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ON THE BRAIN OF A YOUNG CHIMPANZEE. By John Marshall, F.R.S.; Surgeon to the University College Hospital, London.

THE Chimpanzee, whose brain is described in the ensuing pages, came into my possession within twenty-eight hours of its death; and the cranium having been opened without delay, and the brain placed immediately in strong spirits, the state of preservation of this organ is very perfect.

The animal was a young male, in excellent condition, and apparently free from disease. From the vertex to the heel, it measured 2 feet 4 inches; from the vertex to the ischial tuberosities, 1 foot 6 inches. The fore hand was 5½ inches, and hinder hand 5¾ inches in length: the fingers were nearly as long as the palm; the toes were not webbed at their base. The distance from the vertex to the chin was 6¾ inches; from the vertex to the auditory meatus, 2½ inches; the circumference of the cranium, just above the ears, was 14¼ inches; the length of the ears, which strikingly projected away from the sides of the head, was 2½ inches. The temporary teeth were all present, much discoloured, and much worn, but not even the incisors were loose. In the lower jaw, the first permanent molar was well through the gum on the left side, but that tooth was still partially covered on the right: the corresponding teeth of the upper jaw were still beneath the swollen gum; so that, whatever the fact may be worth, the same lateness of eruption of the upper teeth in comparison with the lower, as is observed in man, obtained in this animal. The hair was a brilliant black, and the colour of the iris a bright hazel. The total weight of the recent animal was 16 lbs. and 8 oz. avoirdupois.

Weights of the Encephalon and its parts. The entire brain, including a portion of the medulla and cord, extending $\frac{12}{10}$ inch below the pons, together with the pia mater and cerebral arachnoid, but

* See P. Z. S. 1860, p. 42, pl. lxxv.

excluding the pituitary body and pineal gland, weighed, immediately after its removal from the cranium, exactly 15 oz. Deducting the weight of the membranes afterwards removed (about ½ oz.) and allowing for the blood which these would contain, as well as for the short piece of the spinal cord attached to the medulla, I calculated that the nervous mass of the encephalon, in the quite recent state, weighed at least 14 oz. This is an absolute weight, greater than that of the brain of the young orang, described by Dr. Rolleston in the last number of this Journal (p. 207), which weighed only 12 oz. It also surpasses the absolute weights (9¾ oz. and 13¼ oz.) of the brains of a half grown male and of a female Chimpanzee, as given on the authority of Professor Owen.* The brain of this young animal is, so far as I am aware, the heaviest Simian brain yet on record. It is, however, light indeed, in comparison with the weight of the human brain in a child at about a corresponding period of dentition, which would average at least 38 oz.†

The ratio between the weight of the entire brain (14 oz.) and the body (264 oz.) in our Chimpanzee, both taken in the recent state, and without any sign of emaciation in the animal, is very nearly as 1 to 19, so that the brain was relatively heavier than in Dr. Rolleston's young orang, in which the ratio was as 1 to 22·3. Fitting such a brain to the body of the nearly adult female Chimpanzee, stated by Prof. Owen,‡ to weigh 976 oz., the proportion would be as 1 to 70. The actual proportions observed in the female Chimpanzee mentioned above, whose body weighed 680 oz., were 1 to 51. But much as this, unusually heavy, young Simian brain raises previous estimated ratios, it still remains far below the human proportion, taken at a corresponding age. In Huschke's case of the child of six years, the ratio was 1 to 11; and the proportion in the human adult, is usually given as 1 to 36, or as 1 to 40, in cases of persons killed or dying suddenly, whilst the body is in a healthy state.‡ This, however, refers to European brains. In regard to other races our information is defective.

At the end of several months, the entire brain of our Chimpanzee, hardened and shrunk from the action of the spirit on its watery, saline, and fatty ingredients, weighed only 9 oz. and a few grains. In dissecting its right half, care was taken to weigh the fragments of the cerebral hemisphere, and to ascertain the weight of the right half of the cerebellum, and that of the pons, with the medulla. The weight of the left half of the brain, which still remained undissected, was also recorded. With these elements, and assuming that every part of the brain had equally lost weight from the action of the spirit upon it, it was easy to estimate approximately the separate weights of the cerebrum, cerebellum, and pons, with the medulla, in

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* Quain's Anatomy by Sharpey and Ellis. Vol. ii. 433, note, 1856. Trans. Zool. Soc. Jan. 1846.

† See a table drawn up many years ago by myself, for Dr. Sharpey. Loc. cit. p. 431. ‡ Quain's Anatomy, ut antea, p. 433.

the recent state. The weights of these three portions of the hardened encephalon, respectively, were 7·5 oz. avoirdupois, 1·3 oz. and ·2 oz.; so that the recent cerebrum would have weighed 11·66 oz., the cerebellum 2·02 oz., and the pons and medulla ·31 oz.

According to these calculations, the cerebrum in the young Chimpanzee is to the cerebellum, as 5·75 to 1 nearly. In the adult man it was found by Dr. John Reid to be about 8·5 to 1; and in the new born child it appears from Huschke and others, to be at least 13 to 1. In a child five years of age the ratio would probably be somewhere between these. By the test of weight then, which I am not aware to have been applied before, to the separate parts of the Simian brain, the cerebrum of the Chimpanzee is found to be much smaller, in proportion to its cerebellum, than is the case in man.

To carry still further this mode of comparison, we may next contrast the relative weights of the cerebrum and body, and then of the cerebellum and body, in man and the Chimpanzee, by which double contrast, we see, at once, the relative superiority in size of the cerebrum, in man, and of the cerebellum, in the ape. Assuming the ratio of 1 to 40, between the brain and the body in an adult healthy man, and of 8·5 to 1, between his cerebrum and cerebellum, then the proportion between his cerebrum and his body will be 1 to 44·7 and between his cerebellum and his body 1 to 380; whilst in our Chimpanzee, the proportions as estimated above would be 1 to 22·6, and 1 to 131. It is desirable that many more observations on the weights of these separate parts of the encephalon in the several races of men, and in animals, as compared with their bodies, should be collected: they would yield neater results than those arising from *measurements*, for reasons which will presently be abundantly illustrated.

