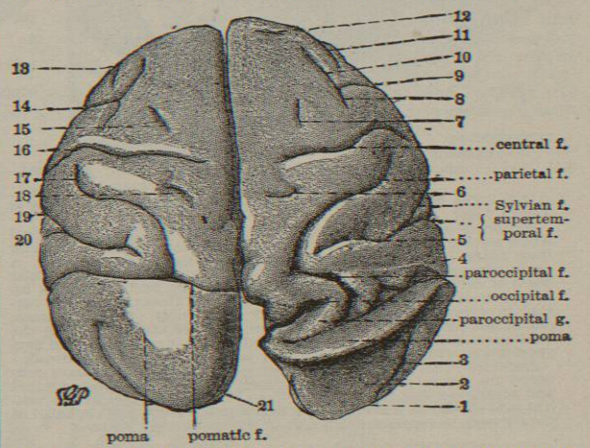


FIG. 787.—Dorso-Caudal Aspect of the Brain of a Monkey (*Macacus*), the Right Poma Lifted; 1,807. × 1. 1, Caudal end of right occipital lobe; 2, surface caudad of poma; 3, unidentified fissure; 4 (light line), line of detachment of the pomatic margin; 5, superfissure resulting from the union of the Sylvian and supertemporal; 6, postcentral (?) f.; 7–15, undetermined frontal fissures; 16, left central f.; 17, left parietal f.; 18, left postcentral (?) f.; 19, left Sylvian f.; 20, left supertemporal f.; 21, fissure on the mesal surface of the occipital lobe, seen also on the right.

Preparation.—The fresh brain was exposed in brine, and left in the base of the skull for support; on the right side, the margin of the overlapping poma ("occipital operculum") was freed by tearing the arachnoid with the syringotome (see article *Brain: Methods*), and the poma reverted and kept in position with absorbent cotton wet with brine. The whole was then placed in 95 per cent. alcohol so as to harden rapidly in the desired shape. When firm it was photographed from the dorso-caudal aspect, the lifted poma being greatly foreshortened. The parts on the left were undisturbed.

(2) the fissures of idiots are commonly peculiar in some way. There is, therefore, no reason, *a priori*, why one should not seek fissural correlation with sex, family, race, capacity, attainment, and character.

§ 347. Some idea of the problems involved and the difficulties of their solution may be gained from the comparison of the cerebrums of the two philosophers, Wright and Oliver, the Swedish carpenter, and the unknown mulatto (Figs. 664, 762, 767, 770, and 788). The first two differ markedly not merely in detail but in general aspect; architecturally speaking, the gyres of Oliver are Corinthian in style, those of Wright, Egyptian. An approximation to this is seen in the mulatto. The mechanic's cerebrum is fissured to an unusual degree and the insula completely hidden; the philosopher had a larger brain, but its lateral aspect presents an equally unusual absence of fissural complexity and the insula is exposed.

* "The so-called ape-fissure has been so termed because it imitates in disposition the opercular [my pomatic] fissure of the apes. It is, however, not a perfect homologue of that fissure, though its presence, when it is due to the fusion of the external occipital with the internal perpendicular sulcus, is a significant sign of disturbed cerebral growth" (E. C. Spitzka, "Insanity," 1887, 286).

† For some years I have been gathering materials for the elucidation of one of the most perplexing subjects in cerebral topography, the so-called "ape-fissure," but this is not the occasion for a full presentation of either facts or opinions.

§ 348. *Comments upon Fig. 788.*—Pending the detailed study and description of this very interesting brain by the writer, to whom it has been generously loaned from the Museum of Harvard Medical School, with the consent of its preparator and first describer, Dr. Thomas Dwight, the professor of anatomy, the following points may be noted: A. The great length of this hemicerebrum as compared with that of the mulatto (Fig. 762).

B. The special length of the caudal part, whether the central or the Sylvian fissure be taken as the dividing line.

C. The height of the frontal region.

D. The apparently slight extent of the prefrontal lobe; *apparently*, because, as is shown upon the dorsal aspect (Fig. 770), a large part of this region is invisible from the side, and is of unusual width.

