of one and the same species; yet they show certain differences, which it is well to record under certain (specific) designations.

Note on Astur soloensis, *Ramsay* (*nec Lath.*).

Dr. Finsch, who has examined my specimen of *Astur soloensis* from Cape Pitt, is of opinion that it is not the true *A. soloensis*, Lath.

I therefore propose for the Solomon-Island bird the name of

6. Astur pulchellus, sp. nov.—Astur soloensis, *Ramsay* (*nec Lath.*), *P. L. S. of N. S. W.* iv. pt. 1, p. 66.

Hab. Solomon Islands.

7. Ptilotis eugeniæ, *Gray*.

After a careful comparison of many specimens, I have reluctantly come to the conclusion (which I have stated elsewhere) that the *Ptilopus* I referred to previously (P. L. S. of N. S. W. vol. iv. p. 73) as *Ptilopus viridis* is the female of *P. eugeniæ* (Gray). It is remarkable that the female of this species should be so brightly coloured on the breast. Moreover, young birds and so-called females, similar in plumage to the adults in all except having a purple breast, were obtained with the specimens I put down as *P. viridis* ♂.

The ornithology of the Solomon Islands is of so great interest that, an opportunity having offered, I have sent one of our taxidermists to the island of "Ugi," who, through the kindness of Capt. Bruce, R.N., will have opportunities of collecting and throwing some light on the subject, by carefully sexing the species. I hope by this means to clear up the doubt as to the sexes of my *Myiagra ferrocyanea* and *M. pallida*, and other birds of which we know little or nothing.

On the Homology of the Conario-hypophysial Tract, or the so-called Pineal and Pituitary Glands. By Professor Owen, C.B., F.R.S., F.L.S., &c.

[Read December 1, 1881.]

The structure and local relations of the pituitary and pineal glands, in Man, have received such close attention in anthropotomical works as to dispense with repetition. But, before entering upon the special aim of the present Paper, I feel bound to refer to

the latest contribution to the subject, that, viz., by Dr. Joseph Sapolini*, who has devoted a special treatise to one portion of the "tract" in question.

He more especially points out the continuation of the "third ventricle" of the brain by its tubular extension downward, called the "infundibulum," with the substance of the "pituitary gland," the texture, the blood-vessels, nerves, and osseous environment of which body in Man are minutely described and amply illustrated. The chief aim of these researches, however, is a teleological one; and the author arrives at the conclusion that the function of the so-called "gland"† is secretory, and that it relates to the supply of the intraventricular fluids of the brain.

Referring to the course from the third ventricle, by the infundibulum, to a cavity or reservoir in the hind lobe of the pituitary‡, he concludes that the fluid secreted by the fore lobe accumulates in the "reservoir," and that, by vermicular movements of the gland, governed by the filaments of the sixth cerebral nerve, which he traces thereto, the fluid it secretes ascends, and passes by the tubular or infundibular continuation of the gland into the third, and thence into the fourth and other continuous vacuities or ventricles of the brain and myelon §.

"May we not then," he asks, "compare the pituitary gland to the liver, and its cavity to the gall-bladder?"||.

* 'L'aire de la Selle Turcique,' 8vo, 1880.

† The term "pituitary" was originally applied thereto on the notion that it secreted the mucosity lubricating the nasal passages.

‡ "C'était mon aniline qui, depuis le troisième ventricule, était descendue à travers l'infundibulum et le canal de la tige pituitaire, jusqu'à la cavité de la glande. Ceci établit qu'il y a une parfaite communication entre la partie centrale du lobule du corps pituitaire et le troisième ventricule cérébral."—*Op. cit.* p. 63.

§ "A l'état physiologique il existe toujours dans les ventricules cérébraux un liquide incolore, inodore, insipide. Ce liquide non seulement peut, mais par moments doit, se mettre en mouvemeut; alors il dépasse dans sa course l'aquéduc de Sylvius, et suivant l'inclinaison du quatrième ventricule, il descend le long du canal rhachidien en passant par le trou du calamus scriptorius. Ce liquide, à l'état normal, augmente par instants dans les ventricules, et ce sera dans le troisième que se déversera le trop plein des autres."—*Op. cit.* p. 63.

|| "Le lobe antérieure de la glande sécréterait donc le liquide qui se rendrait et s'accumulerait dans le réservoir du lobe postérieur; il passerait ensuite par la valvule de la tige pituitaire qui peut et doit s'ouvrir; de là il montrait dans la tige elle-même qui est douée des mouvements vermiculaires, car elle est animée par des filets nerveux émanant du nerf de la sixième paire. Le corps pituitaire ne serait-il donc pas semblable, pour employer une comparaison hyperbolique, au foie qui sécrète la bile, et sa cavité à la vésicule biliaire qui est le réservoir de celle-ci?"—*Op. cit.* p. 64.

To this appeal, Dr. Sapolini, whose treatise issues from a Brussels press, may reasonably look for an affirmative response from the accomplished Professor of Liége. M. Ed. Van Beneden*, referring to the body in Tunicaries (Savigny's "tubercle," Hancock's and Ussow's "olfactory organ"), which is homologized by M. Julin† with the "pituitary gland" of Vertebrates, compares it to the kidney, and holds that by a communication with the "peribranchial cavity" of the Ascidian it discharges its urinary excretion therein.

The researches of which I proceed to communicate results have been conducted with a different aim, which has led me to trace both the pineal and pituitary bodies, their appendages and connections, or what I have termed the "conario-hypophysial tract," from Man downward, until, in *Amphioxus*, where the cerebral expansion of the myelencephalon is too feebly indicated, the homologue of any part of the tract in question has baffled my quest—unless the pore leading to the cavity in such expansion may be in relation thereto.

In the Mammalian series I have to observe that, in the lower and smaller members, as the brain loses in relative size and complexity, the pineal or conarial and pituitary or hypophysial bodies and connections show a relatively larger size, with a less parenchymatous and a less interrupted tubular structure than in the human brain. In the lower, if not lowest, forms of the feathered class I have noted a character of the basisphenoid which seemed to me to bear upon the present topic: it is a median longitudinal groove leading to a foramen opening into the seat of the pituitary body‡.

