So far as this preparation is concerned, there is absolutely no adhesion of endyma to any part of the thalamus dorso-laterad of the habenal sulcus; on the contrary, the endyma is traceable in uninterrupted continuity about each paracele, over, in turn, the ventral surface of the callosum, the caudatum, the tenia, the paraplexus, the fimbria, the thicker portion of the fornix, and the hemiseptum, back again to the callosum.

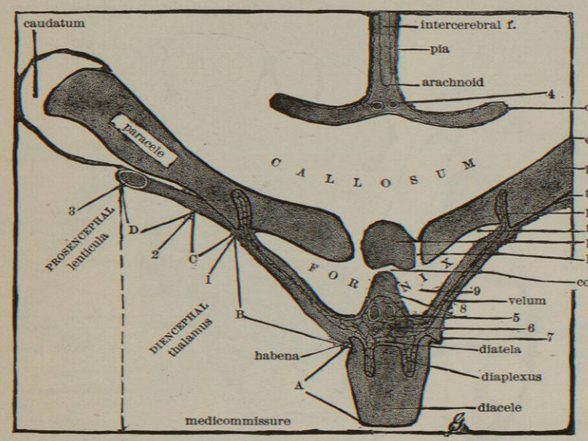

FIG. 732.—Transection, Partly Schematic, of the Fornix and Adjacent Parts at a Level Corresponding with the Interval between the Medicommissure and the Postcommissure; 1,824. × 2.5. 1, Fimbrial sulcus ("sulcus choroideus"); 2, tenial sulcus (in some specimens); 3, tenial vein; 4, precerebral arteries; 5, velar veins; 6, velar arteries; 7, habenal sulcus; 8, interval (natural?) between the velum and the commissure of the fornix; 9, lateral part of the fornix (hemifornix); A, mesal, endymal surface of thalamus; B, C, D, zones of its dorsal surface; B, subformical; C, subendymal; D, subtelaminal. Between the left paraplexus and the tenia the membranous floor of the paracele is the paratela.

The figure represents the caudal surface of the transection; the observer is looking cephalad, and his right coincides with the right of the specimen and the figure; the two sides are substantially identical, but less is shown upon the right; the meson of the figure, the anatomical middle of the various parts and cavities represented, is dextrad of the middle of the area covered by the figure. Throughout the figure the cavities are shaded and the blank areas represent transected surfaces. The arachnoid is represented by a narrow, straight line, the pia by a corrugated line, and the endyma by a heavy line; the endyma is made to adhere closely to the entocelian surfaces, but the pia and arachnoid are separated slightly from the parts which they cover.

Preparation.—See Fig. 744, representing another transection of the same brain. The celian parietes were thoroughly hardened before the brain was removed from the skull, and the membranes and plexuses have retained their connections notwithstanding much handling and considerable transportation. There is some distortion and dislocation of the loosely connected parts about the fornix, but it has been possible to clear up most of the doubtful points by comparison of the two sides and with adjoining sections. So far as respects the exclusion of the dorsal surface of the thalamus from the paracele, the preparation affords unequivocal evidence.

Defects.—As in several other figures representing transections of plexuses, it has been assumed that a plexus consists of a fold of pia covered by endyma; for present purposes it matters not whether there is a complete fold of the pia, or merely an extension of vascular loops. The ventral lamina of the velum is made too low. The medicommissure, the dorsal margin of which is included at the ventral side of the figure, did not actually appear in this section, which was just caudad of it, but is introduced as a readily recognized landmark. The indusium is not shown (§ 217).

§ 188. With some specimens the interval between the paraplexus and the caudatum seems to be occupied by a somewhat substantial lamina, separable from the thalamus, continuous with the caudatum, and perhaps merely a special development of the tenia, but requiring further investigation (Fig. 733).

§ 189. The point illustrated upon Fig. 733 is the continuity of the paracelian floor from hippocamp to caudatum without the intrusion of the thalamus. This figure is to be studied in connection with the transection (Fig. 732), and the dorsal view of the floor in Fig. 735.

There are, however, differences between these and other preparations which are not easy to explain, excepting upon the general supposition that a region in which the conditions are nearly peculiar to the human brain might naturally be expected to present individual peculiarities and even anomalies.

§ 190. There seems to be considerable variation in the details of the parts involved in the apparent representation of the thalamus within the paracele; this is perhaps to be expected, since the conditions that have made the usual statements possible constitute a great and perhaps peculiar modification of the primitive and typical relations—indeed, almost a malformation.

It is hoped that the foregoing descriptions and figures may at least serve to induce anatomists to investigate the subject in all its bearings.

§ 191. *In What Sense does the Thalamus Form Part of the Floor of the Paracele (Lateral Ventricle)?*—So widespread and so deeply rooted seems to be the notion that the thalamus constitutes a part of the paracelian floor in the same sense as do the caudatum and the hippocamp, that, much as I would prefer to avoid the critical attitude, I am induced to comment upon the current representations of this region.

Admitting, for the sake of occupying common ground, that a certain area of the dorsal surface of the human thalamus is covered by endyma; that it is continuous with the caudatum, and that therefore, like that body, it enters into the composition of the paracelian floor; none will deny that an adjoining area of this same dorsal surface is as distinctly covered by pia; that it is continuous with the optic lobes (gemina), and like them wholly excluded from the encephalic cavity.

To represent the entire dorsal aspect of the thalamus as a smooth, unbroken surface is practically to affirm one of two things: either the whole is pial or ectocelian, which would be in contravention of the obvious facts; or else the whole is endymal or entocelian, which would involve not only the gemina but the cerebellum and oblongata, a manifest *reductio ad absurdum.**

§ 192. *The Colliculi.*—This collective term is applied to the rounded eminences and ridges which project into the paraceles ("lateral ventricles") from their parietes. They are the caudatum (caput and cauda), hippocamp ("*hippocampus major*"), calcar ("*hippocampus minor*"), collateral eminence, and occipital eminence. Excepting perhaps the first, each of these represents a corrugation of the entire thickness of the parietes, the ental elevation (colliculus) being collocated with an ectal depression (fissure); this collocation is indicated in the list of total fissures, § 258.