General form, dimensions, and relative position of the parts of the Encephalon. Notwithstanding the care with which the Chimpanzee's brain had been placed, with its upper surface resting on a bed of cotton wool, in the spirit in which it had been preserved, a marked distortion of its shape had taken place, by the time it was perfectly hardened. Such a deformation must occur, to a greater or less extent, in every brain removed from its cranial case, and placed in a similar position. Its effects are surprising to those who are not familiar with them, and cannot be correctly estimated, without comparing the so altered brain with a cast of the interior of the cranial cavity, from which this soft, pulpy, organ has been extracted. It influences the form of the encephalic mass in all three of its cubical dimensions. The general results are, a slight lateral bulging of the cerebral hemispheres, opposite the parts tied together by the corpus callosum; a more marked falling asunder of the hemispheres at each extremity, but especially behind; a moderate elongation of the hemispheres; and lastly, a very marked, compensating flattening, on both the upper and under surfaces, but especially, on the former, so that its characteristic convexity is completely lost. Moreover, the cerebellum, together with the pons and medulla, drag on the cerebral peduncles, so as to make these latter assume a position nearly parallel to the under surface of the brain, instead of descending obliquely from it; hence, the cerebellum falls backwards further than in its natural state, presses somewhat aside the posterior ends of the cerebral hemispheres, and so modifies the proper relative position of these parts of the encephalon. Besides this, the general subsidence of the cerebral hemispheres, the falling asunder of the points of the middle lobes, and the sinking in of the cerebellum between the hinder portions of the cerebrum, diminish the concavity of the orbital surfaces, injure the concave outline of the lower border of the posterior half of the hemisphere, and convert its natural overhanging curve into a nearly even, oblique border, passing backwards and upwards, above the cerebellum. All these changes, which must be still more marked in brains already partially decomposed, will be better appreciated by comparing the photographic illustrations of our Chimpanzee's brain given in Plate VI. figs. 2 and 4, with the outlines, figs. 1 and 3, (also taken from photographs) of a plaster cast, which I made of the interior of the cranium of the animal, before the dura mater was removed from the bone, and in which the divided tentorium was first carefully stitched up, on both sides.

A comparison of these figures is of great interest, for it will not only serve to elucidate a subject of controversy, just now of importance, but it will demonstrate conclusively, that no proper estimate of the *general form* of the encephalon, either of man or of brutes; no exact *measurements* of its parts; and no correct idea of their *mutual positions*, can be obtained, unless by hardening the brain before it is removed, or by correcting the notions derived from an examination of this otherwise flaccid organ, by constant reference to the internal form of the cranial cavity in which it was contained. M. Gratiolet has been well aware of this fact and has availed himself of it in his valuable researches; but he has left an abundant field for future observation. The internal forms of the crania of the different races of mankind, especially, need to be systematically investigated and measured in a similar manner.

The illustrations which accompany this Paper will enable the reader to follow me, in the critical examination which I here feel called on to make, of the various original representations of the Chimpanzee's brain given by Tyson,* Tiedemann,* Macartney,* Schroeder van der Kolk and Vrolik,* and Gratiolet.* Tested by a comparison with the brain and cranial cast in my possession, or (as the reader must do) with the faithful facsimiles of those objects taken by aid of photography, the figures given by these authors will all be found to exhibit, unmistakeably, the Chimpanzee characters; but they differ materially in value.

Tyson's figures are useless for modern science—in the main, owing to their want of artistic rendering; the basal view, as shown by the position of the curved supra-orbital borders, is taken too much

* In the works already cited by Professor Huxley and Dr. Rolleston in this Review. I am not aware of any other original figures of this brain.

from the front, so as completely to disturb the real relative positions of the cerebrum and cerebellum; and the cerebral arachnoid and pia mater have not been taken away. The internal dissection is almost unintelligible.

Tiedemann's two, more carefully drawn, figures represent an apparently, well preserved, specimen, then, and probably now, in the Hunterian Collection. From its small size, and from the imperfect development of the convolutions, this brain was, most likely, taken from a very young animal; the cerebral membranes have been removed; the vertex is somewhat flattened; the orbital surfaces have lost their characteristic concavity; the middle lobes have sunk asunder; and the cerebellum has, undoubtedly, been a little displaced backwards.

Macartney's two figures were drawn from plaster casts of the brain, taken before the cerebral arachnoid and pia mater were removed—at least this is evident enough in regard to the basal view. In size, these figures exactly correspond with the brain in my possession. Owing, probably, to the unavoidable pressure and disturbance in the casting, there is, in spite of the support afforded by the cerebral arachnoid, even more subsidence of the parts at the base, than appears in Tiedemann's corresponding figure. The orbital surfaces, though tolerably concave, are too wide across their base; the points of the middle lobes have fallen asunder; and the cerebellum has, clearly, slid backwards from the hollow of the cerebrum, into which it would naturally fit: moreover, the convolutions are somewhat conventionally drawn and, in certain parts, imperfectly and inaccurately represented.

In the various figures given by Schroeder van der Kolk and Vrolik, the brain is shown, entirely divested of its membranes; the convolutions are carefully and artistically rendered; but all the above-mentioned results of subsidence of the entire enecphalic mass, both laterally and from vertex to base, and the consequent distortion and displacement of its parts, are particularly noticeable; so that, on a question of form and relative position, these now famous representations must come to be regarded as wholly unsafe guides. Barring a certain primness of style, these figures are most carefully executed, and they bear a critical comparison with our photographed views, figs. 2, 4 and 5; but, the very closeness of resemblance between the basal and lateral views and our figs. 2 and 4, shows that all have equally been copied from nearly similarly sunken, or flattened, brains. The width and evenness of the orbital surfaces, the severance of the points of the middle lobes, the dragging back of the cerebellum, and the sinking in of this last-named part between the hemispheres; or, viewed in its effect from above, the sliding of the posterior extremities of the hemispheres, forwards and sideways, over the cerebellum, are all very obvious. One can note, especially, that owing, doubtless, to circumstances connected with the state of the brain, or its mode of preparation, suspension, or support, the unnatural lateral separation of the cerebral hemispheres behind, is greatly exaggerated; as must be admitted by any one who contrasts the figure 2, Plate I., of Sch. van der Kolk and Vrolik, not merely with the accompanying photograph, fig. 5, but even with Tiedemann's and Macartney's figures. Hence, the enormous surface of the cerebellum seen in the upper view of the encephalon, in the Dutch anatomists' representation. We shall examine hereafter the merits, or defects, of their representation of the interior of the lateral ventricle.

Lastly, M. Gratiolet's figures of the Chimpanzee's brain, which are at once the latest and most trustworthy, were taken from a specimen preserved in the Museum at Paris, the form being restored (*restituées*) by constant reference to that of the cranial cavity, from which it had been removed. The general shape of the entire brain, the relations of its several parts, the position of the cerebellum, the various convolutions and all their surface markings, are most conscientiously reproduced, and, so far as the external anatomy of the brain is concerned, leave little room for improvement. The multiplication of accurate data on such a subject is, however, most desirable, and in the face of the very different statements just now made, as to matters of fact, in the anatomy of the Simian brain, new materials for consideration cannot but be welcome to all parties. More particularly it has seemed to me that, on the one hand, our figures 2, 4, and 5, so clearly demonstrate the defects of Schroeder van der Kolk's and Vrolik's representations, and, on the other, all the figures establish, so satisfactorily, the accuracy of M. Gratiolet's restorations, that their publication will be useful to science. The view of the lateral ventricle is also as complete as could well be obtained. In no case has anything been altered or restored.*

In proceeding to describe the brain, from which these photographs have been taken, I must observe that I have studied it side by side with an average human brain, belonging to an adult, of whose cranial cavity I also took a plaster cast, to serve as a standard of correction in all questions of form, size and relative position. Wherever, in the course of the following description, any comparison is made between the human and Chimpanzee's encephalon, it must be understood to refer to this particular human brain.