But leaving here the class of Birds in the present summary, the proportions of the conario-hypophysial tract to the cerebral hemispheres in Reptiles become greater, and a vascular chord is continued upward from the hollow "pineal" part of the tract, beyond the cleft between the pros- and mesencephalon, to a con-

* Archives de Biologie, 8vo, 1881, tom. ii. fascicule ii. p. 230.

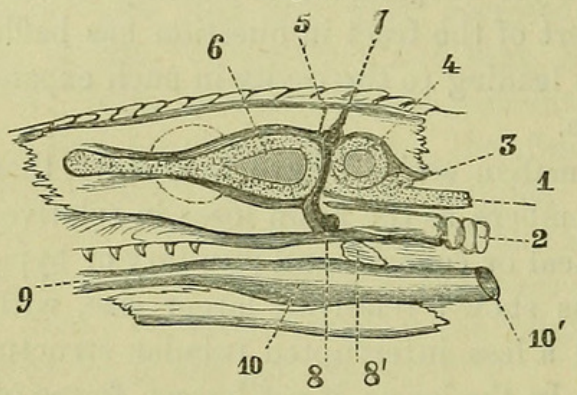
† Ibid. fascicule i. p. 59 *et seq.* (I may remark that, regarding the cylindroid shape as well as position of the neural centre in some Ascidians, I have viewed it as the homologue of the same part in *Amphioxus*, and the co-extensive body beneath as that of the notochord.)

‡ See 'Memoirs on the Wingless Birds of New Zealand,' 4to, 1878: *Dinornis elephantopus*, pl. lxxvi. fig. 4, 5; *D. crassus*, pl. lxxvii. fig. 3, 5; *D. ingens*, pl. lxxxii. fig. 3, 5; *D. gravis*, pl. lxxxi. fig. 4,—in which the foramen, not eustachian i unusually and significantly large.

tiguous opening in the bony cranial roof in a proportion of the class, which proportion is greater in the extinct members*. This "pineal" production perforates, as a rule, the parietal bone, but in some species the suture between that bone and the frontal, rarely the frontal bone itself, and then near the suture, always opposite the interval between the fore and mid brains. Beyond this hole, commonly called "foramen parietale," but which may preferably be termed "foramen pineale," the upward continuation of the conario-hypophysial tract or tube (fig. 1, 7, 8) is closed by the scalp or supracranial integument.

In the class of Fishes the relative magnitude and tubular character of this trans-cerebral tract is still more marked, examples of which I have elsewhere described and figured†. In the Skate

Fig. 1.



Section of cranium and brain of young *Iguana*, showing foramen parietale &c. —1. Neural axis. 2. Vertebral column. 3. Cerebellum. 4. Optic lobe. 5. Thalamencephalon. 6. Cerebrum. 7. Pineal body, 8. Pituitary body—conario-hypophysial tract (including "infundibulum" and "third ventricle"); 8′ indicates the "protopharynx" of the embryo. 9. Mouth. 10. Gullet.

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* See 'Monograph on *Ichthyopterygia*,' Palæontographical Society's volume for 1881, 4to, p. 94, pl. xxiii. fig. 1, *f*; also "Descriptive and Illustrated Catalogue of the Fossil Reptilia of South Africa in the British Museum," showing the parietal or "pineal" foramen in the genera *Galesaurus*, *Petrophryne*, *Dicynodon*, *Ptychognathus*, *Oudenodon*, *Kistecephalus*, and *Procolophon*: in some of these genera the hole is unusually large.

† 'Anatomy of Vertebrates,' 8vo, vol. i. 1866, p. 277. "The third ventricle in Osseous Fishes is prolonged downward into the pedicle of the hypophysis or 'pituitary gland,' fig. 185, *p*, and upward into that of the conarium or 'pineal gland,' fig. 175, *w*. The true vasculo-membranous infundibuliform downward prolongation of the third ventricle exists in all Osseous Fishes. The 'infundibulum' is commonly short and thick, so that the hypophysis is almost sessile, as in the Cod; but in the *Lophius* the infundibulum is longer than the entire brain, and the hypophysis lies at the fore part of the cranial cavity far

(*Raia batis*) the extension of the pineal part of the tract in question reaches beyond the cartilaginous roof of the brain-case; in

Fig. 2.

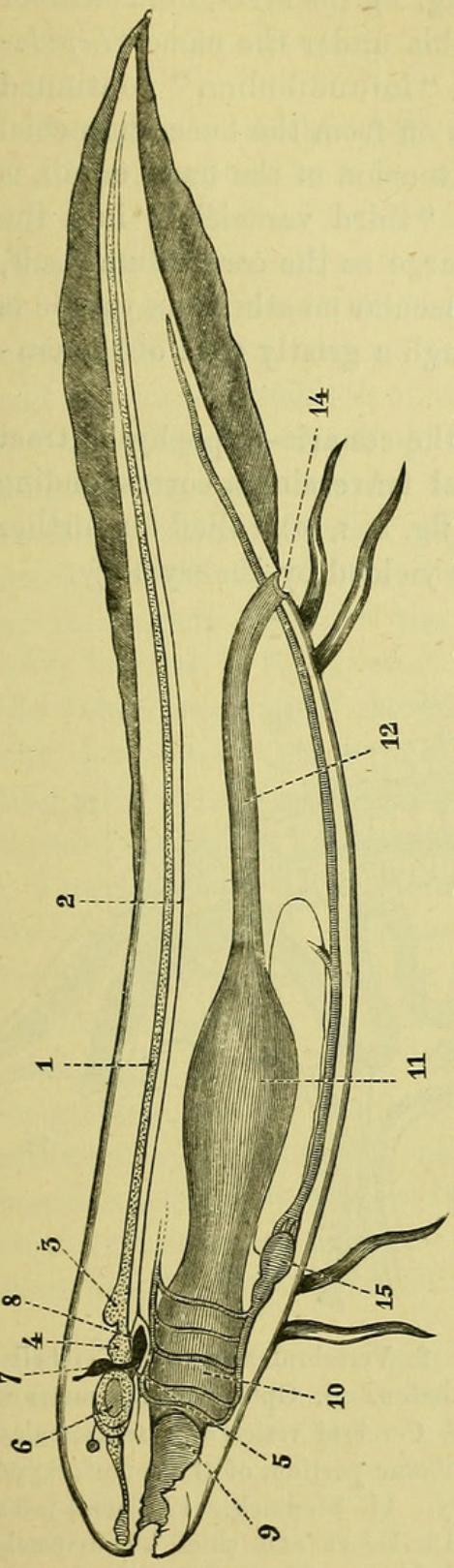
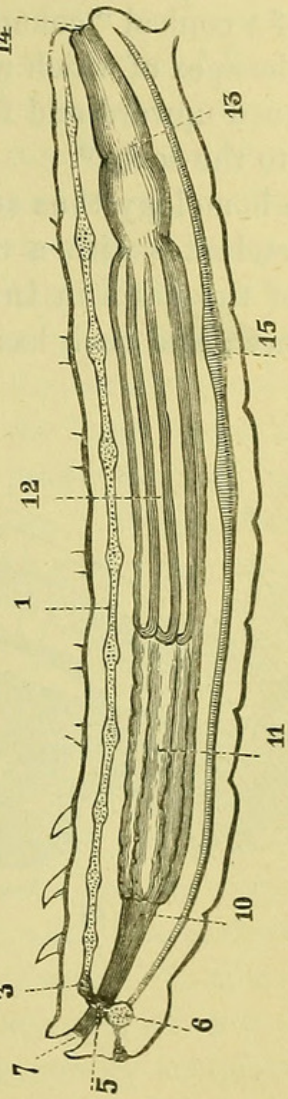