§ 193. *The Callosal Eminence.*—Besides the colliculi named in § 192, all of which are more or less distinct in at least some adult brains, there is one which is perfectly obvious in some fetuses (Fig. 734, 1), and which, from its apparent collocation with the callosal fissure (Fig. 742), may be called, provisionally, the callosal eminence. It, the hippocamp, and the occipital eminence form an irregular triradiation. Its commencement and disappearance require further observation, but its unbroken continuity with the hippocamp confirms the idea that the callosal and hippocampal fissures are essentially parts of one, merely deflected by the splenium of the adult.

§ 194. *The relative size* of the colliculi is not the same in the adult as in the fetus. This is clear from the comparison of Fig. 734 with Figs. 744 and 761. The callosal eminence may disappear wholly; the occipital is seldom recognized (Fig. 744); the collateral is certainly less prominent in the adult than in the fetus (Fig. 734).

§ 195. *Fig. 734 illustrates:* A. The contiguity of the margins of the fimbria and the tenia (the edge of the caudatum) with just room for the entrance of the paraplexus, and the concomitant complete exclusion of the thalamus from the paracelian floor (compare Figs. 732 and 733).

B. The existence of an ental ridge (1) at this period, continuous and corresponding with the hippocampal and callosal fissures; whether it extends still farther cephalad, as in Fig. 742, cannot be ascertained from this specimen.

C. The branching off of a ridge corresponding apparently to the occipital fissure, and representing the adult occipital eminence.

D. The existence of two intermediate ridges, perhaps prefiguring the calcar and collateral eminence.

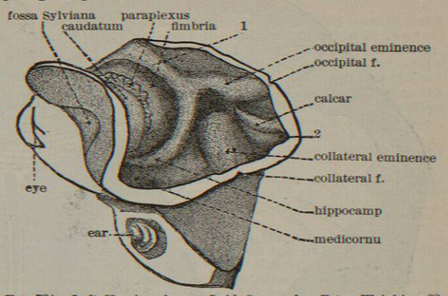

FIG. 734.—Left Hemicerebrum, Laid Open, of a Fetus Weighing 88 gm. (3 ounces), Measuring 15 cm. from Heel to Bregma, and Estimated at Fourteen Weeks; 2,083. × 1.5.

Preparation.—The fetus was received fresh; the head was cut off and pinned by the neck to a cork loaded with sheet lead; a shawl pin was inserted as a handle at one side of the head. A slit was made through the scalp at the lateral angle of the prefontanel, and the guarded cannula adjusted so that ninety-five-per-cent. alcohol should enter the paracele gently, with opportunity for egress at the side of the cannula. After six hours the alinjection was discontinued, but the specimen remained in alcohol for two days, when the scalp was removed and the specimen placed in ten-per-cent. nitric acid. After five hours the calva was so far decalcified that it could be cut away with the scalpel and scissors without jarring the very delicate brain. The left hemicerebrum was then exposed as indicated, and the nape of the neck removed to expose the collateral fissure. Upon a larger scale some of the points would have appeared more clearly.

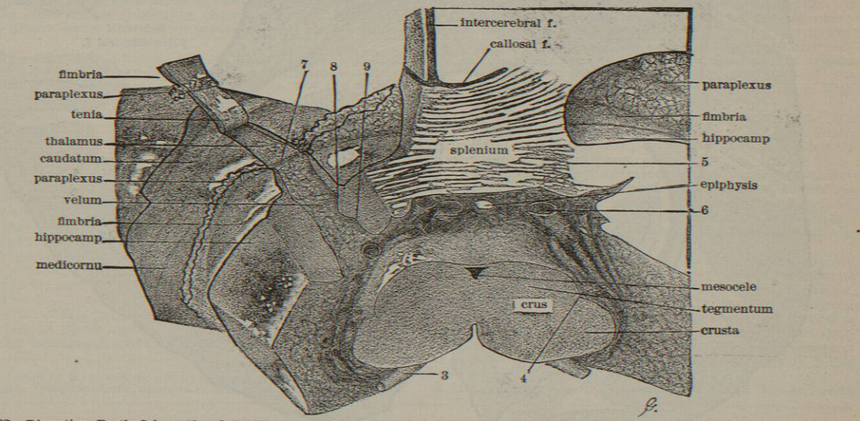

FIG. 733.—Dissection, Partly Schematic, of the Floor of the Left Paracele ("Lateral Ventricle"), Caudal Aspect; 2,345 and 2,347. × 1.5. Compare in part with Fig. 706. 4, Lateral sulcus of the mesencephal; 3, oculomotor nerve; 5, line of somewhat sudden deflection of the splenial fibres caudad into the occipital lobe; 6, large vein; 7, fimbrial sulcus; 8, angle between the fimbria and the hippocamp; 9, hippocampal fissure.

Preparation.—The arteries were injected with the red glue mixture, and the cavities with alcohol. When hardened, a thick slice was taken by one transection at about the middle of the length of the callosum and another at the splenium, just shaving off the tip of the epiphysis. The original transection of the brain stem between the mesencephal and epencephal was modified by carrying two sections cephalo-mesad, meeting at the level of the valvula. On the right of the cerebrum the parts were left undisturbed, excepting that the paraplexus was raised so as to expose the floor of the cavity. On the left, a thin slice of the hemicerebrum is left attached to its opposite by the pia. In order to expose the paracelian floor as completely as possible from this point of view, the sections had to be made in many directions. The paraplexus was trimmed down for a certain distance; then a wedge-shaped piece was cut from the thick caudal wall, hippocamp, etc., including part of the thinner floor, fimbria; this exposed the velum, the double fold of pia between the dorsal surface of the mes- and diencephal and the ventral surface of the fornix. Very cautiously then the two parallel incisions were carried across the floor to and into the caudatum constituting the lateral wall; the strip so enclosed was then lifted; it included (1) a piece of the fimbria; (2) the disconnected part of the paraplexus; (3) a strip of the thin lamina intervening between the plexus and the caudatum; in 2,347 all these were found separable from the dorsal surface of the thalamus, substantially as in the transection, Fig. 732; in 2,345 there were complications which should form the subject of monographic consideration. See § 188.

Defects.—The defects of the figure are due mainly to the attempt to combine the appearances presented by two different preparations.

* For a fuller discussion of the relations of the thalamus to the paracele, and for commentaries on the misrepresentations in standard works, see the first edition of the REFERENCE HANDBOOK, viii., 144–147, and ix., 107, and my papers, 1888, *a*, and 1889, *d*. The delicacy of the membranes, the readiness with which they are detached along a ripa, the rough handling to which brains are commonly subjected during the ordinary processes of removal and examination, the slight degree in which preservatives can reach the parts in question when the entire organ is merely immersed as usual, and, finally, the fact that some agents, excellent for microscopic purposes, do not well preserve the endymal attachments—all these conditions conspire to bring it about that the endyma across the wide rima should be torn, and the dorsal surface of the thalamus protrude through the rent.