The general form of the *cerebrum* of the Chimpanzee, when viewed from *above*, is not so much pyramidal, as Tiedemann indicates, but rather, as Gratiolet figures it, it is a short, wide, ovoid, having its larger end turned backwards, somewhat pointed behind, and considerably so in front. It contrasts markedly, with the long ovoidal shape of the human cerebrum, viewed on the same aspect. Placed side by side, the difference between them is seen to consist, chiefly, in the greater length and more equal width, in man, of the anterior portion,

* I am greatly indebted to my friend Mr. Herbert Watkins, for his pains and skill in securing photographs of the natural size of the parts, from which the accompanying figures are reductions. Complete sets of ten full-sized photographs will be supplied by him, or by the Publishers of this Journal.

which is almost square in front, instead of being pointed, as in the ape. By adding on, as it were, a broad piece in front, the Simian brain would assume, in this aspect, a nearly human shape. But the posterior part of the hemispheres must, also, be somewhat lengthened and widened; and the lateral, or parietal, regions be likewise expanded. In this view, no trace of the cerebellum is visible at the sides, or behind, in either brain.

In the *profile* view, figs. 3 and 4, one is struck, in the Chimpanzee's cerebrum, as compared with man's, first, with its semi-globular shape; or rather, with its almost hemispherical outline above,—the vertex being comparatively low, and situated only a little behind the middle point, between its anterior and posterior extremities; the curve descending only a little more abruptly behind, than in front. In the human cerebrum, the vertex is extraordinarily high and is placed further back; so that the fall of the outline behind, is necessarily more sudden, and the depth of the posterior region is very characteristic. In the ape again, the shortness and shallowness of the anterior portion makes the curve of that part of the cerebrum more abrupt, and more equal to the hinder curve, than it is in man, in whom the elongated and deep, frontal region produces a much more gradual curvature from the vertex forwards, than exists backwards. The remaining points of contrast, in this aspect, are the singular, recurved, beak-like termination of the frontal lobe—its very deeply hollowed interior, or orbital surface—the great downward projection of the point of the so-called middle lobe—and the more marked obliquity and concavity of the lower border of the cerebrum from that lobe, upwards and backwards, in the Chimpanzee; as compared with the flatter orbital surface—less prominent middle lobe—and more nearly horizontal and straighter, lower border of the cerebrum behind that part, in man. In M. Gratiolet's side view, the hinder part of the cerebrum is a little more depressed, than it is in our specimen, and therefore a little less like the human shape. On this lateral aspect, the *cerebellum* of the Chimpanzee appears to bear about the same proportion, measured vertically and from before backward, to the cerebrum, as it does in man: though, in reality, these proportions of the cerebrum, are a little less in the ape, than in man, in whom the cerebellum looks rounder in profile. In the ape, the cerebellum is overlapped by the cerebrum, to the extent of $\frac{5}{10}$ths of an inch, and, in the human brain, by $\frac{6}{10}$ths of an inch, in other words, by about $\frac{1}{9}$th of the total length of the cerebrum in the Chimpanzee, and by only about $\frac{1}{11}$th of that measurement in man. So that the relative amount of overlapping is *greater* in the Chimpanzee. Lastly, in the ape, the direction of the medulla oblongata is a little more oblique, than it is in man. In M. Gratiolet's lateral view, the cerebellum, indicated in outline, is represented as too deep, and the direction given to the medulla oblongata is too nearly horizontal, so that the position of the cerebellum is not quite true: still, it is covered by the cerebrum. In our own photographic view, fig. 4, and in

Schroeder van der Kolk's and Vrolik's corresponding view, in both of which the characters of the lateral aspect of the Chimpanzee's brain are entirely lost: the cerebellum and medulla are pressed horizontally backwards, so that the former is tilted up and projects too far behind, and converts the naturally concave lower border of the cerebrum, from the middle lobe backwards, into an even oblique line. The same criticism must apply, we think, to the lateral view of the Orang's brain, given by Dr. Rolleston, the obliquity which he notices in his paper (p. 206) being evidently the result of displacement from pressure.

The comparison of the Chimpanzee's brain, as seen in *front* and *behind*, with the human brain, does little more than confirm the observations already made. Anteriorly, in the ape, the want of depth and width of the frontal region, and the hollowing of the orbital surfaces; and, posteriorly, the want of height in proportion to the width, and the smoothing down of the parietal regions, as contrasted with the towering height and width of those parts in man, are chiefly noticeable; so that the Chimpanzee's brain has a more compact, rounded, form. We do not observe, in this animal, the wall-sided shape of the lateral regions, mentioned by Dr. Rolleston as characteristic of the Orang, the sides of the cerebrum being very evenly convex. In the posterior view, the cerebellum of the Chimpanzee appears very wide in proportion to the cerebrum; but it is shallow and less full and rounded, than in man; it is distinctly overlapped by the cerebral hemispheres, on each side, but rather less so, than in the human brain.

On the *base* of the Chimpanzee's brain, (see figs. 1 and 2,) the deficient length and width, and the pointed character of the frontal region, anteriorly, as compared with man's, are very evident: the orbital surfaces are extremely concave, and the median ridge, on each side of the longitudinal fissure, disproportionately prominent. The under surfaces of the cerebral hemispheres, from the point of the middle lobes to the hinder extremities of the cerebrum, are relatively shorter, and appear more incurved, or kidney-shaped, than in the human brain. The line of greatest width of the base of the brain, in the Chimpanzee, is half an inch nearer to the posterior, than to the anterior end of the hemispheres, lies just in front of the widest part of the cerebellum, and passes across just behind the pons Varolii; whereas in man, it is placed proportionately further back, namely, $1\frac{1}{2}$ inch nearer to the occipital, than to the frontal, extremity, lies considerably in front of the widest part of the cerebellum, and passes across a little behind the pons. The cerebellum itself appears flatter, and is much wider, in proportion to its length, from before backwards, and also, in proportion to the extreme width of the cerebrum, in the Chimpanzee, than in man, in whom it is more protuberant, and though absolutely wider, less so in proportion to its other dimensions, or to the width of the cerebrum. The greater relative size of the cerebellum in this ape, depends therefore, mainly, on its greater relative *width*,—as shown by measurements taken in its natural state and position, not when it is disturbed and displaced,—a statement somewhat differing from that usually made. In the Chimpanzee, proportionally less of the under surface of the cerebrum is seen on each side of the cerebellum, than in man; but posteriorly, though the area of cerebral surface seen, is less in this animal than in man, yet the antero-posterior measurement of the surface is, in proportion to that of the entire brain, greater in the Chimpanzee, being about $\frac{1}{9}$th of the total length of the cerebrum, and, we may add, $\frac{1}{7}$th the distance from the point of the middle lobe to the posterior end of the cerebrum, instead of $\frac{1}{11}$th and $\frac{1}{8}$th respectively, as in man. As to the medulla oblongata, it is less fore-shortened in this basal view of the Chimpanzee's brain, than in man's, because it inclines a little more backwards. In harmony with Sœmmerring's law, the width of the medulla at its base is, proportionately to that of the cerebrum, wider in the Chimpanzee's, than in the human, brain.