Fig. 2. *Protopterus*.—1. Neural axis. 2. Notochord. 3. Cerebellum. 4. Optic lobe. 5. Foremost branchial arch. 6. Cerebrum. 7. Pineal body. 8. Pituitary body (together, the conario-hypophysial tract). 9. Oral cavity. 10. Branchial cavity. 11. Stomach. 12. Intestine. 14. Vent. 15. Heart and chief blood-vessels.

Fig. 3.



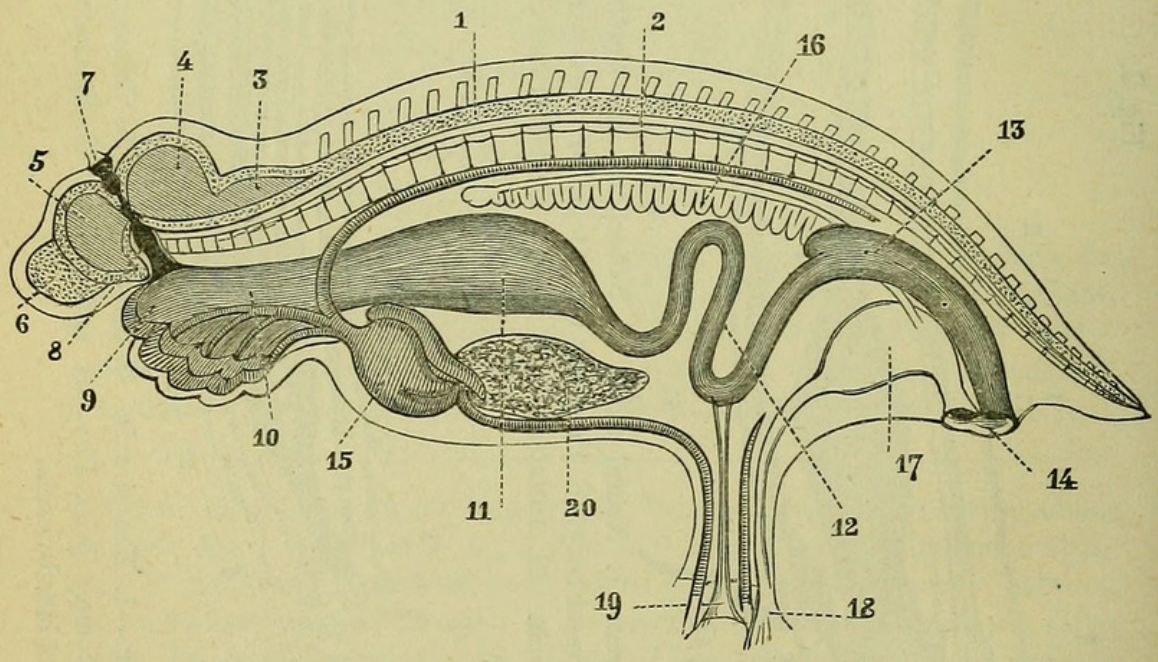
Larva of Sphinx.—1. Neural axis. 3. Hind brain. 5. Connecting tracts or "crura," of 6, Fore brain. 7. Neural mouth, or neurostome. 7–10. Pharynx and gullet. 11. Stomach. 12. Hepatic intestine. 13. Rectum. 14. Vent. 15. Heart and chief blood-vessels.

in advance of the cerebral lobes (but in vertical parallel with the palate). In the Cod the hypophysis, fig. 185, *p*, is a subspherical mass, with an irregular surface almost half the size of the human 'pituitary gland,' and illustrating the vast proportional size of this constant appendage to the brain of Fishes" (p. 280).

the spiny Dogfish (*Acanthias*) its progress is there arrested. The direction of the pineal tube is forward as well as upward in all fishes. In that esculant form, *Protopterus* (fig. 2), the first-found member of which was referred to the Amphibia under the name "*Lepidosiren*," the width and length of the "infundibulum" continued from the flattened discoid body, 8, cut off from the bucco-branchial cavity, 9, 10, by a thin lamelliform extension of the basis cranii, is continued by a proportionally wide "third ventricle" into the base of a conical "conarium," 7, as large as the cerebellum itself, from the apex of which conarium a vascular membranous tubule is continued upward and forward through a gristly part of the cranium to the scalp*.

The homology thus suggested of the conario-hypophysial tract in Vertebrates with a vascular canal traversing a corresponding part of the brain in Invertebrates (fig. 3, 7, 10), called for further evidence; and such has been amply yielded by Embryology.

Fig. 4.



Mammalian embryo.—1. Neural axis. 2. Vertebral axis. 3. Cerebellar vesicle and medulla oblongata=epencephalon. 4. Optic vesicle=mesencephalon. 5. Vesicle of third ventricle. 6. Cerebral vesicle=prosencephalon. 7. Pineal portion, 8. Pituitary or infundibular portion, of the conario-hypophysial tract. 9–10. Bucco-branchial cavity. 11. Stomach. 12. Small intestine. 13. Large intestine. 14. Vent. 15. Heart and chief blood-vessels. 16. Primordial kidney. 17. Urinary bladder. 18. Pedicle of allantois. 19. Pedicle of umbilical vesicle. 20. Liver.