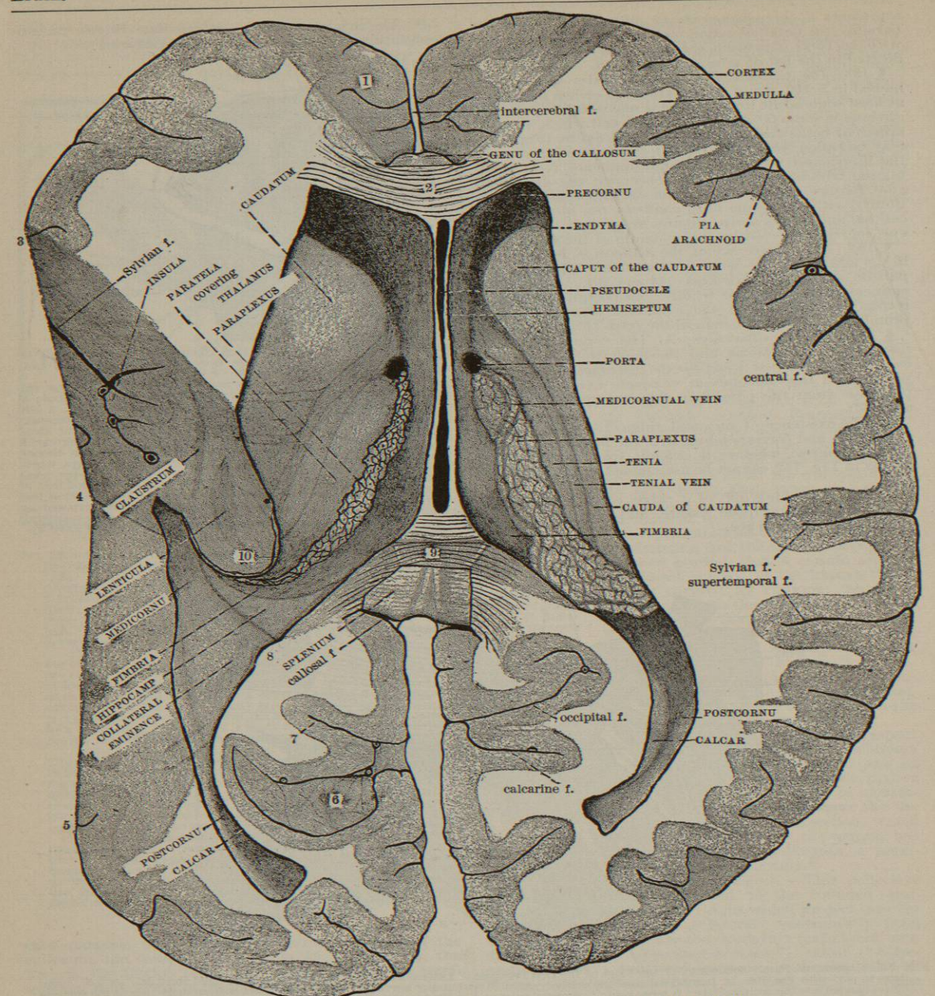

FIG. 735.—The Paraceles ("Lateral Ventricles") of an Adult Male, Exposed from the Dorsal Side; 2.867. ×1.2.

Preparation.—The entire body (an emaciated consumptive, weighing only 37.71 kgm., 83.25 pounds) was alinjected through the femoral artery. Eight and one-half litres were introduced on the first day, and some escaped from the mouth. On the second day, and again on the fourth, another litre was injected. On the fifth day there was injected a litre of Pansch-Gage starch mixture (see article *Brain: Methods*, etc.). When the brain was removed, on the eighth day, the only odor was of the alcohol. The substance had already hardened somewhat and the arteries were well filled, notwithstanding some of the mass had extravasated into the thorax. The brain was transected through the mesencephal (see *Brain: Methods*), and the paraceles exposed by removing the dorsal portion of the cerebrum in thick slices down to the level of the callosum; then in thinner slices and wedge-shaped pieces till the desired condition was reached. On the left the medicornu was exposed into the part extending cephalad; the terminal portion extending also mesad could not be shown without cutting away an undesirably large mass. On the left also the occipital lobe was cut to a slightly lower level than on the right; hence, on the right appears the dorsal slope of the calcar, while on the left the plane of section coincides with the line of its greatest elevation, and the width of the postcornu is correspondingly reduced. To lessen the width of the figure a part of the lateral convexity was removed by dorso-ventral incisions between 3 and 4, and 4 and 5, so the line representing the pia ceases at 3 and 5. Finally, the left paraplexus was trimmed off quite closely. (For the rest of this explanation, see at bottom of page 179.)

§ 196. *Fig. 735 illustrates:* A. The general relation of the paraceles (lateral ventricles) to the cerebrum; although relatively much smaller than in the fetus, they are absolutely extensive; here their natural extent has been maintained by the injection of alcohol; when examined in a fresh brain or in one hardened in the usual way their walls are often found nearly in contact.*

B. The terminal dilatation and squareness of the postcornu, as contrasted with the pointed form which usually exists in brains not prepared by filling the cavities; sometimes, indeed, there has been doubt as to the extent of the postcornu, as admitted by Huxley, Zoöl. Soc. Proceedings, 1861, p. 250; in Krause's "Handbuch" (1880), Fig. 479, the postcornua are merely linear.

C. The great thickness of most of the parietes as compared with their thinness in the fetus, Fig. 667.

D. The retention of the fetal tenuity of a portion of the mesal wall, viz., the hemiseptum (halves of the septum lucidum).

E. The considerable length and width of the human pseudocele (fifth ventricle); so far as I have observed it is wider than in any other animal; in Fig. 726 (of the sheep) it is unnaturally wide.

F. The relation of the cortex (cerebral ectocinerea) to the medulla (alba), as an ectal layer following the fissural indentations.

G. The relation of the insula to the Sylvian fissure; the former is a typical subgyre, the latter is a typical superfissure.