If, finally, we take as a sort of arbitrary *central point for the entire cerebral mass*, the centre of its common stalk, the medulla oblongata, where it intersects the pons; and imagine lines drawn thence to the extreme occipital, frontal, parietal and vertical points of the cerebrum, we find that, in the Chimpanzee, the actual lengths of those *cerebral radii*, as they might be called, are respectively, 23, 29, 26, and 29 tenths of an inch, whereas, in man, they are 33, 43, 39 and 46 tenths of an inch. These numbers show, not only, the absolutely, far greater size of the human cerebrum, but taking *its* size as the standard, they show that the deficiency of the Chimpanzee's cerebrum, is most marked in the vertical radius, next in the parietal, then in the frontal, and least of all, in the occipital. In other words, the superiority of development of the human cerebrum follows the same order, as to regions,—being greatest in the vertical and parietal combined, next in the frontal, and least of all, in the purely occipital regions. The numerical ratios of these and other measurements will be found in the following Tables. In Table I. the ratios are given in reference to the human measurements as units; a plan which I cannot but think is preferable to that of making every separate animal's brain a separate unit of comparison with man's.

Table I.

Measurements of the parts of the Encephalon in Man and the Chimpanzee, given in $\frac{1}{10}$ths of an English inch, with the ratios between them, taking the human measurements as units.

Cerebrum.

a. Extreme breadth . . .	in Man	50,	in Chimpanzee	37	= 1 to ·74
b. " length	"	65	"	44	= 1 to ·68
c. " height	"	45	"	29	= 1 to ·65
d. Length of orbital surface . .	"	23	"	15	= 1 to ·65
e. Extreme depth of frontal lobe .	"	35	"	20	1 to ·57

f.	From point of middle lobe to hinder end of the brain . . .	in Man	48,	in Chimpanzee	34	= 1 to ·7
g.	Cerebral radii, occipital . .	〃	33	〃	23	= 1 to ·7
h.	〃 frontal . . .	〃	43	〃	29	= 1 to ·67
i.	〃 parietal . .	〃	39	〃	26	= 1 to ·66
j.	〃 vertical . . .	〃	46	〃	29	= 1 to ·63
k.	Projection of cerebrum beyond cerebellum	〃	6	〃	5	= 1 to ·83

Cerebellum.

l.	Extreme breadth	in Man	36,	in Chimpanzee	30	= 1 to ·73
m.	〃 length	〃	24	〃	16	= 1 to ·66
n.	〃 depth	〃	14	〃	8	= 1 to ·57

TABLE II.

Ratios between the dimensions of different parts of the Encephalon, in Man and in the Chimpanzee.

Cerebrum.

a to *b*	in Man	1 to 1·3,	in Chimpanzee 1 to 1·2
a to *c*	〃	1 to ·9	〃 1 to ·74
c to *b*	〃	1 to 1·44	〃 1 to 1·5
d to *f*	〃	1 to 2·03	〃 1 to 2·26

Cerebellum.

m to *l*	in Man	1 to 1·5,	in Chimpanzee 1 to 1·83
m to *n*	〃	1 to ·57	〃 1 to ·5
n to *l*	〃	1 to 2·57	〃 1 to 3·75

Cerebrum and Cerebellum.

m to *b*	in Man	1 to 2·75,	in Chimpanzee 1 to 2·7
n to *c*	〃	1 to 3·2	〃 1 to 3·6
l to *a*	〃	1 to 1·39	〃 1 to 1·23

Medulla and Cerebrum.

Breadth of Medulla oblongata to that of cerebrum . . .	in Man 1 to 7,	in Chimpanzee 1 to 5·7

N.B.—All the above measurements, except those of the medulla, were taken by aid of the intra-cranial casts. They necessarily differ from those taken from the brain itself by various anatomists. Such measurements as relate to internal parts will be given hereafter.

The *Fissures, Lobes and Convolutions.* The *Sylvian fissure*, more vertical than in man, even in the preserved Chimpanzee's brain, fig. 4, S, appears still more so in the cast, fig. 3; but in the cast of the human brain it is, also, somewhat more upright than in the preserved specimens, though not so much as in the Ape. The *fissure of Rolando*, figs. 4, 5, R, is very distinct in the Chimpanzee's brain, passing obliquely forwards from the longitudinal fissure, in a zigzag line, and separating the first ascending convolution, fig. 5,$^{4,4'}$, from the second ascending convolution $^{5,5'}$. The V-shaped figure which the two fissures of Rolando make, where they unite with the longitudinal fissure, is a very striking feature in the upper aspect of both the Quadrumanous and the human brain; but, in the Chimpanzee, the point of the V is situated a little in *front* of the transverse axis of the hemispheres, whilst in man it is, to a still greater extent, *behind* that axis. Suppose the whole length of the hemispheres to be represented by 100, then from the fore-part of the brain to the point of the V, would measure, in the Chimpanzee, 49, and, in man, 57. It is obvious, on further examination, that whereas nearly one-half of the upper surface of the cerebrum lies in front of the fissures of Rolando in man, a very little more than one-third is so placed in the Chimpanzee. In the Orang's brain, figured by Dr. Rolleston, the proportion appears to be mid-way between the two. There can be no reasonable doubt, that the part of the hemispheres situated in front of these remarkable fissures in man, the Orang and the Chimpanzee, and we may add, in still lower Quadrumana, are homologous parts, in the truest sense of that term. The anterior cornua of the lateral ventricles project into them, passing beyond the first ascending convolution on each side. The *external perpendicular*, or vertical, *fissure*, figs. 4, 5, V, is particularly well developed in the Chimpanzee's brain; it is not bridged over, on the upper surface of the hemispheres, by any superficial convolutions, so that its posterior border, named by M. Gratiolet the *operculum*, is smooth and uninterrupted. It is continued, on the internal surface of the hemisphere, as a distinct *internal perpendicular fissure.* In the particular human brain which we have dissected for the purposes of this paper, the external perpendicular fissure is obliterated, but it can be unmistakeably traced on the internal surface of the hemispheres, within the longitudinal fissure, as the internal perpendicular, or vertical, fissure. In the ape, this fissure cuts off 23 parts, posteriorly, out of 100 of the length of the hemispheres as visible above; in man, the corresponding portion represents 20 parts out of 100; in the Orang figured by Dr. Rolleston, the proportion seems to be intermediate. There can be as little doubt here, as in regard to the parts in front of the fissure of Rolando, that the portions of the hemispheres behind the perpendicular fissure, in man, the Orang, and the Chimpanzee, as well as in the lower apes, are strictly homologous parts of the cerebrum. We shall see that the posterior cornua of the lateral ventricles extend into them. Between the fissure of Rolando on each hemisphere, and the perpendicular fissure, is an equally homologous region which, in the Chimpanzee, occupies the remaining 28 parts out of 100, of the total length of the cerebrum; whilst, in man, it constitutes 23 parts, *i. e.* as seen directly from above; but this particular region, and also the part behind the perpendicular fissure, it must be remembered, are just those which gain so much in their vertical dimensions, in the human brain. If, in fact, we measure longitudinally over the vertex, the relative spaces occupied by these three regions, which may be distinguished as frontal, parietal and occipital, though they do not exactly coincide with the margins of those bones, we find that the proportionate dimensions in the Chimpanzee would be 46, 28, 26, instead of 54, 23, 23, out of 100, as in man.

