

SECTION OF ANATOMY AND PHYSIOLOGY.

ON THE POSITION OF ANATOMY IN GENERAL,
AND THE CENTRAL NERVOUS SYSTEM IN PARTICULAR,
WITH LIME-LIGHT DEMONSTRATION
OF ANATOMY FROM THE MORPHOLOGICAL
SIDE (MACROSCOPIC, MINUTE, AND DEVELOPMENTAL).

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THE first half of this Address, of which the following is a summary, was called forth by the letters which appeared in *Nature*, October 26 and November 9, 1893, from Professor Ray Lankester, of Oxford. Coming from a man of his acknowledged standing and eminence, being, as he is, the most distinguished of the young school of English morphologists now remaining, and the matter they contained being from his point of view unfortunately too true, led me to contrast the position and the conditions under which the teachers of human anatomy in Germany and in the three divisions of our own country have to work. No one knows better than Professor Ray Lankester that matter of the same character could not be used by a professor, however eminent, in the philosophic or natural science faculty, in any German university, in reference to his scientific colleagues of the medical one, often quite as eminent as himself.

In doing so I had to enter into some detail in regard to the manner in which medical teaching was done in our own country—by universities, by colleges, and by private enterprise, the latter more especially in London, to some extent in Edinburgh and Glasgow, and also, up to a very recent date, here in Dublin. In Germany, on the other hand, all medical teaching was done by universities only, and by teachers appointed by the State. Comparable acquirements and results in the shape of morphological contributions to knowledge could only be looked for in our own country from those holding university positions, or similar ones in certain of the metropolitan or provincial colleges, who were in the fortunate position of having a certain amount of leisure apart from their teaching duties.

In order to appreciate or understand Professor Ray Lankester's position it was necessary to note the rise of the young school of English morphologists, due largely to the scientific insight and forethought of the distinguished Professor of Physiology in the University of Cambridge, who, associated with his famous pupil, the late Professor F. M. Balfour, created the great school of morphology in connection with that university, the Oxford side being represented by the late Professor Moseley, and now by Professor Ray Lankester.

The older representatives of English natural science were generally medical graduates. Professor Huxley, by far the most distinguished of those who remain, had such a training.

The young school, however, have little, if any, connection at all with medicine, and judge us and our work by the pure scientific standard, and it is in this sense that Professor Ray Lankester's judgment must be said to be true.

The human morphologist's vision must from its nature be always a more limited one than that of the comparative morphologist, and he must recognise that it takes a Darwin to write of the "Descent of Man," a Huxley to fix his "Place in Nature," a Haeckel to speak of his "Evolution," and a Weismann to raise controversy regarding the "Continuity of his Germ Plasm"—that these are men who have garnered in their minds all the knowledge of their time in respect to organic nature, who are able to formulate new conceptions, and to change the current of thought in almost every branch of knowledge.

The second half of the address was taken up by throwing on the screen examples of the manner in which my inward thought had endeavoured to make for itself outward expression during the preceding ten years. The screen pictures exhibited were from slides, reductions from my 15 × 12 inch negatives. Of the latter I had made nearly one thousand, exhibiting original observations on vertebrate morphology and embryology. More than half the number dealt with the anatomy of man in his infantile and adult stages; his external form in various positions and actions (from the living model), also his internal structure, with particular reference to his central nervous system.

The smaller half dealt with the embryology of the dog-fish and salmon among fishes, with that of the frog and newt among amphibians, with the chick, duck, and canary among birds, and with that of the rabbit, rat, mouse, guinea-pig, hedgehog, mole, calf, sheep, pig, dog, cat, monkey (two examples), and man amongst mammals. My observations have thus covered all the divisions of the vertebrata except reptiles, the embryos of which I have hitherto been unable to obtain, except one of a rattlesnake.

I have not only photographed the external form of the

several examples mentioned under the different classes, but also the serial sections into which the embryos have been cut at a direct enlargement of from ten to twenty times, so that the whole internal form can be read from the prints taken from the negatives without the trouble of looking down the microscope. The prints can be made transparent, and the sections placed in order one over the other; reconstruction figures or even models can in this way be made with the greatest ease.

My observations have of necessity been much more complete in certain examples than in others. In the rat I have, both as regards external form and serial microscopic sections, a very complete series of specimens at intervals of four hours from the eighteenth hour after union of the sexes up to birth, which occurs at the end of the third week. In the human example I have also been able, by the kindness of many friends in Dublin and in various parts of Ireland and England, to make and work over an almost complete series of specimens, varying in length from less than 10 mm. up to birth.