E. The simplicity of the visible gyres, due to the few contortions of the main fissures, and the comparative infrequency of minor ones; *visible*, because the unseen cephalic surface of the prefrontal lobe presents a much greater complexity.

F. The condition of the minor fissures as sharp incisions rather than as slight depressions, like those in the Swedish brain (Fig. 767).

G. The visibility of the insula, at least equal to that in the mulatto (Fig. 762). Whether any of this condition is due to the pressure during hardening which may have occasioned also a peculiar roundness of the temporal lobe, it is impossible to determine, and Dr. Dwight does not recall the condition of the parts when the brain was removed.

H. The great length of the supertemporal fissure, and its dorsal subdivision.

I. The bifurcation of the Sylvian fissure, constituting perhaps an episylvian and hyposylvian as in the mulatto.

J. The complete independence of the precentral and subfrontal fissures.

K. The union of the proximal parts of the presylvian and subsylvian fissures, so as to separate the pre- and postoperculum.

L. The presence of an unusual, curved fissure (14) ventrad of the subcentral.

M. The crossing of the temporal region ventrad of the supertemporal fissure by several irregular fissures (transtemporal).

N. The complication of the zygal form of the orbital fissure by a branch extending cephalad from the middle of the zygon.

O. The complete interruption of the central fissure by an isthmus which is more clearly indicated in Figs 770 and 771.

P. The fulness or "plumpness" of the gyres, remarked by Dr. Dwight.

§ 349. *Is There a Criminal Type of Fissures?*—Benedikt and others have held that, in murderers for example, there is a tendency to fissural confluence or to a condition resembling that in certain carnivora. The materials at my disposal lead me to share the doubts expressed by Donaldson (*Amer. Neurol. Transactions*, 1892, p. 54), Schwekendiek (*Amer. Jour. Neurol. and Psychiatry*, i., 569–573), and Schäfer ("Quain"), 1893, 161. Upon the whole, notwithstanding the able contributions of Dercum (1889, 1892), Mickle (1896), Mills (1886), Weinberg (1896),