Turning next to the outer side of the cerebral hemisphere, fig. 4, the so-called *parallel fissure*, situated parallel with and behind, the Sylvian fissure, is rather more complicated in our specimen than in M. Gratiolet's figure. On the inner surface of the hemisphere, besides the internal perpendicular fissure, there is seen a longitudinal *fissure*, surmounting the convolution of the corpus callosum. And lastly, on the under surface, rather than on the internal surface, of the hinder part of the hemisphere, is seen, very well marked, the *fissure of the hippocampus*, commencing, as described by Gratiolet, along the outer or lower border of the fimbriated convolution, and passing backwards in a curved direction, towards the hinder extremity of the hemisphere. The corresponding fissures plainly exist in the human brain dissected by us, *pari passu* with that of the Chimpanzee.

Now, whatever grounds of definition as to the leading sub-divisions of the cerebral hemispheres may be adopted, it is at once apparent that all those sub-divisions of the human cerebrum, called *lobes*, are present in the Chimpanzee. In the phraseology of the older anatomists, the *anterior* and *middle lobes* are well distinguished by the fissure of Sylvius, which, however, is comparatively not quite so deep as in man. At the bottom of this fissure, is plainly seen the *insula*, or island of Reil. Looking at the Chimpanzee's brain, it is quite indifferent whether we choose the usual arbitrary definition of the limits between the middle and *posterior* lobe, viz., a line drawn in front of the cerebellum, or whether we select the one more recently laid down, according to which the posterior lobe signifies that part "which covers the posterior third of the cerebellum and extends beyond it";* for, in either sense, the posterior lobe exists in our Chimpanzee's brain, inasmuch as the cerebrum projects half an inch beyond the cerebellum in its natural and undisturbed position, whilst the human cerebrum, under the same conditions, projects only a tenth of an inch more.

If, however, we reject these arbitrary modes of distinguishing the various lobes, and follow a more philosophical method, for example, the one suggested by Gratiolet, a corresponding conclusion is forced upon us, viz., that all the great masses in the human brain have their anatomical representatives, or homologues, in the Chimpanzee. The *frontal* lobe (figs. 4 and 5) F, together with the *parietal* lobe P, marked off by the first ascending convolution $^{4,4'}$, which is included in the latter, lie above the Sylvian fissure, and in front of the vertical or perpendicular fissure; the *temporo-sphenoidal* lobe, T, lies below the Sylvian fissure; the *central lobe* is the island of Reil; and the *occipital lobe*, O, is the part behind the external vertical fissure. Though this latter fissure is broken across by convolutions, its place can

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* Professor Owen. Annals and Mag. of Nat. Hist. June, 1861, p. 457.

usually be recognized in the human brain, by tracing outwards from the longitudinal fissure, the internal vertical fissure, which is always present, though thrust backwards at its upper end by the enlargement of the parietal lobe, so as to be somewhat oblique instead of vertical. On the internal surface of the hemispheres of the Chimpanzee, the *fronto-parietal* and *quadrate* lobes are seen to occupy the space in front of this fissure, a small *internal occipital lobule* lies behind it, and the *temporo-occipital lobe* is at once distinguishable, below the anterior portion of the fissure of the hippocampus. As thus defined, it is impossible to escape from the conviction that all the above-named parts exist in the Chimpanzee, as well as in man; and that, amongst others, the little occipital lobules at the posterior extremity of each hemisphere, in the former, are the homologues of those in the latter. We shall see that this conclusion is fully supported by the closest scrutiny of the convolutions, and of the internal structure of the cerebrum.

As to the *convolutions* in the Chimpanzee's brain, one can hardly pay a better tribute to M. Gratiolet's general accuracy, than to adopt his description of them, whilst referring to our own specimen. After pointing out the general characters of the frontal, parietal and occipital lobes, a remarkable notch which interrupts the border of the orbital surface, (seen in our fig. 4), the large size of the occipital or posterior lobe, and the even or perfect edge of its operculum, figs. 4, 5, in front of 10,10′, he proceeds thus, p. 50:—

"The convolutions of the frontal lobe are very large, even larger and wider than those of the Orang. The *superior frontal* convolution* (figs. 3, 3′, 4 and 5,) is subdivided into two parts, of which the highest is marked by secondary sulci.

"The *middle frontal* convolution, 2, is well marked. The *inferior frontal* or supraciliary convolution, 1,1, is very large, and broadly designed, so that the frontal lobe is well developed in all its parts.

"The *first ascending* convolution, 4,4, is slender, flexuous, and only slightly inclined backwards: it presents no marginal notches, and its surface is absolutely smooth.

"The *second ascending* convolution, 5,5, is equally simple and smooth; it passes up by the side of the preceding one, forming parallel flexuosities with it; but having reached above the bent convolution, 6, (pli courbe), it forms an elbow, and spreads out into a large lobule, 5′5″, which is prolonged back to the external perpendicular fissure. This lobule, [named by M. Gratiolet *the lobule of the second ascending convolution*] is very elegantly subdivided by a rather complicated sulcus, which serves to separate two distinct convolutions, one external, 5′, the other internal, 5″. The external convolution pursues a very simple course; but the internal one is folded several times upon itself, an arrangement which is tolerably constant.

"The commencement of the *bent convolution* (pli courbe), 6,6′, is remarkable. In the Orang and in the Gibbon, it begins at the top of the Sylvian fissure. *In the Chimpanzee, it arises in front of the summit of that fissure by a large extremity,* fig. 4, *and describes a very extensive curve around it.*

"As to the descending part, 6′, of the bent convolution, it is very slender, scarcely flexuous, and rather long, * * * *

"The convolutions of the temporal lobe, are very simple, * * * *. [They are

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* We substitute here the references to our figures, for those given by M. Gratiolet to his. The italics are in the original. My own additions are between brackets[].

named the *superior temporal* or *marginal*, 7,7, the *middle temporal*, 8,8, and the *inferior temporal*, 9. The *convolution of the hippocampus major* is marked * in fig. 2. The Island of Reil has five shallow convolutions.]