H. The relation of the claustrum to the insular cortex ectad and the lenticula entad (see also Fig. 782).

I. The constitution of the caudatum by two regions, a larger cephalic, the caput, and the cauda, narrow, and following the curve of the medicornu.

J. The junction of the occipital and calcarine fissures so as to constitute as it were a single bifurcate fissure.

K. The size and distinctness of the collateral eminence, an ental elevation or colliculus, corresponding to the collateral fissure upon the ventro-mesal aspect of the cerebrum.

L. The existence, on the left, of an elevation, the occipital eminence, corresponding with the occipital fissure. This colliculus is distinct in the fetus (Figs. 734 and 761), and in some adults (Fig. 744) is better marked than in this specimen.

M. The location of the portas (foramina of Monro), and their visibility in a direct dorsal view of the paraceles; by reference to Figs. 720 and 724, it will be seen that each porta opens into the corresponding paracele obliquely, looking laterad, cephalad, and also dorsad; hence it is visible from three different directions at right angles with one another.

N. The distance between the two portas. Deducting the slight length of the passages themselves, this distance represents the width of the aula, the mesal division of the prosocele, which is commonly reckoned as merely the cephalic part of the "third ventricle."

O. The continuity of the hemiseptum, a part of the mesal wall of the paracele, with the fimbria, a part of its floor; indeed, their topographical relations may be illustrated by bending a sheet of paper or metal, and holding it so that one portion is vertical and the other nearly horizontal; the former will represent the hemiseptum, the latter the fimbria.

P. The narrowness of the human fornix as measured by the distance between the lateral margins of the two fimbrias in their horizontal portions: compare the sheep, Fig. 726. It is true the word *fornix* does not occur on the figure; but, as discussed in § 197, the fornix is constituted by the two hippocamps, with their fimbrias, united at the meson by the commissure (Fig. 732); in this dissection the commissure is invisible, being upon a lower plane, so the fornix, as a whole, cannot be indicated.

Q. The smallness of the paraplexus as compared with its fetal condition, Figs. 667 and 747.

R. The formation of the free margin of the paraplexus by the medicornual vein, considerable in size and more or less contorted, by which the blood of the plexus is returned to the velar vein.

S. The considerable width of the attached portion of the paraplexus. This appears on the left side where the plexus has been trimmed quite closely. The rima is the line of apparent interruption of the parietes for the intrusion of the paraplexus, and is unusually wide in this specimen.

T. The completeness of endymal continuity and celian circumscription. These terms have been discussed in §§ 63–66, as exemplified upon the mesal aspect of the brain, Fig. 687. There only the mesal cavities are visible. In the present figure (aside from the pseudocele, which is not a true member of the series) there appear only the great lateral cavities of the prosencephal. The continuity of the endyma is represented by the uninterrupted heavy line surrounding either paracele. Likewise is the endyma a continuous sheet upon the sides and floor of this cavity. At the margins of the rima it may be traced as a smooth surface upon the intruded paraplexus, and its cut edges are represented on the left in this figure. I am aware that several authors claim or admit the existence of orifices along the medicornu whereby the neurolymph may escape therefrom into the adjacent subarachnoid space; but I am compelled, at present, to regard these as artifacts, like the half-dozen ruptures of the endyma near the porta in the preparation shown in Fig. 721.

U. The *apparent* entrance of the thalamus into the composition of the floor of the paracele. This condition is presented on the left side; on the right it is hidden by the overlapping paraplexus.

§ 197. *Fornix* is a collective noun, a comprehensive name applied to a congeries of parts, each of which has its own name, and all of which, with a single exception, may exist in lower vertebrates and in man or other mammals, in certain anomalies, without the formation of the fornix as a whole.

§ 198. *Columns of the Fornix.*—In each hemicerebrum there is a bundle of fibres ascending from the albicans and thalamus, passing just caudad of the precommissure, forming the cephalic boundary of the porta, diverging presently from its opposite, pursuing a curved direction along the floor of the medicornu and ending in the temporal lobe; in the aulic region, where it is most compact and exposed, this is commonly called an "anterior pillar of the fornix"; see Fig. 739.

§ 199. *Hippocamp* ("*hippocampus major*").—In each

*The paper of E. A. Spitzka (1900) will contain an account of the topographic relations of the paraceles to the cerebral surfaces.

(Fig. 735.)—1, Cut surface, extending meso-ventro-cephalad; 2, cut surface of the genu, the cephalic curvature of the callosum; part of its natural, pial surface lies just cephalad; the transverse lines on the areas 2 and 9 are introduced merely to indicate the direction of the callosal fibres, not as representations of microscopic structure; 3, point of disappearance of the pia as a result of cutting away part of the lateral convexity of the cerebrum; 4, meeting-place of the two oblique cut surfaces caused by the exposure of the medicornu; 5, point of reappearance of the pia, which was interrupted at 3; 6, is an area just caudad of the left calcarine fissure; 7, the occipital fissure; 8, the occipital eminence (see under *Defects*); 9, oblique cut surface of the splenium, of which a part of the natural surface is shown just caudad; 10, the cut edge of the paratela covering the thalamus; from 10 a line should pass mesad to the narrow area between the two lines.

Defects.—The alcohol had so bleached the cinerea as to render the recognition of its outlines somewhat difficult, so the width of the cortical zone is only approximately accurate.

The absence of shading upon the larger part of the surface would imply that it is all upon one level; really, however, the highest part corresponds nearly with the length of the exposed portion of the right caudatum, and from that level there are gentle slopes cephalad, caudad, and laterad. The cut edges of the hemiseptums are also at a lower level than the adjacent lateral parietes. Not all of the arteries are represented. The occipital eminence (8) is indistinct upon the right and made too small upon the left. The cut edge of the paratela (10) is made too thick and the relations of parts are indistinct (see § 191).

On the left, near the word *fimbria*, is a defective patch of shading du to a blemish in the paper.

The arachnoid is represented distinct from the pia at only two places, viz., on the right, near the cephalic end, where the former crosses the wide mouth of a fissure, while the latter dips into it as a fold, and at the collosal fissures, just caudad of the splenium.

hemicerebrum there is a corrugation of the entire thickness of the parietes, resulting in the formation of a total fissure, the hippocampal (§ 259, C), and an ental elevation, or colliculus, the hippocamp, along the medicornu; the hippocamp is thickened also, and intimately associated with the fibres of the column already mentioned.