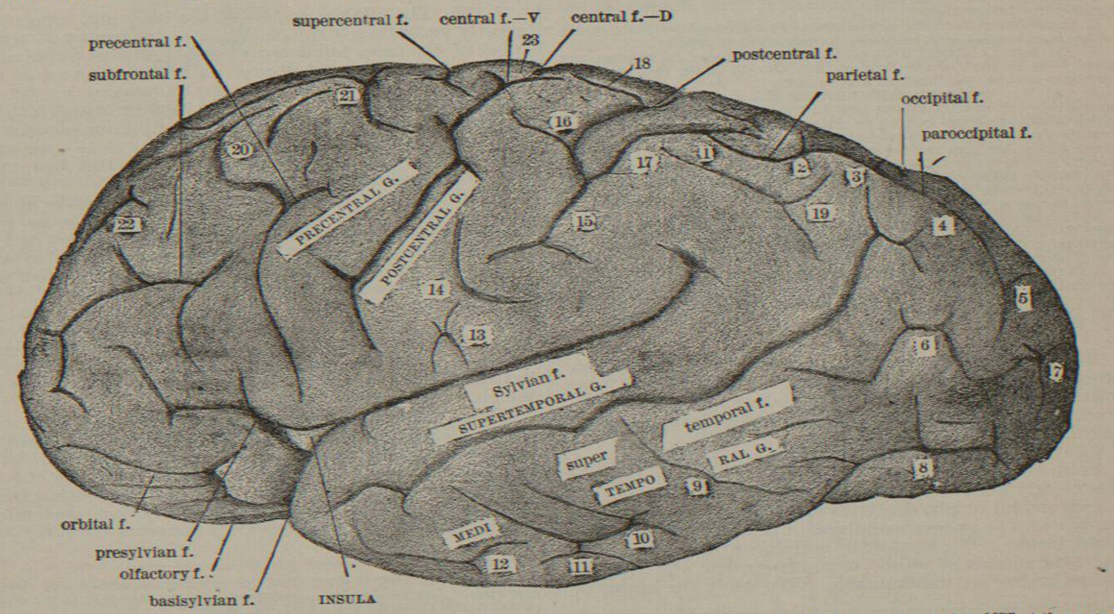


FIG. 788.—Lateral Aspect of the Left Hemicerebrum of Chauncey Wright, a Distinguished Philosophical Writer, who died in 1875 at the age of forty-five. × .85.

Preparation.—The brain was removed with care (in the usual way) and hardened in zinc chloride; there seems to have been considerable dorso-ventral sinking and lateral spreading. In the absence of a cast or measurements of the cranial cavity, it is of course impossible to say how extensive this distortion has been; enough, probably, to account for the flatness of the dorsal surface, and the consequent foreshortening of the fissures of that region as seen from the side, but not sufficient to have produced the great width of the prefrontal lobes, noted under Fig. 768. The figure accompanying Dwight's suggestive remarks upon this brain (*American Academy Proceedings*, 1877, xiii., pp. 210–215) is stated to be somewhat diagrammatic, largely, apparently, for the sake of exhibiting the entire lateral aspect to better advantage.

Wilmarth and others, I am disposed to regard as premature any conclusions as to fissural correlation, and to urge renewed and systematic efforts in three directions, viz.: (1) The determination of the standard fissural pattern for the *average well-born, orderly, and educated white male*; (2) the collation of the conditions in large numbers of individuals of the other sex, of other races (especially the African), and mental and moral conditions; (3) the detailed description and portrayal of the fissures of individuals of marked characteristics.

§ 350. *The Value of Organization.*—In France there has existed for many years a "Societé mutuelle d'Autopsie." In 1890 was formed the American Anthropometric Society, which has already received the brains of Harrison Allen, Edward D. Cope, Joseph Leidy (its first president), of his brother, Dr. Philip Leidy, and Dr. James W. White. I had already prepared a "Form of Bequest of Brain" which was first executed in 1889, and which, as since amended, is here reproduced:

FORM OF BEQUEST OF BRAIN.

I, ..., now of ...., student of .... from .... to ...., and graduated from .... in ...., recognizing the need of studying the brains of educated and orderly persons rather than those of the ignorant, criminal, or insane, in order to determine their weight, form, and fissural pattern, the correlations with bodily and mental powers of various kinds and degrees, and the influences of sex, age, and inheritance, hereby declare my wish that, at my death, my brain should be entrusted to the Cornell Brain Association (when that is organized) or (pending its organization) to the curator of the collection of human brains in the museum of Cornell University, for scientific uses, and for preservation, as a whole or in part as may be thought best. If my near relatives, by blood or by marriage, object seriously to the fulfilment of this bequest, it shall be void; but I earnestly hope that they may interpose neither objection nor obstacle. I ask them to notify the proper person promptly of my death; if possible, even, of its near approach.

Signature ....

Date..........................
Witness.........................

NOTES.—1. A duplicate copy of this form should be filled out and retained by the testator.

2. The bequest should be accompanied by a photograph and a sketch of life or character, or a reference to published biography.

3. The testator should give notice of any change of address, not merely on account of the bequest, but also in order that copies of circulars or other publications may be sent.

4. A brain is safely transmitted in a tin pail of some liquid of nearly its own specific gravity (about 1.04) in which it will just float without either pressing on the bottom or rising above the surface. The most readily prepared is nearly saturated brine, made by dissolving in water as much common salt as it will dissolve, then pouring it off, and adding a little water till the brain is just suspended. Preservation as well as safe transportation may be assured by adding sufficient salt to water containing three, four, or five parts of commercial (forty per cent.) formalin.*

5. The lid of the pail should be secured with surgeon's adhesive plaster; the pail should be addressed as follows: *Anatomical Department, Cornell University, Ithaca, N. Y. Specimen of Natural History. Perishable.*

6. Copies of provisional diagrams of the fissures will be mailed upon application. For a statement of reasons for the study of the brains of educated persons, see Buck's REFERENCE HANDBOOK OF THE MEDICAL SCIENCES (Wm. Wood & Co., New York), VIII., 163, and IX., 110.