"We have already stated that the occipital lobe, O, is very large. It presents several parallel sulci, amongst which the one which separates the *middle occipital* convolution, 11, from the *superior occipital convolution*, 10,10′, predominates. The *operculum*, [viz. the border in front of 10,10′], is entire and well developed.

"But the chief ground of distinction between the brains of the Chimpanzee and Orang is the absence [in the Chimpanzee] of the *superior* connecting convolution (le premier pli de passage).

"Thus, *the first or superior connecting convolution is absolutely wanting*. [This, if present, would pass across the operculum opposite to 10, fig. 5].

"*The second connecting convolution is hidden under the operculum*. [This lies opposite to 10′].

"*The third*, fig. 4, C, *and fourth*, D, *connecting convolutions are superficial*."

From the foregoing quotations, it will be seen that the arrangement of the convolutions in our specimen, coincides remarkably with the description of M. Gratiolet. It must be noted, however, that all those on the vertex, are considerably *broader* and flatter than in the *restored* figure given by that author; but they resemble in this respect, very strikingly, those represented in Schroeder van der Kolk's and Vrolik's plate. This flatness, evidently the result of pressure, affords a special confirmation of the view that the brain figured by the Dutch anatomists, like our own specimen, had been deformed during its preservation.

Of the convolutional characters which, in M. Gratiolet's opinion, distinguish the Chimpanzee, viz., the great size of the occipital lobe, the neatness of definition of its operculum, the mode of origin of the bent convolution, the absence of the first connecting convolution, and the hidden position of the second, all are strictly fulfilled upon the left cerebral hemisphere of our specimen; but, on the right or dissected side, of which a photograph is preserved, there was a rudimentary superior connecting convolution, of very small size, passing from the outer margin of the lobule of the second ascending convolution, outwards, and then, bending inwards and backwards, across the perpendicular fissure, to join the occipital lobe. The presence of this superior connecting convolution in the Chimpanzee, and on one side only, is another example of that variety and want of symmetry, as regards these connecting convolutions, noticed by Dr. Rolleston in his interesting paper (p. 212). Nevertheless, vary as they may, the several connecting convolutions are evidently, as M. Gratiolet first pointed out, the traces, or homologues, of much more highly developed, but corresponding, parts of the brain in man. On the whole, too, the evidence is still in favour of this particular connecting convolution being less developed in the Chimpanzee, than in the Orang. As to the second connecting convolution, it existed on both sides of the Chimpanzee's brain, concealed under the operculum, but of good size. In reference to what M. Gratiolet describes as a very remarkable feature in the Chimpanzee's brain, viz., the broad origin of the bent convolution (pli courbe) in front of the top of the Sylvian fissure, instead of at its summit, as in man and the Orang, I feel disposed, from a comparison of the parts in the Chimpanzee with the human brain, to consider this, so-called, unusually broad and forward origin of the bent convolution, 6, as in reality the homologue of the so-named "lobule of the superior marginal convolution," which is regarded by Gratiolet as peculiar to man: on such a supposition the bent convolution would arise in man's, the Orang's, and the Chimpanzee's brains, all at the same point; and if Dr. Rolleston's supposition be correct (l. c. p. 212), all these would possess a "marginal lobule," which, however, like the connecting convolutions, would be far more highly developed in man. On the interesting question of the relative superiority of the Chimpanzee's and Orang's brain, our specimen, on the whole, is in favour of the claims of the latter. The Chimpanzee's convolutions are more symmetrical. But the subject of the cerebral convolutions is too prolific a one to be discussed at length here.

It is utterly impossible to follow M. Gratiolet's analysis without coinciding with him, entirely, as to the correspondences of his essential subdivisions of the cerebral masses. One general fact he illustrates very fully, viz., that uniformity and symmetry of arrangement are marks, so far as they go, of inferiority of cerebral development. Now, this is not merely true in regard to different species of animals, or different individuals of the same species, but in any one brain, even in the human brain, there are certain convolutions which are more uniform and more symmetrical than the rest, and these very same convolutions vary less in different, though allied, groups of animals. The convolutions which are thus characterized in the Quadrumana and in Man, are those which belong to Foville's first order, those which form as it were the extreme rim or circumference of each cerebral hemisphere, viz., the convolution of the corpus callosum, on the inner side, and the convolution which surrounds the Sylvian fissure, on the outer side. The various fissures, or sulci, which separate these primary convolutions from those which occur next to them, also partake of the same comparative simplicity; whilst the further one recedes from them, on to the external surface of the hemisphere between them, the greater complexity and variety one meets with, both in the convolutions and in their intervening sulci. In accordance with this rule, the under surface and the internal surface, of the hemispheres are more simple than their external, or convex, surface; and hence, whilst the detection of corresponding parts becomes more and more difficult in certain portions of the latter region, as we ascend in the scale of organisation; in the two former the necessary landmarks continue very clearly recognisable. This is certainly the case in regard to the internal and under surfaces of the posterior part of the hemispheres; and if any one will examine the series of basal views of Quadrumanous brains in Gratiolet's work, in which the cerebellum has been removed, so as to show the under surface of the back part of the hemispheres, he will be able to trace in one of the more or less simple, yet elegant, curved lines, proceeding backwards from the outer side of the corresponding cerebral peduncle, an evidently homologous fissure, present in many, otherwise most varying, brains. This fissure is the *fissure of the hippocampus.* Its extension backwards to the tip of the occipital lobe is seen in all; and it serves at once to identify parts which, on the upper surface of the hemisphere, cannot so easily be compared. It is at the bottom of the middle half of this fissure, that the cerebral substance is tucked in, in the form of two deep hidden sulci, to constitute the hippocampus minor and eminentia collateralis, in the posterior cornu of the lateral ventricle, where that prolongation of the great internal cavity of the brain exists. But supposing that prolongation did not exist in any particular brain, still the presence of even a *rudimentary* fissure occupying the above-described characteristic position, would suffice to justify the conclusion that the surrounding parts of the cerebrum were homologous parts. Now, a careful comparison of these parts in the human brain, in the brain of our Chimpanzee, and in the brain of a common Green Monkey, has satisfied me that the fissure of the hippocampus and its two deep hidden sulci, are present in all three.