In addition, I have photographed complete series of sections made in the sagittal, coronal, and horizontal directions of the adult brains of the cat, dog, seal, rabbit, monkey, and in man not only the adult, but also at birth and several intervening stages.

I had made 150 slides for the screen, selecting examples from all those stated in the preceding summary of my work. Time, however, prevented me from showing more than one hundred.

The Plates which accompany this summary I have had made in order to give readers an idea of those which were thrown on the screen.

As the number had to be limited I selected negatives for reproduction which dealt with the anatomy of human

foetuses (Plates IV. and V.), or with that of the human embryo and lower mammal (Plate I.). Plates II. and III. were selected to show the aid which photography can give in the easy reading of serial sections, and of the many uses to which these can be applied.

All the Plates are reductions from 15 × 12 inch negatives, except, of course, the lithographic ones, which were made simply as explanatory of the preceding five.

EXPLANATION OF THE PLATES.

The first three Plates require to be studied or observed with the heading of each turned towards the right hand of the observer, and in my remarks in reference to these three I will take it for granted that the reader is so observing them.

The remaining plates are to be studied in the direction of the heading.

PLATE I. represents mainly a series of rat embryos at different ages and from different aspects; there is in addition a very fine human embryo and a canary bird embryo.

The embryos are arranged in three rows, of which the lower is double towards the right hand. Of the four embryos which form the double part of this row, the two smaller are at 10 days 16 hours date after union of the sexes. The heart, and the cephalic and allantoic ends of the embryo can be noted. The medullary groove, except in the region of the mid-brain, is still in great part unclosed. The two larger are at 11 days 16 hours, at which date the various divisions of the encephalon can be recognised. Of the visceral arches, the mandibular is the most prominent, and the limbs are budding from the side of the trunk.

The remaining five embryos of this lower row and the two at the right hand of the second row are seven members of a family of rats at 12 days 16 hours. Four of

the seven show the lateral aspect, two the front aspect, and the remaining one (the last at the left hand of the lower row) the dorsal aspect, in particular the fossa rhomboidalis, the beginning cerebellum and the mid-brain.

In all of these embryos the several divisions of the central nervous system can be readily observed, the budding hemisphere brain, the thalamic and mid-brain, the isthmus, the two lateral plates which are to unite to form the cerebellum, and the great extent of the after brain or medulla—all are to be noted.

Of the three remaining embryos of the second row, the last one at the left hand is the front aspect of a canary embryo of about the sixth day. The other two and the two at the left hand of the upper row are four members of a family of rats at 13 days 16 hours. The two of the upper row show the lateral aspect and have the foetal placenta attached; the two of the second row show the ventral and the dorsal aspects.

The remaining embryo at the right hand of the upper row is the finest human embryo at this stage in my possession. It is at the same stage of development as the rat embryo of 12 days 16 hours immediately underneath it in the second row.

The two can be compared and conclusions can be drawn by each man for himself, according to his leanings and the knowledge he possesses for forming an accurate judgment.

All the embryos on this plate are enlarged about three times. In Plate VI., Figs. 1 and 2, are enlargements of the human embryo and the rat embryo of 12 days 16 hours spoken of above. I have in these diagrams roughly marked in the various divisions of the central nervous system—the hemisphere brain, the thalamic and mid-brain, the isthmus (the depression between the mid-brain and cerebellum), the cerebellum, the medulla with its thin roof,

and the spinal cord. In connection with these can be seen the neck, pons, and cephalic flexures, the first of these being much better marked in the human than in the rat embryo.

The nasal groove, the eye, the ear, as well as the various visceral arches, the maxillary, the mandibular, the hyoid, and the first branchial, the second branchial being covered in; the heart, the liver, the fore and hind limbs, the umbilical cord, and the primitive segments in the trunk region are all to be noted.

PLATE II. represents the sections under the cover-glass of one of my serial slides of a sheep embryo. They are enlarged about four times the size of nature, the direction in which the sections have been made through the head can be read from the long vertical section, Fig. 3 of Plate VI., by connecting the numeral 4 of 4th ventricle with the t. of the word striatum. The sections run in rows of six, the one most cephalad being at the right hand of the lower row, the last of the sections—that in the caudal direction—being at the left hand of the upper row.

The medulla is cut in the region of its greatest width, and the membranous roof is in two divisions. In the majority of the sections the tænia of the medulla has made its appearance. The cut thalamic and hemisphere brain lie cephalad of the head flexure.