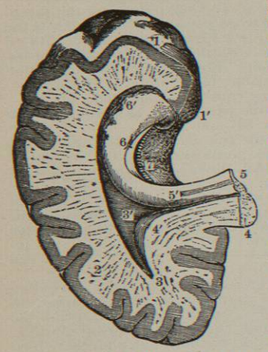

FIG. 736.—The Left Hippocamp and Adjoining Parts. × 5. (From Quain, altered from Hirschfeld and Leveillé.) 1, Apex of the temporal lobe; 1′, uncus; 2, cut surface of the cerebral medulla surrounded by the cortex; 3, at the apex of the postcornu; 3′, collateral eminence; 4, part of the splenium, nearly mediscted; 4′, points to the calcar; 5, cut end of the lateral portion of the fornix which is continued at the hippocamp (5′) and the fimbria (6); 6, the fimbria; 6′, the terminal expansion of the hippocamp, called *pes hippocampi*; 7, dentate gyre (*"fascia dentata"*).

Preparation.—The left occipito-temporal region of the cerebrum was separated from the rest, together with a part of the splenium and fornix, and the dorsal and lateral parietes of the postcornu and medicornu sliced away so as to expose nearly the entire extent of the cavities.

Defects.—The specimen had not been allinjected, and the figure looks somewhat diagrammatic, especially as to the dentate gyre (7); the actual extremity of the medicornu does not appear (see Fig. 728). There is no indication, along the free margin of the fimbria, that one surface of this lamina was covered by pia and the other by endyma, and that they were continued in and upon the removed paraplexus.

§ 200. *Fimbria.*—In each hemicerebrum between the hippocamp, with its corresponding cortex, and the rima, or line of intrusion of the paraplexus, there is a zone consisting of alba alone, and forming, as it were, a margin for the hippocamp (Figs. 733, 735, and 759). This is the fimbria (*corpus fimbriatum, tænia hippocampi*).

§ 201. The column and its caudal, curved extension, the hippocamp and the fimbria, are simply portions of the prosocelian parietes, mainly of the paracelian floor; they are continuous with the mesal wall, hemiseptum (Fig. 732), and thus indirectly with the roof (callosum); excepting at the ventral end, in the tip of the temporal lobe, however, their substantial continuity with the caudatum and tenia and other portions of the paracelian parietes is interrupted by the rima. It would be perfectly legitimate, therefore, to designate the irregular, elongated portion of either paracelian floor, composed of hippocamp, fimbria, and fornicolumn, by a special name, *e.g.*, *hemifornix*.

§ 202. *Commissure of the Fornix.*—The parts composing either hemifornix pertain each to its own hemicerebrum, and in brains in which the callosum is undeveloped, these have no connection across the meson dorsad of the aula and portas, representing the primitive mesal cavity of the prosencephal. So far as I know, the fornicommissure is thinner in man than in any other mammal; Fig. 731.

§ 203. The fornix is monographed by Honegger in the *Recueil Suisse* (zoölogie), 1890, v., 311–434. The hippocamp has been treated by Alex. Hill, in a paper of which an abstract is published in the Royal Society Proceedings, vol. iii., p. 5. Variations in the form of the hippocamp and the collateral eminence are described by Howden in *Journ. Anat. and Physiol.*, xxiii., p. 283, January, 1888. J. G. MacCarthy has described an interesting feature of the hippocampal structure in *Journ. Anat. and Physiol.*, xxxiii., p. 76, 1898. In the same journal are several recent papers by G. Elliott Smith discussing instructively the fornix and the commissures generally.

§ 204. *Lyra.*—When the fornix is transected through the columns (Fig. 737) and turned caudad the exposed ventral surface, including the splenium, is seen to present lines which have been rather fancifully compared to the strings of a harp; the lyra is not a part, but merely a surface.

§ 205. *Fig. 737 illustrates:* A. The general form of the velum, a double fold of pia between the thalami and the superposed cerebrum, one of the layers belonging to each of the two segments (Fig. 710); the great veins are between the two, and others enter them from adjoining organs. The free lateral margins of the velum project into the paraceles as the paraplexuses (Fig. 720), and its rounded apex hangs in the aula and the two portas as the auliplexuses and portiplexuses (Figs. 721 and 724).

B. The triangular form of the fornix; the cephalic, or "ascending" part, consisting of the two parallel columns, constituting the so-called "anterior pillar"; it expands caudad, the sides being incurved instead of nearly straight, as with the cat, and at the splenium is quite wide. Each lateral half here is practically composed of

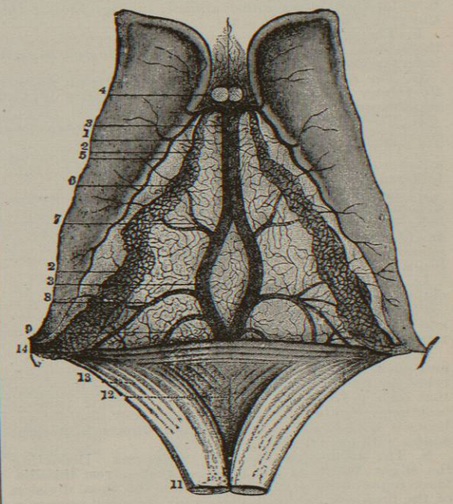

FIG. 737.—The Velum and Lyra. × 1.5. (From Quain, after Sappey and Vicq d'Azyr.) 1, The narrower cephalic part of the velum; 2, left paraplexus, the margin of the velum which enters the paracele as the paraplexus; 3, left velar vein, partly covered by the right; 4, columns, with small veins said to come from the callosum and septum, the precornual veins; 5, tenial vein; 6, medicornual vein; 7, thalamic vein; 8, vein from left medicornu; 9, postcornual vein; 11, body of fornix, transected and reflected; 12, lyra; 13, on the lateral part of the fornix; 14, splenium. (The names here employed for the veins are those adopted in the article *Brain, Circulation of*, in this volume.)

Preparation.—With a preparation such as is represented in Fig. 735, if the fornix were transected at its middle (*f*), the caudal half turned caudad, and the cephalic half, with the attached hemiseptums, removed down to the middle of the height of the portas, the appearances would be nearly as in the present figure.

Defects.—The relation of the parts shown to the rest of the brain would be clearer if there were included at least an outline of one side or of the adjoining region. The tenias are omitted, between which and the fornical margins, fimbrias, the paraplexuses enter; at the mesal side of each paraplexus should be a line, a ripa, indicating where the endyma covering the plexus was torn or cut in the separation of the fimbria. The whole, especially the lyra, is somewhat idealized.

the corresponding hippocamp and fimbria, which, as they continue along the medicornu, are sometimes called the "posterior pillar."