Besides the nine named in § 315 whose brains have already come into our possession, the "Form" has been filled out by more than fifty, including undergraduates, alumni, and teachers in this and other institutions of learning.

§ 351. *The Public should be Educated in This Respect.*—From the physiological and psychological standpoint it is clearly desirable to study the cerebrums of persons whose mental or physical powers were marked and well known.† The present condition of things is illogical and unprofitable. We scrutinize and record the characters and attainments of public men, clergymen, and friends, whose brains are unobtainable. We study the brains of paupers, insane, and criminals, whose characters are unknown or perhaps not worth knowing.

It is at once a reproach and an irreparable loss to science that the community has not yet been convinced that the preservation and study of one's brain is an honor to be coveted. Who can set a limit to the results that might have been attained from the examination of the brains of soldiers like Grant, Sherman, and Sheridan; of preachers like Beecher, Brooks, and Howard Crosby; of naturalists like Agassiz, Gray, and Jeffries Wyman; of lawyers like Tilden, Conkling, and Benjamin Butler? How long must science wait for a general sentiment such as is embodied in the declaration of an eminent historian, that science is as welcome to his brain as to his old hat, and that he wishes he had ten of them?*

§ 352. *Brain Weight.*—This interesting topic is discussed from the human side in the article *Brain, Growth of the*, but a few words may be added here as to comparative weight.†

§ 353. In *absolute* weight the human brain is exceeded by those of whales and porpoises (2,265–3,171 gm., 5–7 pounds) and of elephants (4,530 and upward, 10 pounds or more). The lowest of these figures approximates the greatest weight claimed for a *non-hydrocephalic*‡ human brain. A negro brain described by Dr. C. Tompkins, *Virginia Med. Monthly*, January, 1882, pp. 291–293, weighed 1,983.80 (70 ounces or 4 pounds 6 ounces). Van Walsem has described (*Neurologisches Centralblatt*, xviii., No. 13, 1899) the brain of an epileptic idiot which weighed, when fresh, 2,850 gm. (90 ounces, or 5 pounds 10 ounces)!

§ 354. But in no animal other than those mentioned above is the brain as heavy as the smallest human, viz., that of a Bushwoman, 871 gm. (30.75 ounces). In a bull it was 337 gm., in a lion, 198, and in an adult gorilla only 425 (15 ounces) (Owen, iii., 144). The largest ape brain is then only half as large as the smallest normal human.

§ 355. The *relative weights* of the body and brain vary greatly according to the condition of the former at death. Most of the cases tabulated were of persons dying after more or less prolonged disease, and the figures are as follows: for 81 males, 1 to 36.50; for 82 females, 1 to 36.46; according to Bischoff, 1 to 35.20. Quain concludes that in healthy individuals dying suddenly from disease or accident, the ratio is probably about as 1 to 45. In comparing man with animals in this respect this last ratio should commonly be adopted.

§ 356. Owen estimates the adult male gorilla at 200 pounds, or 90,720 gm., and the brain would be as 1 to 213; in a bull it was as 1 to 2,000, and in a lion as 1 to 555. On the other hand, in a sparrow the ratio was as 1 to 25; and in a marmoset (*Midas*) 1 to 20 (Owen, iii., 142); and in *Jacchus vulgaris* (No. 664, Cornell University Museum), as 1 to 19. But it is to be noted that in these small monkeys, as in birds, the cerebrum is *not fissured*. Perhaps the least misleading mode of stating the case is to say that the human brain is relatively heavier than that of any animal larger than a cat in which the cerebrum is fissured.