* *Tom. cit.* p. 282, fig. 186.

In the Vertebrate embyro (fig. 4) the myelencephalon, 1–6, first appears as a longitudinal channel of the ectoblast, opening "neurad;" and soon, by upward or neural extension and convergence of its side-walls, it is converted by their confluence into a tube.

Passing over the histological steps in the formation of the grey and white matters and the reduction thereby of the canal to the minute central one of the adult myelon, what here concerns my argument is the progressive forward extension of the cord, with corresponding expansions into the beginnings of the "hind brain," or epencephalon (fig. 4, 3), of the mid brain or mesencephalon (*ib.* 4), and of a large vesicle (*ib.* 5), dividing the latter from the fore brain, or "prosencephalon" (*ib.* 6). All these expansions, as shown in the diagram (fig. 4), are hollow; but the relative size of the cavity, of the so-called "third ventricle" (5), is now the largest of the embryonal cerebral vesicles; and this disproportion moreover coincides with an incomplete phase of the Vertebrate alimentary canal; and, what is more to the present contention, the huge homologue of the "third ventricle" extends into two productions of its wall, one downward (8) to a canal, "infundibulum," now communicating with the anterior end of the digestive cavity (9); the other upward (7), to the "thalamencephalon"*.

I next pass to the phenomena of the development of the digestive cavity. What subsequently becomes an alimentary canal, begins like the myelon, as a groove, parallel therewith, but opening in the opposite direction, or "hæmad," and there communicating with the vitellicle. It is developed most conspicuously or in greatest proportion from the hypoblast. As the alimentary rudiment extends beyond the yolk-sac, forward and backward, it becomes tubular, but as yet is closed at both ends. It absorbs, or receives, nutriment from the yolk-bag, which recedes as it diminishes and becomes excluded from the abdomen by completion of

* In his exemplary monograph 'On the Development of Elasmobranch Fishes,' 8vo, 1878, Mr. Balfour writes:—"During stage L the infundibulum becomes much produced, and forms a wide sack in contact with the pituitary body, and its cavity communicates with that of the third ventricle by an elongated slit-like aperture" (p. 176). . . . . "During the same stage the pineal gland grows into a sack-like body" (p. 177). . . . . At a later stage (P)—"The pineal sack has also become greatly elongated, and its somewhat dilated extremity is situated between the cerebral rudiment and the external skin. It opens into the hind end of the third ventricle, and its posterior wall is continuous with the front wall of the mid-brain" (p. 177).

the walls of that cavity, save where the primitive yolk-canal, fig. 4, 19, passes on to the shrunk vitellicle, now shut out as an appendage, ultimately to be absorbed or cast off at birth. Here, however, we have a primordial "mouth" and "gullet," or parts holding functionally, though transitorily, those relations to the digestive sac. The persistent indication of such course of the embryonal food is called "umbilicus:" it points to one inlet of food which has made way for another; and that other will make way for a third. As well devote pains and speculation to the "function" of the navel as to analogous remnants of a later communication with the alimentary canal, doomed likewise to obliteration with concomitant solidification of parts.

In low radiate forms of life, *Medusa* e. g., the vitelline entry, or "protostome," is permanent; a "deutostome" may, in like manner, appear as another step in the rising scale which is not parted with.

But to return to our Vertebrate grade. The alimentary tube, parallel with the myelonal one, communicates or anastomoses therewith at both ends; a common canal thus results, but of which the hæmal portion will be modified to give sustenance to the body, the neural portion to the mind. In the course of differentiation the caudal intercommunion is first abolished. The anterior end of the alimentary tube (fig. 4, 11), extending forward, comes into close contact and continuity with the canal which may be described as commencing below at the "infundibulum," and as continuing upward by the third ventricle to the base or origin of the pineal production of the thalamencephalon, which production, perforating, as in the embryo Iguana, the soft lamellar basis of the cranial roof-bones, is only arrested in its aim to form a mouth, or "deutostome," at the vertex, by failing to overcome the resistance of the superincumbent epithelial layer—such resistance being encouraged by the processes now on foot to establish an external communication, elsewhere, with the fore part of the alimentary canal.

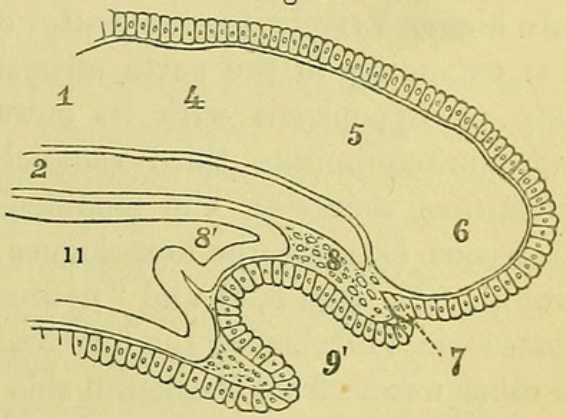
In *Amphioxus* and its earlier or humbler relatives the Ascidians, a mouth, or oral passage, is formed, which opens behind into a vascular expansion from which the alimentary canal is continued. This branchial sac is on the under or hæmal side of the fore part of the neural axis, issuing, in the lower division of Vertebrates, in the perfection of a water-breathing apparatus, and manifesting in the embryos of the higher half of the subkingdom unequi-

vocal traces of a branchial organization, as shown in fig. 4, 10. But, although this organization subsides, the hæmal mouth, or "tritostome," is in them retained.

Having noted, briefly, the indications of an earlier or neural mouth-way, or œsophagus, in the embryo of Vertebrates next above the brainless *Amphioxus*, I may premise that, with the appearance, in Invertebrates, of a brain including both supra- (fig. 3, 6) and sub- (*ib.* 3) œsophageal masses or ganglions—better termed, respectively, "hæmœsophageal" and "neurœsophageal"—the canal dividing them is developed as a "gullet" (*ib.* 10), and its outward opening is established as a "mouth" (*ib.* 7) or "deutostome."