C. The nature of the lyra (§ 204). The line from 12 ends at the meson, the location of the fornicommissure or thin part connecting the thicker lateral portions.

D. The double relation of the splenium to the callosum and the fornix. The larger part, body, of the callosum consists of fibres which pass laterad, dorsad of the paraceles, constituting their roof; at the splenium some fibres pass dorsad, some caudad, some ventrad, and others in intermediate directions; now all the constituents of the fornix form parts of the floors rather than the roofs of the paraceles, and at the splenium fornix and callosum become continuous.

§ 206. *Modifications of the Prosocelian Parietes.*—Primarily the cerebrum is a pair of lateral extensions of a small mesal rudiment, the first (cephalic or "anterior") encephalic vesicle; this forms their only bond of union with one another and with the other segments; their walls are thin and vary little in thickness or composition. Secondarily, the two hemicerebrums are closely conjoined by the callosum and other commissures; between the cerebrum and the crura (and thus the oblongata, the myel, and indirectly the entire body) are developed extensive fibrous communications, the capsulas or "internal capsules"; the parietes are, for the most part, extraordinarily thickened, the most notable, and physiologically the most important of these increments constituting what are commonly called the "corpora striata," from the appearance presented on sections of alternating strips of alba and cinerea. Each striatum, however, is now recognized as composed of an entocelian ("intraventricular") portion, the caudatum, and an ectocelian ("extraventricular") portion, the lenticula ("lenticular" or "lentiform nucleus"), separated by the capsuia already mentioned (Figs. 739 and 782).

§ 207. *The Caudatum and Lenticula.*—With all Reptiles, Birds, and Mammals, and at a very early period, the lateral wall and floor of the paracele present a more or less distinct elevation; in man, and some other mammals, the form is such as to suggest the application of *caput* to the cephalic (precornual) portion, and *cauda* to the tapering continuation along the medicornu, thus of *caudatum* to the entire mass (Fig. 735).

Between the caudatum and the cortex the greatly thickened hemicerebral wall presents (*a*) the medullary lamina called *capsula* (§ 208); (*b*) next the cortex, a subcircular disc of cinerea, the *claustrum* (Figs. 739 and 782); and (*c*) the *lenticula*, consisting of three zones, all more or less striated, the ental the smallest, and the ectal, also called *putamen*, the largest. The lenticula, like the claustrum, may be a dismemberment of the cortex. This entire region, from caudatum to operculums, is of great morphological as well as physiological interest and should be studied in the other mammals.

§ 208. *Capsula and Corona.*—As already stated (§ 206) the capsula or "internal capsule" is the thick layer of fibres between the caudatum and thalamus mesad and the lenticula laterad; it is continuous with the crura caudad, and expands in the substance of the cerebral alba in such a way as to be called there *corona* (*radiata*). The histological and physiological aspects of the capsula and corona are considered in other articles; here an attempt will be made to indicate only their topographical relations by explanations of the accompanying figures (738 and 739).

§ 209. *Fig. 738 illustrates:* A. The general relations of the alba (medulla) to the ectocinerea (cortex).

B. The locations of the two great masses of entocinerea (central tubular gray), the caudatum and the thalamus.

C. The intermediate position of the lenticula, as a blunt wedge-shaped mass between the caudatum and thalamus.

D. The position of the capsula ("internal capsule") as a stratum of alba between the lateral lenticula and the other two masses, and constituting a fibrous path for motor and sensory conduction between the cortex and the crura.

E. The existence of two zones in the lenticula, the more lateral being distinguished as *putamen*; a third would have appeared at a level farther ventrad (Fig. 739).

F. The existence of a thin, cinereal lamina ectad of the lenticula, between it and the cortex; this is the claustrum; it and the cortical corrugations of this region are shown upon a larger scale in Fig. 782.

§ 210. *Fig. 739 illustrates:* A. The existence and relative positions of four important masses of connecting fibres, the *callosum, columns of the fornix, precommissure,*

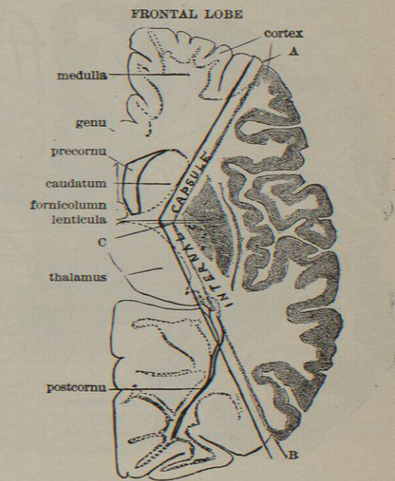

FIG. 738.—Longisection of the Right Hemicerebrum at the Level of the Aula. × .05. (From nature [2,397] and from Gray.)

Preparation.—The mesal outlines of the removed frontal and occipital regions were adapted from Gray. The plane of section corresponds nearly with the direction of the dotted line from *aula* on Fig. 739. The line *A*, *B*, *C* should have been dotted. This line and the one parallel with it mesad by the "internal capsule" were introduced with reference to another figure which is not given here.

and *chiasma*, differing from one another in either their direction or their appearance upon this section. The most ventral, the chiasma, is mainly a decussation, as described in the article *Cranial Nerves*. The next, precommissure, is a true commissure, connecting corresponding regions of the temporal (and frontal?) lobes; at the meson it is seen as a raised transverse band, but laterad, on account of its deflection caudad, it is divided obliquely, and appears as an elliptical dotted area. The two columns have at this level a nearly dorso-ventral direction, appearing as raised bands just dorsad of the precommissure (the line from the word *aula* ends upon the right), but they are curved in such a way as to be divided obliquely in two places—one at the level of the precommissure, and the other about 1 cm. (on this scale) dorsad. Finally the callosum, a true commissure, uniting corresponding regions of the cerebrum, is divided in the direction of its fibres.

B. The general relation of parts and cavities at this important level. Two segments are represented—the diencephal (thalami, chiasma, and diaterma) and prosencephal (the remaining and much the larger part). Of the cavities, the mesal space between the chiasma and precommissure is the cephalic part of the diacele, the darkest portion being the optic recess. The prosocele is represented by the *aula*, the mesal space dorsad of and including the precommissure; by the considerable lateral cavities, *paraceles;* and by the intervening *portas*. All these are true encephalic cavities, but the dark triangular area still farther dorsad is the pseudocele.