VIII. RHINENCEPHAL.—§ 357. *Olfactory Bulb and Tract.*—These parts of the human brain have already been shown from various aspects in Figs. 663, 670, 672, 689, 751, 752, and 765. In Fig. 789 they present almost diagrammatic simplicity as a tongue-like extension from the region of the postcribrum ("anterior perforated space") more or less completely covering the olfactory fissure.

* For other liquids adapted to the transportation and preservation of the brain, see the article, *Brain: Methods*.

† Among the individuals best adapted to subserve this object are college professors, who have usually somewhat sharply defined capacities and attainments, and are the subjects of prolonged and discriminating observation and discussion among their trustees, colleagues, and students; no professor's brain should be lost to neurological science.

* It is encouraging to know that the brain of the late George Grote, historian of Greece, has been described by John Marshall in the Jour. of Anat. and Physiol., vol. xxvii., pp. 21–68.

† The two papers of Waldeyer (1896) contain the titles of six hundred and thirty-seven books and papers relating to fissures, gyres, commissures, and brain weight, and published, for the most part, between 1879 and 1898.

‡ The brain of a Chippewa Indian squaw, eighty-five years old, rachitic, in the Army Medical Museum, Anatomical Section, No. 1,031, weighed when fresh 73.5 ounces (2,083.72 gm.), but it was *hydrocephalic*, and the curator informs me that the "ventricular liquid was probably included in the weight."

§ 358. *Fig. 789 illustrates:* A. The length of the olfactory bulb at this period, as compared with its tract, which latter is the longer in the adult.

B. The concealment of the entire olfactory fissure by the olfactory bulb; in the adult, usually, the fissure projects considerably beyond the bulb (Fig. 672).

C. The apparent continuity of the insula with the lateral root of the olfactory tract.

D. The partial covering of the insula at this period.

E. The thickness and roundness of the margin of the operculum.

F. The formation, at this period, of the presylvian fissure, constituting the cephalic limit of the operculum, but the non-existence of a subsylvian fissure.

§ 359. The corresponding parts in several other vertebrates are shown in Figs. 680 (turtle), 685 (frog), 717 (salamander), 682 and 686 (cat), and 688, 726, and 794 (sheep). Any remnant of the former anthropotomical idea that the olfactory tracts and bulbs constitute merely the first pair of cranial nerves* will probably be dispelled by noting the relative extent of the corresponding parts in still lower forms, the lamprey (Fig. 790) and the hag (Fig. 791).

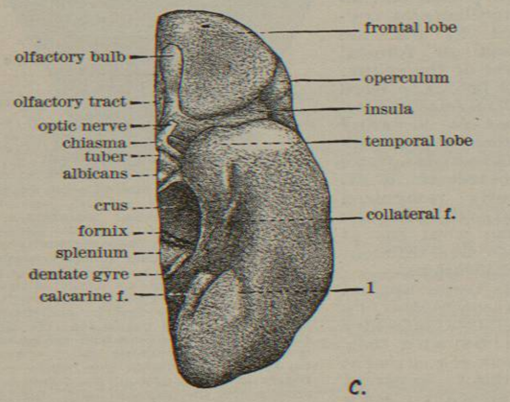


FIG. 789.—Ventral Aspect of the Left Hemicerebrum of a Fetus, Size and Age Unknown; 1,820. × 1. The lateral aspect of the same preparation is shown in Fig. 751.

§ 360. *Fig. 790 illustrates:* A. The representation of all the six definitive segments in this lowly vertebrate; the mesencephalic lobes (geminum) are prominent; the cerebellum is small and was removed with the rest of the roof.

B. The preponderance of the olfactory bulbs over the lateral masses presumably representing the cerebral hemispheres.

C. The concomitantly large size of the lateral portion of the rhinocele.

§ 361. *Fig. 791 illustrates:* A. The most distinctive character of the myxinoid brain, *i.e.*, the insignificance of the intermediate region represented in most vertebrates by the more or less prominent cerebellum and quadrigeminum; hence the entire organ naturally divides itself into a caudal portion, the oblongata, obviously an enlargement of the myel, and the brain proper, comprising four pairs of lobes narrowing caudad.