In cerebral Vertebrates, also, there appears a beginning, or attempt so to speak, of a canal or tubular extension directed brainward. This developmental phenomenon is contemporaneous with the enlargements of the fore end of the myelencephalon, as seen in the embryos of Cyclostomous fishes *. In fig. 5 these enlargements are represented by the figures 4, 5, 6, the latter now pushing beyond the notochord, 2. Toward the middle one of these extends the tubular production (8′) from the digestive sac (11). In the line opposite to the production (8′) is an infolding of the ectoblast (7), which Scott indicates as that of the nasal cavity and hypophysis ("gemeinsame Einbuchtung für Nasengrube und Hypophysis," *loc. cit.* p. 171, Taf. ix. fig. 31, N. H. E). Beneath this has commenced the wider infolding of the ectoblast (fig. 5, 9′), which, extending backward, and subsequently expanding and developing the branchial sacs, ultimately effects a communication with the alimentary cavity (11), and establishes the perma-

Fig. 5.



Enlarged scale of a longitudinal vertical mid-section of an embryo of *Petromyzon Planeri* at the eighteenth day.

* See Owsjannikow, "Die Entwicklungsgeschichte der *Petromyzon fluviatilis*," Bulletin de l'Acad. Imp., St. Pétersbourg, tom. xiv. 1870, p. 325; Calberla, Morpholog. Jahrbuch, Bd. iii. p. 226; Scott (W. B.), Morpholog. Jahrbuch, Bd. vii., erstes Heft, p. 131, "Beiträge zur Entwicklungsgeschichte der Petromyzonten," from which treatise the subject of fig. 5 is taken.

nent oral entry thereto. In the more highly organized cartilaginous fishes (Elasmobranchs) the hæmal permanent mouth, or "tritostome," is also due to involution of the epiblast, forming a sac, beneath the base of the brain, the closed end of the sac coming into contact with the fore end of the alimentary cavity, developing upward the infundibulum. Mr. Balfour sees the rudiment of the hypophysis in a process of the mouth-involution which becomes "constricted off." But he recognizes that the blind anterior end of the alimentary canal—which he terms "throat"—is in close contact with the "pituitary involution." This "involution becomes longer and dilated terminally, while the passage connecting it with the mouth becomes narrower and narrower, and is finally reduced to a solid cord, which in its turn disappears. The remaining vesicle then becomes divided into lobes, and connects itself closely with the infundibulum." (*Op. cit.* p. 190.)

In higher Vertebrates the deuto- or pseudo-pharynx (figs. 1, 2, 4, 8), extending to the parts ultimately modified as a pituitary body or hypophysis with its onward and neurad extensions —the infundibulum, third ventricle, and pineal production— constitutes therewith the modified canal which traverses the interspace between the homologues of the Invertebrate "hæmœsophageal" (fig. 3, 6) and "neurœsophageal" (fig. 3, 3) brain-masses—in Vertebrates the fore brain and following brain-parts. In other words, from the neural side of the embryonal or primary buccal cavity a communication (figs. 1–4, 7, 8) is more or less carried on toward the surface from the part where what is a diverticulum from the primitive closed œsophagus (fig. 5, 8′) seems to be seeking, as it were, its outlet at the neural aspect of the body above a wide interspace (fig. 4, 5) now separating the rudiment of the fore brain (6) from those of the mid (4) and hind (3) brains.

In all Invertebrates with appreciable homologues of these divisions of the Vertebrate brain, the neural mouth (fig. 3, 7) is opened at this part, the primordial attempt to attain it in the Vertebrates is fulfilled, and the communication of such neural mouth with the alimentary canal is completed and becomes the persistent gullet (*ib.* 7, 10).

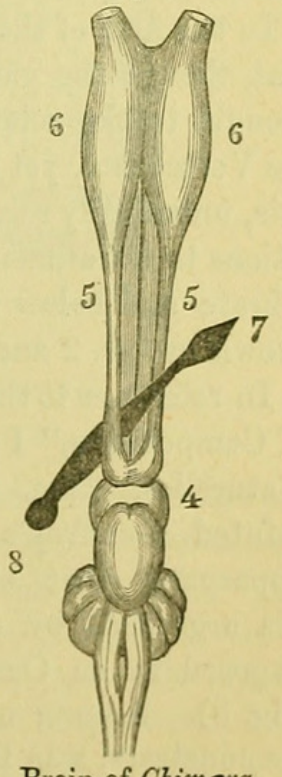
The proposition, therefore, which I now submit to the Society is, that the conario-hypophysial tract in Vertebrates is the modified homologue of the mouth and gullet of Invertebrates. That the neur- or subœsophageal ganglion, or ganglionic masses, or neural cords (fig. 3, 3, 5), constituting the centres whence are

derived and caudally continued the homologue of the Vertebrate myelon (*ib.* 1), together with the part of the gullet they encompass, are consequently the homologues of the parts of the brain (fig. 2, 4, 3) posterior to the cerebrum (*ib.* 6) and of the ventricle (fig. 4, 5) intervening between the upper and lower ends—pineal (*ib.* 7) and pituitary (*ib.* 8)—of the conario-hypophysial tract. Thus, as it appears to me, is the *Unity of Organization or Composition* vindicated, though in a transitory manner, between the Vertebrate and Invertebrate brain-possessing animals. The foregoing developmental phenomena have mainly guided me to a homological application which, so far as my readings have extended, appears not to have suggested itself.

An obvious difference from the mature Vertebrate is the relative extent of the interspace dividing the fore brain from the mid brain, depending chiefly on the functional relations of the interposed alimentary canal in Invertebrates (fig. 3, 7–10). The proposed homology appears to me to throw some welcome light on the similar though transitory proportions of the same interspace in the Vertebrate, even the Mammalian, embryo, as exemplified in fig. 4. And we now look with interest upon the evidences afforded by mature Vertebrates at the lower end of their scale for any retention of this character—a passing one—in the higher forms.

Fishes, especially the cartilaginous, yield such illustrations. I may refer to Busch's descriptions and figures of piscine brains exemplifying such suggestive characters, in his excellent monograph 'De Selachiorum et Ganoideorum Encephalo'*, from which the illustrations of such character in the brain of the Sturgeon (*Acipenser sturio*), and more especially in that of the *Chimæra monstrosa*, are taken, in figs. 173 and 179 of my 'Anatomy of Vertebrates.' The long cord-like lamellæ continued from the optic lobes (fig. 6, 4) to the cerebral one (*ib.* 6), equal in longitudinal extent both mes- and prosencephalon combined. The so-termed "third ventricle" appears as an elongated widely open channel, the side walls of which (*ib.* 5, 5) are thickened and, expand-

Fig. 6.