Three kinds of surfaces are included, viz.: entocelian, lined by endyma; ectocelian, covered by pia; and pseudocelian, with no distinct membrane. There is ectocinerea (cortex), entocinerea (caudatum and thalami), and

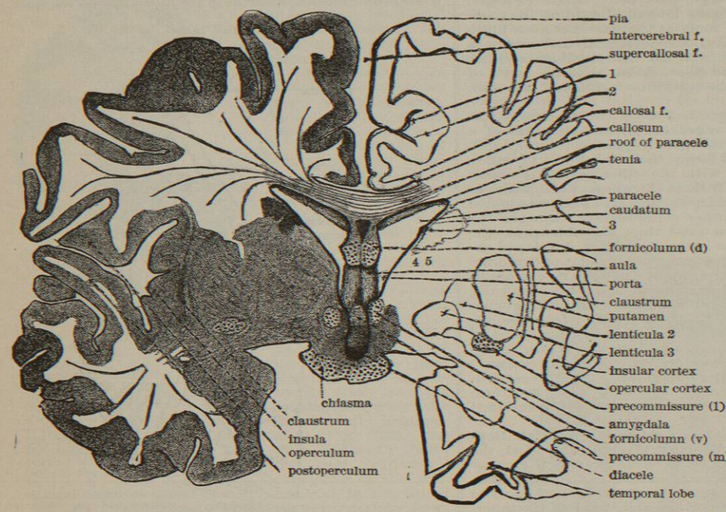

FIG. 739.—Transection at the Chiasma and Precommissure, Caudal Aspect. (From Dalton, by permission.) Reduced one-sixth and modified (compare Figs. 724, 738, and 782). 1, A subgyre (covered gyre) at the bottom of the supercallosal fissure; 2, margin of the cortex dorsad of the callosal fissure; 3, tenial vein; 4, the cephalic part of the thalamus, faintly outlined on the other side; 5, capsula.

Defects.—The dots representing cut fibrous areas are too heavy. The lines representing the callosal fibres are diagrammatic; one of them is interrupted. The pseudocele is not specified. The area of the thalamus is too vaguely indicated. See § 210.

what may, for the sake of a general term, be called *medicinerea*, the lenticula, and the claustrum, probably dismemberments of the ectocinerea.

C. The extension of the hemicerebrum nearly equally in three directions from the place of its morphological centre, the porta; were this brain not somewhat depressed by its own weight, the width and height would be nearly the same.

D. The thickness of most of the parietes as compared with the earlier fetal conditions shown in Figs. 667 and 716; the hemiseptums and the terma, however, have retained their tenuity in great degree.

E. The absence of the crista which was seen in a young brain (Fig. 793), and is constant in the cat (Fig. 686); whether it is absorbed or merely obscured in the human adult is not known (§ 366).

F. The overlapping of the prosencephal at the sides of the diencephal, of the cerebrum upon the thalami.

G. The relations of the several layers of alba and cinerea between the thalamus and the lateral surface of the cerebrum. The capsula (5) has an oblique direction, dorso-laterad, between the thalamus and caudatum and the lenticula (see Fig. 738). The lenticula itself comprises three more or less distinct segments, each extending farther dorsad than the one mesad of it; all present the alternating lines of white and gray which led to the application of *striatum* to the united lenticula and caudatum. The thin lamina of cinerea between the putamen, the most lateral division of the lenticula, and the insular cortex is the claustrum, and the alba between it and the lenticula is commonly, but inappropriately, called the "external capsule."

H. The relations of the insula to the parts just named, and to the overlapping gyres which constitute the operculums (see Fig. 782).

I. The relation of the cinereal mass called *amygdala* to a fissure opposite the *m* of *postoperculum*, which has thence been called the amygdaline fissure; but it is doubtless homologous with the postrhinal of quadrupeds. (§ 372, Fig. 765.)

§ 211. Besides the precommissure, a medisection displays two extensive lines of cut surface (Figs. 670, 682, 687, and 765), indicating that there was a continuity of the apposed, mesal surfaces of the two hemicerebrums. Of these the dorsal, more extensive and more substantial, is the *callosum* (Figs. 724, 737, 739, and 740); the ventral is the *commissure of the fornix* (Figs. 732 and 743).

§ 212. *Callosum.*—When the fresh hemicerebrums are divaricated, as in Fig. 740, the bottom of the intercerebral fissure is seen to be formed by a white mass which unites them for more than the middle third of their length; upon hardened brains this, the callosum (*corpus callosum, trabs cerebri*, etc.), is easily determined to be fibrous, and somewhat firm in consistency, and to extend into the hemicerebral masses. At about the middle of its cephalo-caudal extent, the trend of the callosal fibres is almost directly laterad, but at the cephalic and caudal ends, especially the latter, the direction is oblique, giving rise to the conditions known as *preforceps* and *postforceps* (Figs. 735 and 740). The rounded cephalic region of the callosum is the *genu*, and the caudal, the *splenium*. As seen in medisections (Figs. 670, 687, and 743) the genu appears like a folding of the callosum upon itself, the ventral continuation being the *rostrum*, which, in man and other primates, is connected with the terma by the thin *copula*. The gentle curve of the genu gives to the cephalic part of the pseudocele a rounded outline.

§ 213. *Fig. 742 illustrates:* A. The primary continuity of the hippocampal and callosal fissures, and of the frontal extension marked 1.

B. The existence of several early fissures, some of which are probably transitory.

C. The continuity of the callosum, fornix, and terma.

D. The degree of separation of the callosum and the fornix at this period, and the concomitant form and extent of the pseudocele.