Internal structure of the Brain. The cerebral convolutions of the Chimpanzee's brain are very large on the outer surface of the hemispheres, where indeed, as is seen in fig. 5, the sulci are, proportionately, quite as deep as in the human brain. On the frontal lobe, they are also bold; but in the occipital lobe the convolutions are smaller, and the sulci for the most part shallower, though both are still very numerous, so that the smoothness of this part of the brain is not owing to an *absence* of convolutions, but to their diminutive size and depth. The superior occipital convolution is, however, almost devoid of any surface-markings. This part of the brain is smoother than in the Orang. It certainly would seem as if it were behind the rest in development, at least in the young Chimpanzee. We may remark, as suggestive of a similar idea, that these posterior convolutions were found to be more tender than those of the parietal or frontal regions; and, as is recognisable in fig. 5, that the grey cortical layer is thinner in them than elsewhere. In the human brain, also, the occipital convolutions are not so bold as those on the sides and fore part of the hemispheres; but the difference is not nearly so marked as in the ape. The average thickness of the grey matter is about $\frac{3}{30}$ths of an inch, in the Chimpanzee, as compared with $\frac{4}{30}$ths, in man. In proportion to the size of the brain, it is curious that the quantity of white matter in the centre of the hemispheres seems smaller than in man.

Of the various *commissures* of the cerebrum in the Chimpanzee, we will speak first of the *corpus callosum.* This is both shorter and thinner in proportion than in man, as the following measurements, in 30ths of an inch, taken in each case from the *hardened* brain, will show. In the ape, the length, the greatest thickness, the least thickness, and the average thickness of the corpus callosum divided along the middle line, are respectively 51, 6, 2 and 4·5 thirtieths of an inch; in man the corresponding quantities are 93, 16, 6 and 13. The sectional area of the longitudinally divided corpus callosum in the Chimpanzee, is therefore $\frac{230}{900}$ths of a square inch; whilst in man it is $\frac{1209}{900}$ths of a square inch. Comparing these numbers with the area of the internal surface of one of the cerebral hemispheres, in the Chimpanzee's and in the human brain, we find them to be as 1 to 28·5 in the ape, and 1 to 12·5 in man; so that the corpus callosum is more than twice as large, proportionally to the size of the brain, in man, as it is in the Chimpanzee. We may add, that the corpus callosum in our specimen is exactly of the same length as in Schroeder van der Kolk's figure, whilst the brain itself is a little longer. As in man, the corpus callosum of the ape, is thickest behind. The section of the *anterior* commissure is not so round as in the human brain, but it is proportionally as large. The *posterior* commissure also exists, but it is small. The so-called *soft* commissure is large. On the whole then, the system of *transverse* commissural fibres is defective in the Chimpanzee, as compared with man; and as the section of the medulla oblongata, in the former, is even larger in proportion to the cerebrum, than in the latter, it would seem as if the relative deficiency of white substance within the hemispheres, already noticed, is, to a great degree, owing to the fewness of these, as well as other, commissural fibres. Of the *longitudinal* system of commissures, the fornix is thin; the tænia semicircularis is only just recognisable; and the striæ longitudinales are slender.

Of the middle and fifth *ventricles*, nothing is to be remarked. The fourth is very wide, corresponding in this respect with the cerebellum. The *lateral ventricle*, examined on the right hemisphere, proved to be a very large cavity. It consisted, as in man, of a body (fig. 5), ** and three cornua; an anterior cornu *, a descending cornu (of which only the commencement is seen); and a very obvious, posterior cornu. * * * The body measured 12/10ths of an inch long, the anterior cornu 6/10ths, the posterior cornu nearly 5/10ths, and the descending cornu 20/10ths; whereas in the human brain, these parts measured respectively, 21/10ths, 14/10ths, 12/10ths and 26/10ths of an inch. Comparing these dimensions with the lengths of the two brains, (44/10ths, and 65/10ths of an inch) we get as ratios for the Chimpanzee, ·207, ·103, ·18 and ·45 to 1, and for man, ·32, ·21, ·184 and ·4 to 1. From this we perceive that the lateral ventricle was proportionally longer in the human brain, except as regards the descending cornu; and that the posterior cornu was only fractionally longer. It is worthy of note, as may be seen by comparing the dissected with the undissected side of fig. 5, that, in the ape, the body of the lateral ventricle corresponds almost exactly with the parietal lobe of the hemisphere, P, whilst the anterior cornu projects into the frontal lobe, F, and the posterior runs, beyond the vertical fissure, into the occipital lobe, O: the descending cornu of course occupies the temporo-sphenoidal lobe, Fig. 4, T. In the human brain, the same relations are observed, together with a coincidence in the measurements of the parts. In our Chimpanzee's brain, the posterior cornu begins at a line, midway between the hinder end of the corpus callosum and the internal perpendicular fissure. The widths of the cornua of the lateral ventricle vary according as their sides are held asunder, but they are large cavities. About the same proportionate quantities of corpus striatum and optic thalamus are seen in the anterior cornu and body of the ventricle, as in man. In fig. 5, the thin curved margin of *the fornix*, with the rounder commencement of the *hippocampus major*, are seen entering the descending cornu. On the inner side of the floor of the posterior cornu is a convex eminence, *the hippocampus minor*. Between the bend of the hippocampus major and the hippocampus minor is a triangular eminence, also prolonged into the posterior cornu; this is a small *pes accessorius* or *eminentia collateralis*. All the parts to be found in the human posterior cornu are thus represented in the Chimpanzee, in proof of which we may refer to the irrefragable evidence of the photograph, fig. 5. A comparison of the natural parts with Schroeder van der Kolk's and Vrolik's figure, 4, Plate II.,—which is so differently interpreted just now, being equally quoted* to show the *presence* and the *absence*, in the Quadrumanous brain, of the same parts, viz. the *posterior lobes*, the *posterior cornu*, and the *hippocampus minor*, has compelled me to the conclusion that, although those anatomists have had to dissect a displaced and deformed posterior lobe, and have removed its substance rather freely, still the eminence figured, and marked *e*, by them, is really a *hippocampus minor*. To make this clear we may refer to the annexed sketch, fig. A., drawn by myself from nature, in which the parts are shown of their true size.

FIG. A.

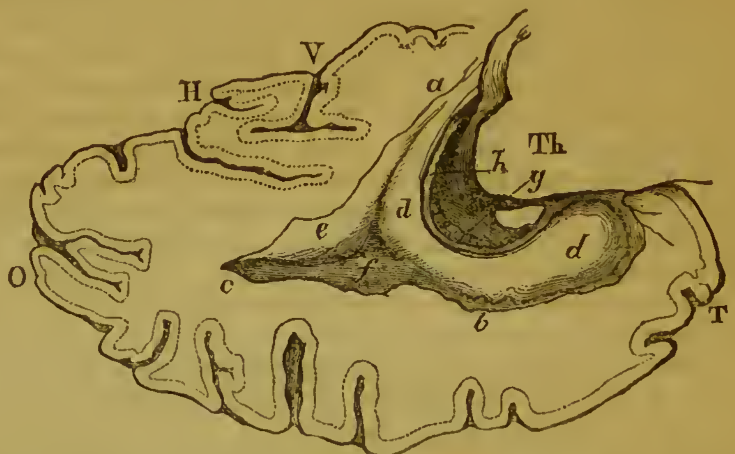

Fig. A. O, occipital lobe. T, temporo-sphenoidal lobe. Th, back of thalamus opticus. V, internal perpendicular fissure. H, part of fissure of hippocampus. *a*, hinder part of body of lateral ventricle. *b*, descending cornu. *c*, posterior cornu. *dd*, hippocampus major. *e*, hippocampus minor. At *f*, the small eminentia collateralis; both of the latter extend into the posterior cornu. *g*, fascia dentata. *h*, continuation of fornix or corpus fimbriatum.