Brain of *Chimæra*.

* 4to, 1848.

ing into the cerebral hemisphere, seem to represent the "crura cerebri." They indicate that these so-called cords or tracts, in Vertebrates, may be homologous with the parial cords or tracts girting the gullet and connecting the fore brain (fig. 4, 6) with the hinder masses (*ib.* 3) in Invertebrates; to which pair of intercommunicating tracts the oral end of the gullet in Invertebrates and the conario-hypophysial tract in Vertebrates hold like relations.

Such perception of the homologies above indicated led to thoughts of their bearing upon the following higher generalization.

At the period of my student's career in Paris the biological mind was exercised by the question of "Unity of Plan" or "of Composition" in the Animal Kingdom as exemplified between Articulates and Vertebrates by reversing the position of the former, and turning what was regarded the under or ventral side of the crustacean or caterpillar upward, as shown in fig. 3, so as to correspond with the upper or dorsal side of the Fish or Quadruped. The alleged "Law" was further elucidated, as between Vertebrates and Mollusks, by bending a quadruped so as to bring the pelvis in contact with the nape, and so parallelling it with a cuttle-fish—propositions adopted as demonstrative of their "Unity of organic Plan or Composition" by Geoffroy St. Hilaire.

To the first of these attempts Cuvier opposed the obvious fact that, though the ganglionic cord of the Articulate might be so brought to the relative position, or place, of the spinal cord of the Vertebrate, yet the chief part of the nervous system, or neural axis, universally recognized as "brain" in both, held opposite relations to the alimentary canal, being above the mouth in the Vertebrate and below the mouth in the upturned Articulate (as is shown in figs. 2 and 3).

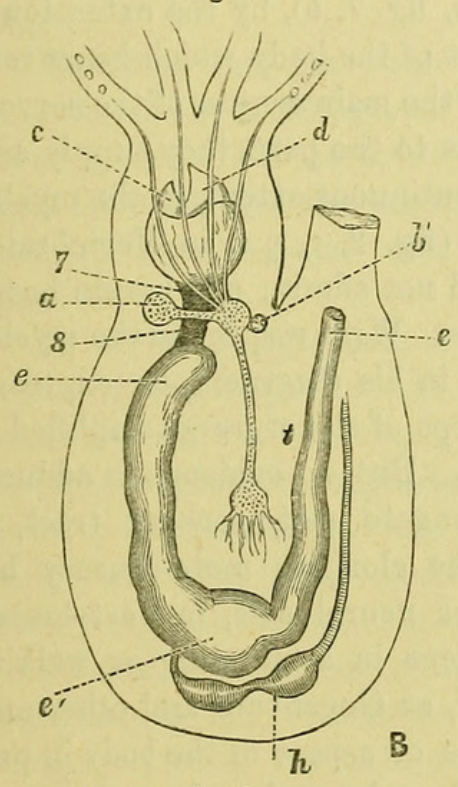
In reference to the second exemplification of the alleged "Unity of Composition," I need only refer to the 'Annales des Sciences Naturelles,' Tom. xix. p. 241, pl. xii. (1830), in which Cuvier refuted Geoffroy's conclusions to his own satisfaction and apparently that of the 'Académie des Sciences,' illustrating his argument by diagrammatic views of the organs which he exposed in an Octopus (fig. 7) and in a doubled-up Quadruped (fig. 8). Among other difficulties which he thereby seemed to demonstrate, was the impossibility of making the brain (figs. 7, 8, *a*) hold a corresponding position in relation to the alimen-

tary canal (*ib.*, *e*), a fact which was deemed by anatomists of the "Positive School" conclusive as against the "Transcendentalists."

Having satisfied myself that there is a way out of the difficulty by rightly determining the homologies of the mouth and gullet in Mollusks and Articulates with recognizable structures in Vertebrates, I have submitted the facts and conclusions which have led me to harmonize the oppositions, and to show that the ingenious idea of MM. Laurencet and Meyranx, adopted and advocated by Geoffroy, was not, in point of fact, open to the objection which relegated it to the limbo of exploded notions, where it seems to have rested now for half a century.

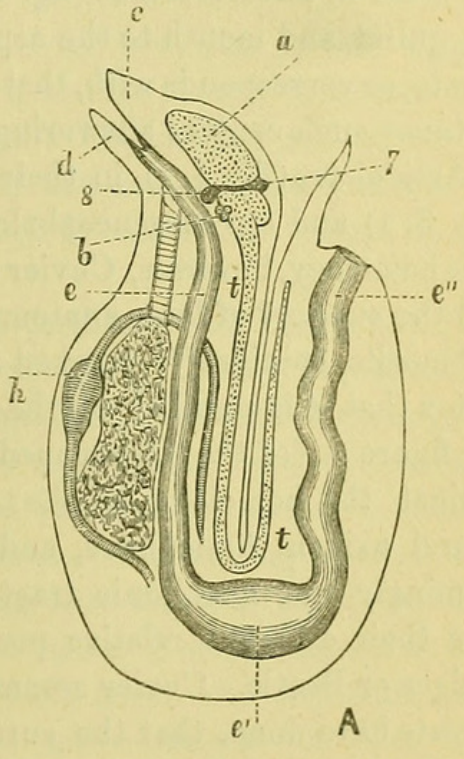
I reproduce the diagrammatic illustrations (figs. 7 and 8) by

Fig. 7.



Cuttle.

Fig. 8.



Mammal.

Schematic views as referred to in the text.

which Cuvier exemplified his objections, in order to show how the homology I have propounded of the "conario-hypophysial tract" affects the argument and conclusion of the great anatomist. The sole liberty I have taken with that diagram (fig. 8) is to add to the brain of the Mammal the tract in question (7, 8); the significance of which to his argument Cuvier as little suspected as have his successors who have devoted time and thought to the higher generalizations of Biology.