I have marked in the names of the several noteworthy features of the sections in Fig. 7 of Plate VIII., which is an enlargement of one of them. Part of the epithelial lining of the dorsal half of the thin medullary roof of the 4th ventricle has disappeared, the first step perhaps in the formation of the foramen of Majendie. The inrolling of the hemisphere wall to form the striatum, the fusion of this with the subthalamic portion of the thalamic brain, the ending of the choroid plexus at the

bottom of the interpallial fissure, and its succession by the thickened part of the anterior wall of the thalamic brain, from which will arise the anterior pillars of the fornix and the callosum, the cavities of the third and lateral ventricles with the foramen of Munro, are all to be distinguished.

PLATE III. represents an enlargement about three and one-third the size of nature of the sections under the cover-glass of one of my slides, from a series of long vertical sections of the sheep. The sections are very oblique, so that the spinal cord is not shown, although all the divisions of the developing encephalon can be recognised. I have given an enlargement of the head portion of one of the sections—Fig. 8 of Plate VIII., with the names of the several divisions marked in. With this Fig. has to be associated Fig. 3 of Plate VI., which is an enlargement of a section from a long vertical series of a younger embryo, in which the cutting plane fell almost parallel with the median one of the embryo. The Fig. does not represent the exact median plane, but is a little to one side of it, cutting the wall of the embryonic spinal cord instead of the central canal, and showing the hemisphere outgrowths, which would not be shown had the section been exactly median. The infundibulum, the optic and mammillary recesses of the thalamic brain, the striate part of the hemisphere brain with the hypophysis from the primitive mouth cavity can all be noted. In Fig. 8 of Plate VIII. the anterior and posterior divisions of the central olfactory apparatus, the striatum, the third and lateral ventricles, the choroid plexus, the nasal, and the superior and inferior maxillary regions of the face, as well as the remaining structures, the names of which are given in full, are to be observed. In addition to the head end of the embryo in Plate III., the heart, the lungs, the curve formed

by the ribs, the liver, the intestinal tube, the Wölffian body, the genital eminence and tail are all shown.

PLATE IV. represents a series of nine human foetuses, with the brain and spinal cord of a tenth. They varied in length from $7\frac{1}{2}$ cm. to 20 cm., natural size (head and trunk measurement, the head extended on the trunk, not flexed, as in the ordinary intra-uterine position). They are all reduced to about one-third the size of nature.

Four of the smaller ones, from $7\frac{1}{2}$ to 11 cm. in length, have been cut along or near the median longitudinal plane, and the two halves lie adjacent to one another. All the four show the transitory fissures on the median surface of the hemisphere wall. The presence of these on this aspect is to be correlated with the fact that this part of the wall at this stage (before the appearance of the callosal fibres) is by far the thinnest portion.

The cranial aspect of the hemisphere wall in these four, and at much later stages in well-preserved specimens, is, in my experience, always smooth. It is so even after the callosal fibres have appeared, at which date the transitory fissures of the median aspect of the wall have disappeared, with one, or at the most, two exceptions. These transitory fissures are arranged radially along the median aspect, and run at intervals from its dorsal to its ventral border. They are eight in number in my specimens.

Of the remaining five foetuses on the plate the hemisphere of the smaller one (in the second row) has been dissected to show the lateral ventricles from the front. The olfactory lobes at this stage are still hollow, and communicate freely with the ventricular cavity.

In the remaining four the callosal fibres have appeared. The largest of the four—that at the left upper border of the plate—shows the median aspect of the hemisphere brain, where the callosum, the parieto-occipital fissure, and

the beginning of the calcarine can be seen, as well as the lateral aspect of the mid- and hind-brain.

The remaining three show the dissections made to expose the ventricular aspect of the median wall of the hemisphere brain. In the largest of the three—the second at the left upper border of the plate—the striatum has been turned down by cutting the peduncle uniting it with the thalamus.

In the foetus at the left lower border of the plate the striatum has been removed altogether, and is shown on the plate lying adjacent to the head.

Of the remaining foetus the head only has been dissected, and appears by itself at the left hand of the second row.

The brain and cord shown by itself also on this row was placed in to show the calcarine fissure arising independently of the parieto-occipital, thus differing from its mode of origin in the foetus at the left upper border of the plate. In order that the reader could follow more clearly the remarks made here, I have given in Plate VII. two diagrams—Figs. 5 and 6—of the two foetuses at the left lower border of Plate IV., natural size, with the main features of structure marked in. Fig. 5 is after the appearance of the callosal fibres, Fig. 6 before their appearance.

In Fig. 5 the cranial aspect of the hemisphere wall was smooth, the striatum is simply turned down to show the cut peduncle (in this respect differing from the photograph in which it lies separate from the head). The choroid plexus was removed to show the choroid fissure. The septum pellucidum was completely absent, and the adjacent ventricles were thus thrown into free communication otherwise than by the foramina of Munro. The fornix, the hippocampus major and minor, the hollow olfactory lobe, the optic nerve, the divisions of the cephalic half of the

striatum, and the thickness of the hemisphere wall are all to be observed.