§ 214. *Splenium.*—This region of the callosum is much less easy to understand than the genu from the study of normal adult brains, but most of the difficulties are removed or diminished by the study of fetal and hydrocephalous specimens (Figs 742 and 743). From these it is clear that, like the genu, the splenium represents a

flexion of the callosal sheet upon itself so that there is a dorsal lamina, a ventral lamina, and a caudal connecting portion; commonly the dorsal and ventral portions are

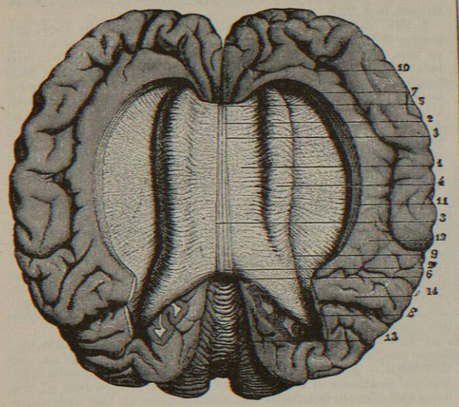

FIG. 740.—The Dorsal Aspect of the Callosum, Exposed by Divaricating the Hemicerebrums. (From Quain, after Sappey and Foville.) × 0.5. 1, Dorsal surface of the body of the callosum; 2, mesal ridge or raphé; 3, lateral ridges, bounding furrows in which, sometimes at least, are lodged the precerebral arteries; 4, lateral ridge, said to be formed by the arching of the callosum over the paracele; 5, cephalic curved margin, genu; 6, caudal curved margin, splenium; 7, preforceps, callosal fibres passing cephalad into the frontal lobes; 8, postforceps, fibres entering the occipital lobes; 10, cephalic portion of the callosal gyre, the line crossing the cephalic end of the supercallosal fissure; 11, callosal fissure; 12, caudal part of the callosal gyre, the line crossing the paracentral gyre; 13, cephalic surface of the cerebellum, the number being just caudad of the occipital fissure.

Preparation.—While fresh the dorsal portions of the hemicerebrums were separated widely; the curved margin of the callosal gyre ("*gyrus fornicatus*") has been detached and pushed laterad so as to expose more completely the extension of the callosal fibres into the hemicerebrum; caudad this gyre has been divided. See § 212.

in close contact, but in hydrencephals (Fig. 743), as in the fetus at a certain stage, they are separated by a considerable interval; in these cases the pseudocele has a greater extent and a somewhat rounded caudad end. For the most part the callosum extends dorsad of the paraceles, thus constituting their actual (though not primary) roof; but the fibres extending obliquely cephalad and caudad from the genu and spleni-

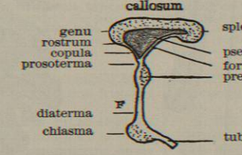

FIG. 741.—Six Diagrams of the Development of the Human Callosum; to be viewed from below upward. The chiasma and tuber are introduced merely to facilitate orientation by comparison with Figs. 670 and 687. In A the primitive end wall of the mesal series of cavities is undifferentiated but reinforced by the chiasma which demarcates the tuber below and the terma above. In B the terma is reinforced by the precommissure, and its dorsal end (margin really, but seen as an end in medisection) is enlarged, constituting the proton * or rudiment of the callosum and fornix. In C the elongation of the whole terma renders more obvious its demarcation into the diencephalic portion (diaterma) and the prosencephalic (prosoterma); the calloso-fornical proton presents a slight cavity or vacuole, the proton of the pseudocele. In D the callosum, fornix, and pseudocele are enlarged especially caudad. In E and F the process continues and all the adult structures are seen. The lateral wall of the pseudocele is the hemiseptum, and it (the pseudocele) is never in communication with either the ental or the ectal surfaces.

* This neuter noun is employed to designate the primitive, undifferentiated mass or rudiment of a part, thus in the sense of *Anlage* of the German embryologists (as adopted by Minot and others), and of *fundament*, as proposed by Mark ("Comparative Embryology"). It avoids certain obvious objections to those terms as English words, is shorter than *primordium* (proposed by Willey), and is in harmony with the following phrases from Aristotle, kindly quoted by President B. I. Wheeler: τὸ πρωτον; ἡ πρωτη ὑλη; ἡ πρώτη αἰτία.

um are parts of the mesal wall of the precornu and postcornua respectively, while those which compose the ventral lamina and the splenium are parts of the para-

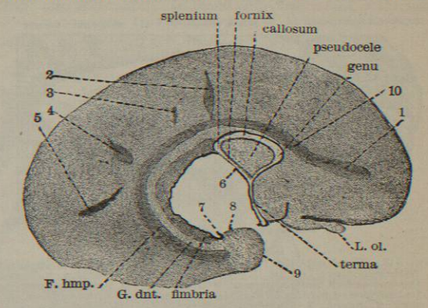

FIG. 742.—Mesal Aspect of the Left Hemicerebrum of a Fetus, Measuring 16.8 cm. from Heel to Bregma, and Estimated at Eighteen Weeks; 2.084. × 1.5. 1, Cephalic extension of the primitive callosal fissure; 2, 3, 4, 5, short but distinct radial fissures, some of them probably transitory; 6, point of reflection of the endyma from the fornix at the dorsal end of the porta; 7, point of reflection of the endyma at the tip of the rima upon its other margin, the tenia, which has been removed; 8, region which would have become the uncus; 9, tip of the temporal lobe; *F. hmp.*, the hippocampal fissure; *G. dnt.*, the dentate gyre (*fasciola* or *fascia dentata*); *L. ol.*, olfactory bulb.

Preparation.—The fetus was ill preserved and the head distorted; the entire head was mediseсted with a scalpel; the brain was so tender that the caudatum and plexus broke loose.

Defects.—The terma is shown too thick; the tenderness of the specimen did not permit determining the location and form of the chiasma and precommissure.

celian floors, continuous with the fornix (Figs. 733 and 744).

§ 215. *Fig. 743 illustrates:* A. The complete separation of the fornix and callosum as far as the splenium, which is thus a common bond between them, although usually, and perhaps properly, reckoned as a constituent of the callosum only.

B. The concomitant extension of the pseudocele and of the hemiseptum.

C. The large size of the porta.

D. The wasted appearance of the visible gyres, in contrast with those of Chauncey Wright (Fig. 788).

§ 216. *Fig. 744 illustrates:* A. The continuity of the splenium with both the floor, roof, and caudo-mesal wall of the paracele; some of the fibres pass dorsad, some ventrad into the hippocamp, while others, constituting the postforceps, extend caudad into the calcar, dorso-caudad into the occipital eminence, and ventro-caudad into the collateral eminence.

B. The unusual distinctness of the occipital eminence, this being, in fact, the preparation in which it first attracted my attention (comp. Fig. 761).

C. The prominence of the calcar, here seen, of course, greatly foreshortened; of the left hippocamp only a segment of the caudal convexity appears in this prepara-