After demonstrating, by reference to the Badger, that colour does not indicate the back of an animal, Cuvier proceeds to affirm that naturalists have for the recognition of that aspect a more certain character, viz. the position of the brain:—"Ils ont pour reconnaître les dos un caractère plus certain: c'est la position du cerveau"*.

Now, by the term "cerveau" Cuvier does not here mean the sum of neural expansions usually called "brain," but only one of them, that, viz., which he indicates (as in figs. 7 and 8) by the letter *a* in both Cephalopod and Mammal; it is the part which is termed the "superœsophageal mass, ganglion, or pair of ganglions" in Invertebrates, and the "cerebrum" or "cerebral hemispheres" in Vertebrates. It is divided, as already remarked, from the "subœsophageal ganglions," completing the totality of the brain in Invertebrates (fig. 4, 3, fig. 7, *b*), by the extension of the gullet and mouth to the aspect of the body which bears relation to, or corresponds with, that of the main centres of the nervous system—such centres answering, as to the parts they supply and, in Articulates (fig. 4, 1), in their continuous extent, to the myelon (fig. 3, 1) and ep- mesencephalon (fig. 2, 1, 3, 4) in Vertebrates. This homology, however, Cuvier did not admit; and herein he has had the support of later anatomists. With respect to the myelon —"moelle épinière"—marked *t t* in his diagram†, he expressly states that it is peculiar to the type of structure exemplified in his figure A (of the Quadruped)‡. But no evidence is adduced against the homology of the elongate moto-sensory tract, or neural axis, in Articulates, and the elongate moto-sensory but seemingly non-ganglionic tract, or neural axis, in Vertebrates, save their different relative positions in a standing or walking Badger or Beetle. Cuvier assumed, as Gegenbaur and other anatomists have done, that the surface or aspect of the body in progressive motion determines the homology of such surface, and that the surface nearest to which lies the neural axis in Articulates answers to that which is furthest from such axis in Vertebrates. But there are both Vertebrates and Invertebrates in which, during progressive motion, neither the neural nor the hæmal surface is downwards or next the earth.

* *Tom. cit.* p. 251. † *Tom. cit.* pl. xii.

‡ "*t t*, la moelle épinière propre au Mammifère," *tom. cit.* p. 257 (referring to his subject as a representative of a Vertebrate animal).

The subœsophageal mass or ganglions in Cephalopods send off the nerves to the prehensile arms, and are in communication with the viscera, the muscles, and the soft parts of the trunk. Moreover, in Vertebrates this epencephalic homologue is in direct nervous communication with the organ of hearing (*b*, figs. 7 and 8). The fore brain, on the opposite side of the gullet in the Cephalopod (fig. 7, *a*), supplies the nervous masses subservient to the large and complex organs of vision, and also parts which may exercise the sense of smell. But, if the subœsophageal mass, *b*, and the moto-sensory neural continuations of the trunk, *t*, be, in the Cephalopod, homologous with those in the Insect (fig. 3, 1) and Crustacean, the ground on which I predicate, in the Articulate, of the neural aspect of the body, that it answers to that commonly called "dorsal" in Vertebrates, is applicable also to the Mollusk, fig. 7.

Therefore the part which Cuvier indicates in his diagram, and terms brain ("cerveau," *a*), is not a true criterion of the back ("dos"); it occupies in the Cephalopod and other cerebral Invertebrates the aspect of the belly, or tract of the body which I term "hæmal," and which is called the ventral or under part.

To be sure this cannot be predicated of the brain ("cerveau," *a*) of the quadruped. And why? Because the alimentary tract and outward anterior opening which would demonstrate its holding a position opposite to that of the rest of the nerve-centres has been atrophied, and exists as an arrested residuary embryonal part (figs. 3 and 8, 7–8). It is the superadded respiratory organization in connection with the oral end of the alimentary canal and the concomitant opening of the mouth in a new position, in the Vertebrate, which turns the cerebrum to the side occupied by the rest of the nerve-centres—in other words, to the neural aspect of the body. Individual development being achieved, the Vertebrate becomes "hæmastomous," the Invertebrate remains "neurostomous."

At the embryonal stage of the higher subclass at which the primary mouth was continued across the brain, the "Unity of Plan" between the Vertebrate and Invertebrate animal was exemplified; and that "unity" is, in the main, preserved under the recognition of the neural and hæmal aspects of the body, as shown in figs. 2 and 3, representing the Articulate and Vertebrate types.

In the view of the homologous surfaces of the Invertebrate and Vertebrate bodies as determined by that which may happen to be the upper surface in horizontal station and progression, which surface is accordingly termed "dorsal," the opposite or under surface being "ventral," the chief nerve-mass in the Articulate (fig. 3, 6), called "cerveau" by Cuvier, poses as the homologue of the brain in the Vertebrate; and not only so, but being the only part of the central nerve-mass which is "dorsal" in position, or "above" the alimentary canal, it might be entitled, according to the above homology of the body-surfaces, to be the homologue of the entire central nerve-mass (my "myelencephalon") in Vertebrates, which is also "dorsal;" while the ganglionic nerve-cords in Articulates would be in the opposite homological category.

Accordingly the accomplished Anatomical Professor at Heidelberg, in logical concord with such determination of homologous surfaces, holds the so-called "supercesophageal ganglion" of the Articulate to be, or to represent, the whole myelencephalous tract in the Vertebrate. With Gegenbaur*, as with Cuvier, the "spinal cord" is therefore peculiar to Vertebrates, being "dorsal" in position; it bears no true homology with the so-called "ventral" cords, whether ganglionic or not, in Invertebrates.

Dohrn†, while admitting the homology or equivalency of the supercesophageal ganglions, subcesophageal ganglions, and sub- or ventral cords therefrom continued, whether ganglionic or otherwise, in Annelids and Arthropods, with the myelencephalous tract in Vertebrates, notwithstanding the opposite sides of the body which they seem to hold, has recourse to ideal ancestral forms in order to reconcile the differences as to relative position shown by the actual or modern subjects‡.

My contention is that the true grounds for determining the homology in question are not the positions of the body which may be assumed by the living animal, but the relative positions to such body of the central parts of the nervous and vascular systems, which relations I have expressed by the terms "neural" and "hæmal." The convenience of these terms or signs is exempli-

* 'Grundriss der vergleichenden Anatomie,' 8vo, p. 264.