In Fig. 6 the transitory fissures are present on the median aspect of the hemisphere wall. The fissure separating the olfactory lobe from the adjacent hemisphere runs radially and serially with the others, but it is not transitory in character. Sufficient attention has not as yet been paid to this feature. The median aspect of the remaining divisions of the encephalon are also given in this Figure. The thalamic brain with its optic, infundibular, and epiphysial outgrowths, its thin roof, from the epiphysis to the foramen of Munro, as well as its anterior wall from the foramen of Munro to the optic recess, can be noted. In the dorsal half of this anterior wall arise the anterior, the fornix, and the callosal commissures, the true history of which has yet to be written. The mid-brain, the isthmus, the hind- and after-brain are also to be seen.

For purposes of comparison with Fig. 6, I have given a median section through the head of a foetal dog (Fig. 4 of the same plate), and of a chick (Fig. 9 of Plate VIII.). The amount of hemisphere brain in all three can be noted with the respective olfactory outgrowths. The thalamic brain does not differ so markedly in the human and dog diagrams as in that of the chick, where the epiphysial outgrowth is very large and directed towards the front. The optic commissure is also very much larger in the chick than in either of the others. The mid-brain region of the dog is much more extensive than in the human, and it is not covered by the hemisphere brain. In the chick it is still more extensive than in the dog, but laterally its real extent is not shown in median section, this falling between its lateral outgrowths. The median section of the cerebellum is also much more extensive in the chick than in either of the mammalian diagrams.

The reader must understand in this comparison that the diagrams of the chick and dog are enlarged $3\frac{1}{3}$, whilst that of the human is natural size.

PLATE V. represents the lateral aspect of the central nervous system of two foetuses, about 31 cm. in length natural size (head and trunk measurement), and supposed to be about the eighth month. They are reduced in the plate to about one-third the size of nature. They require little, if any, explanation, as the anatomy is clear. The central sulcus and the two central convolutions are easily made out on the cranial surface of the respective hemispheres. The various opercula do not as yet in either of them cover in the central lobe. The cephalad ends of the temporal lobes are still in some measure smooth. The features mentioned are common to the hemispheres of both foetuses, but in the regions cephalad and caudad of the respective central convolutions a single description would not be applicable, this being more true for the caudad direction than the cephalad one.

In this plate and in Plate IV. a large amount of the visceral anatomy of the thoracic and abdominal cavities is shown. It is not my purpose in this short summary to enter into this at all, but attention may be drawn to one feature of interest in connection with the vertebral column. A glance at the various dissected foetuses on Plate IV. will show that the curves in the neck and lumbar regions of the column depend to a large extent on the position of the head and the inferior extremity; by flexing or extending the one or the other, the bends in the neck and lumbar regions can be produced or made to disappear at pleasure.

PLATES VI., VII., and VIII.—I have already described the various figures on these plates in the course of my remarks regarding the preceding five. In regard to the lettering which appears upon them, I have abbreviated

the words in many instances, but I have always used the first and succeeding letters of the respective word in the abbreviations. I append a list of these :—

Hem. brain has been used for Hemisphere brain.		
Str.	„	Striatum.
Ant. olf.	„	Anterior olfactory.
Post. olf.	„	Posterior olfactory.
Olf.	„	Olfactory.
Chor. plex.	„	Choroid plexus.
Lat. vent.	„	Lateral ventricle.
For.	„	Fornix.
Hip. major	„	Hippocampus major.
H. min.	„	Hippocampus minor.
Ped.	„	Peduncle connecting thalamus with striatum.
P. b.	„	Pituitary body.
F. ch.	„	Choroid fissure.
O. n.	„	Optic nerve.
F. M.	„	Foramen of Munro.
Th. br.	„	Thalamic brain.
Co.	„	Optic commissure.
Opt. rec.	„	Optic recess.
Inf.	„	Infundibulum.
3rd vent.	„	Third ventricle.
M. B.	„	Mid brain.
Cr.	„	Crus.
Cr. flex.	„	Cranial flexure.
Med.	„	Medulla.
4th vent.	„	Fourth ventricle.
Cer.	„	Cerebellum.
Max.	„	Maxillary arch.
Man.	„	Mandibular arch.
1st br.	„	First branchial arch.
Sup. max.	„	Superior maxilla.
Inf. max.	„	Inferior maxilla.
Umb. cord	„	Umbilical cord.
Ali. canal	„	Alimentary canal.