B. The large size of the olfactory bulbs, especially as seen from the ventral side.

C. The continuity of the olfactory bulbs across the meson, as seen from the ventral aspect.

D. The unusual location or trend of the mesal body provisionally named "epiphysis or dorsal sac," viz., nearer the cephalic than the caudal limit of the segment interpreted as the thalami or diencephal.

E. The vagueness of certain features due to the imperfect condition of the specimen. It was prepared by me in 1875 and the membranes, including the metatela, prematurely removed. There has not been time to prepare another, and the published accounts and figures do not clear up all the doubtful points.

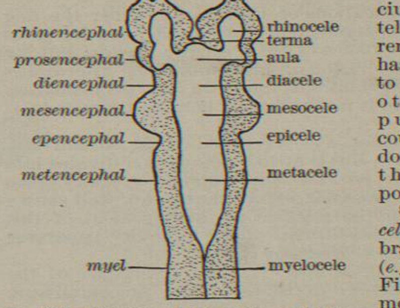


FIG. 790.—Diagram of the Brain of the Sea-Lamprey, *Petromyzon marinus*, as if the roof of the cavities was removed: enlarged. It is based upon several preparations made by me in 1874, and would be changed in some respects if made from microscopic sections; but the main features are believed to be accurate.

§ 362. *Rhinocele.*—In vertebrates generally (*e.g.*, the lamprey, Fig. 790) and in most mammals (*e.g.*, the sheep, Fig. 792), the olfactory bulb and crus contain a cavity, the *rhinocele*, continuous with the paracele and united with its opposite across the meson by the aula. Strictly and by analogy *rhinocele* should apply to the entire cavity of the rhinencephal, but for the present it is at least convenient to employ it also for either lateral portion.

§ 363. The development of the olfactory portion of the brain varies so greatly among mammals that Broca, Turner, and others have proposed groupings based thereon, viz., into *macrosmatic*, *e.g.*, the armadillo; *microsmatic*, *e.g.*, man and apes; and *anosmatic*, the porpoise, where the olfactory tract and bulb seem to be wholly absent, although the early fetal conditions are not known. The conditions in dogs are peculiar, as appears in the following abstract of P. A. Fish's paper, 1891:

1. The facts do not warrant Broca's statement as to the existence of a true ventricular axis (core of solid material in place of the primitive cavity) in the olfactory bulb, even in rat-terriers.

2. The bulb is not completely but partially occluded, or perhaps in process of becoming entirely so.

3. The cavity of the tract, in some wild forms as well as domestic, is completely closed, thereby cutting off all communication between the paracele and the cavity of the bulb.

4. The acuteness of the sense of smell is

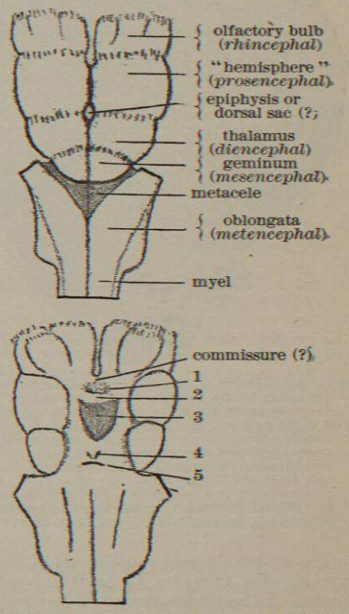


FIG. 791.—Dorsal (Upper) and Ventral (Lower) Aspects of the Brain of the Hag, *Bdellostoma*; 212. × 2.5.

* For the present it will probably prove convenient at least to avoid modification of the accepted numerical designations of the heterogeneous cranial nerves by regarding as the "first pair" the nervous filaments which connect the olfactory bulbs with the nasal mucosa.