† 'Ursprung der Wirbelthiere,' &c.

‡ I concur with the remarks by Balfour, *loc. cit.* p. 167, on Dohrn's hypothesis, and deem any other objection superfluous.

fied by the trouble, not to say perplexity, which arises when characters, or developmental phenomena, repeated in Vertebrates and Articulates, are endeavoured to be expressed or expounded on the "dorsal" and "ventral" homological hypothesis.

Balfour, for example, in his keen and accurate views of the primary growths of the myelon, in Elasmobranchs, traces the formation of the central cavity by the "dorsal" folding of the lateral halves of the primitive open canal, which includes the grey matter and carries in also a fold, now become the lining of the cavity, of the embryonal ciliate epiderm.

The primal nerve-roots are, or are attached to, free margins of the dorsal folds, and become the "dorsal," or, in anthropotomy, the "posterior" roots of the spinal nerves. The white matter of the myelon becomes external and lies in greater proportion along the under, or ventral, or anthropotomically "anterior," part, than on the "dorsal" part of the myelon.

Now comes the difficulty arising from the non-appreciation of the homology of the conario-hypophysial infundibular tract with the annulose gullet. "The transverse section of the ventral nervous cord of an ordinary segmented Annelid consists of two symmetrical halves placed side by side. If by a mechanical folding the two lateral halves of the nervous cord became bent towards each other, while into the groove between the two the external skin became pushed, we should have an approximation to the vertebrate nervous system." . . . . "If this folding were then completed in such a way that the groove, lined by external skin and situated between the two lateral columns of the nervous system, became converted into a canal, above and below which the two columns of the nervous system united, we should have in the transformed nervous cord an organ strongly resembling the spinal cord of Vertebrates"*. But a resemblance, however strong, between the two parts or organs is not, of itself, a ground for predicating homology. For, as the accomplished developmentalist proceeds, "It is well known that the nerve-cells are always situated on the ventral side of the abdominal nerve-cord of Annelids, either as a continuous layer, or in the form of two, or more usually, three bands. The dorsal side of the cord is composed of nerve-fibres or white matter. If the folding I have supposed were to take place in the Annelid nervous-cord, the grey and white matters would have very nearly the same relative situations as they have in the

* Balfour, *op. cit.* p. 165.

Vertebrate spinal cord. The grey matter would be situated in the interior and line the central canal, and the white matter would nearly surround the grey. The nerves would then arise, not from the sides of the nervous cord as in existing Annelids, but from its extreme ventral summit "*.

Parts of the important organs "spinal marrow" and "abdominal cords," ganglionic or otherwise, would doubtless hold the same relative situations in an abstract view of the structures, irrespective of their assumed relative positions in the Annulate and Vertebrate bodies; but in relation to the accepted position of the nerve-centres in the two groups they would hold opposite relative situations in and to the body; the extreme summits of the primitive folds giving origin to the nerves would be dorsal in the Vertebrate, and ventral in the Annulate modifications of the animal structures.

Obliterate the mouth and part of the alimentary canal dividing the fore brain from the hind brain in Annulates, and the parts of the homologue of the myelencephalon ("cerebro-spinal tract" or abdominal nerve-cord) become wholly on the neural aspect of the body, as in Vertebrates. In both divisions the infolding of the side walls completing the central canal occurs on the neural side. In both the nerves arise from the neural summits of such infoldings; and in both the "external skin" would pass from the neural side of the groove into the central (then becoming) ciliate canal. In both the hæmal side of the cord would manifest an excess of the "white matter;" and this with the opposite predominant grey matter would present not "very nearly," but the very same relative positions to the body of the animal containing them (compare figs. 2 and 3).

Of these propositions, the base or support is the homology of the pineal, third ventricular, infundibular, pituitary residuary modifications in the Vertebrate brain with the persistent functional canal traversing the homologous tract in the Annulate or Articulate brain†.

* Balfour, *op. cit.* p. 165.

† I have elsewhere ('Archetype of the Vertebrate Skeleton,' 8vo, 1848, p. 2) pleaded in favour of single substantive "terms" in place of "descriptive" phrases," and may here cite, as synonyms of "myelencephalon"—"nervous system" (p. 165), "cerebro-spinal nervous system" (p. 99), "central nervous system" (p. 100), "nervous part of the brain and spinal cord" (p. 100); again, as synonyms of "myelon"—"spinal marrow," "spinal cord," "abdominal nerve-

As animals descend in the scale, the instinctive or reflex actions of the nervous system predominate over those that are "willed," or the voluntary actions.

In both Vertebrates and Invertebrates, as a rule, the parial limbs diverge from their arches nearer the neural than the hæmal sides of the trunk—nearer to the centres whence their nerves originate. In Vertebrates the joints or segments of the limbs bend toward the hæmal aspect; in Invertebrates they bend from the hæmal aspect: and thus the most frail and precious of the organic systems, namely the neural axis, is brought in Arthropods towards the least exposed and safest surface of the body, that, viz., which is downward, next the ground—therefore called the "belly," or ventral surface or aspect. When the myelencephalous tract runs along the most exposed, dorsal, side, it receives an immediate protection by a vertebral column. But the surfaces or aspects of the body which are truly homologous in the Snake and Caterpillar are the *neural* and the *hæmal*, not the *dorsal* and the *ventral*.

The Neuroptera of Madeira and the Canary Islands.

By Robert M'Lachlan, F.R.S., F.L.S., &c.

[Read December 1, 1881.]

It has always appeared to me that attempts to work out, group by group, the fauna or flora of special countries or districts are duties to which the attention of naturalists should be especially directed. It is by means of such attempts that we are enabled, little by little, to grasp broad generalizations on the probable origin of the productions of certain districts, to ascertain the geographical distribution of species, and to form some idea of the possible means whereby, through a process of evolution, certain forms have acquired their existing characteristics as distinguishing them from others to which they are most closely allied.

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cord" (p. 165), "Annelid nervous cord" (*ib.*); also, as synonyms of "myelonal canal"—"medullary canal"(p. 128), "neural canal" (p. 100), "central canal of the nervous system," equivalent to "myelencephalous canal;" "spinal canal" (p. 99), which, in surgery, is a synonym of "vertebral canal." The pages here quoted refer to the 'Elasmobranch Fishes' of Balfour.