* By Professor Huxley, in this Journal, p. 76; and by Professor Owen, in the recent No. (June 1861) of the Annals and Mag. of Nat. History, p. 456.

The hippocampus minor, as in man, corresponds, on the surface of the Chimpanzee's brain, with the upper of the two deep hidden sulci at the bottom of the fissure of the hippocampus; and the eminentia collateralis with the lower of those sulci. Hence, as already deduced from other considerations, even the presence of this fissure, without its sulci and the corresponding projections into a posterior cornu, would suffice to identify corresponding parts of the cerebral hemisphere. The remaining points, which seem worthy of notice, are the following. The hippocampus major corresponded to a thick rolled convolution and sulcus; its lower end, fig. A, *d'* was much expanded, and, what I shall call, to avoid confusion, its *convex* border was twice, though feebly, indented. The fascia dentata was quite distinct. Of the corpora quadrigemina, the upper pair were the larger, but the less prominent. The pineal body was large, soft, and contained no gritty particles. The habenulæ were distinct. The pituitary body was large, and wider than deep. The corpora albicantia were beautifully seen, quite distinct from each other, and connected, as in man, with the anterior pillars of the fornix. On the medulla oblongata, the corpora olivaria were neatly defined and of good size; and the decussation of the pyramids was very prettily seen. In some of these points Macartney's description is not quite correct.

Lastly, all the parts of the cerebellum, so far as I have yet examined them, are the same as in the human encephalon; only the lateral hemispheres are wider and flatter. I have still preserved this and also the left half of the brain, on which I propose some day to follow the arrangement of the fibres.

I may be permitted to add, in conclusion, that my sole object in this paper has been to record the results of an anatomical investigation. I have no theory, zoological, or physiological, to support; I have no leaning towards any of the developmental hypotheses of the origin of species. But, on the question of facts, and the interpretation of those facts, my results, as to the existence of a posterior lobe, of a posterior cornu, and of a hippocampus minor, in the Chimpanzee, will be found to harmonize with the investigations and conclusions of Prof. Huxley and of Prof. Allen Thomson, already published in this Review.

Description of the Figures in Plate VI.

N.B.—Nearly all the figures are, as nearly as may be, two-thirds the linear dimensions of the objects.

Fig. 1. Under view of a plaster cast of the interior of the Chimpanzee's skull, taken before the membranes were removed from the base; (from a photograph.) F F, frontal lobes of the cerebrum; T T, temporo-sphenoidal lobes; O O, occipital lobes; V, pons Varolii; M, medulla oblongate; C C, cerebellum.

Fig. 2. Under view, or base of the Chimpanzee's brain, hardened in spirit, with the pia mater and arachnoid taken away. Intended to show the displacement of the parts, especially of the cerebellum, from their natural positions; (from a photo-

graph.) The capital letters as in fig. 1; 8, the external inferior temporal convolution; 9, the middle inferior temporal convolution; * the convolution of the hippocampus major.

Fig. 3. Left side view of the plaster cast shown in fig. 1. Intended to show the natural rounded form of the brain, and the position of its parts; (from a photograph.) The capital letters the same as in figs. 1 and 2, except P, which indicates the parietal lobe of the cerebrum.

Fig. 4. Photographic view of the left side of the Chimpanzee's brain. F, P, O, T, frontal, parietal, occipital and temporal, lobes of the cerebrum; R, fissure of Rolando; V, external perpendicular, or vertical fissure; S, Sylvian fissure; C, cerebellum; as in fig. 5: 1, inferior frontal convolution; 2, middle frontal convolution; 3, 3′, superior frontal convolution; 4, 4, first ascending parietal convolution; 5, 5, second ascending parietal convolution; 5′, 5″, lobule of the second ascending convolution; 6, 6′, bent convolution (pli courbe); 6′, its descending part; 7, 7, superior external temporal or marginal convolution; 8, 8, middle external temporal convolution; 9, inferior temporal convolution; 10, superior occipital convolution; the operculum is the anterior border of this convolution immediately behind the vertical fissure V; 11, middle occipital convolution; 12, inferior occipital convolution; C, third external connecting convolution (pli de passage): D, fourth external connecting convolution.

Fig. 5. Photographic view of the upper surface of the Chimpanzee's brain; the right half being dissected to show the lateral ventricle and its cornua. Most of the letters generally as in fig. 4. L, the longitudinal fissure. On the left side, 5′, 5″, are the external and internal convolutions of the lobule of the second ascending convolution; 10, 10′, the superior occipital convolution,—the operculum being the edge in front of 10, 10′. The first connecting convolution (pli de passage) is absent; its seat, when present, is a little to the left of 10. The second connecting convolution is hidden under the operculum, in front of 10′; * is opposite to the anterior cornu of the lateral ventricle, * * level with the body, and * * * with the posterior cornu. In the latter, are seen, to the inner side or left-hand, the hippocampus minor; in front of this is the bent end of the hippocampus major entering, with the fornix, into the descending cornu; between them is a small triangular portion of the small eminentia collateralis. Compare with the woodcut A, in which the whole extent of the hippocampus major is shown.

Fig. 1.

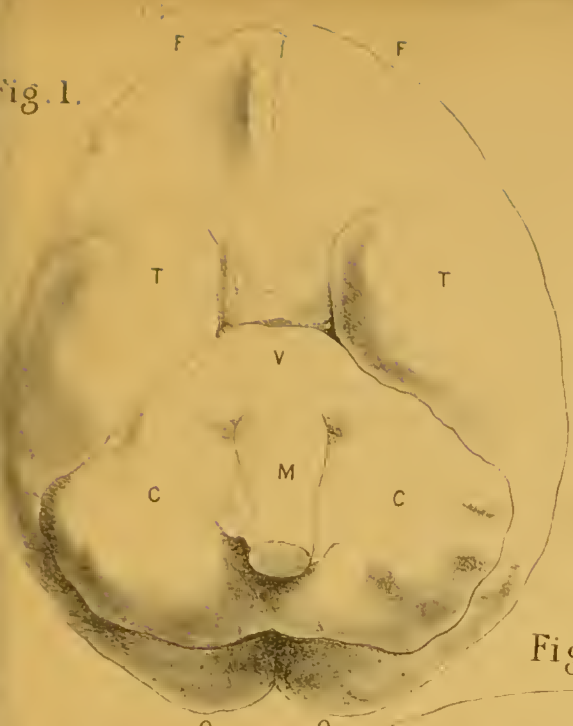

Fig. 2.

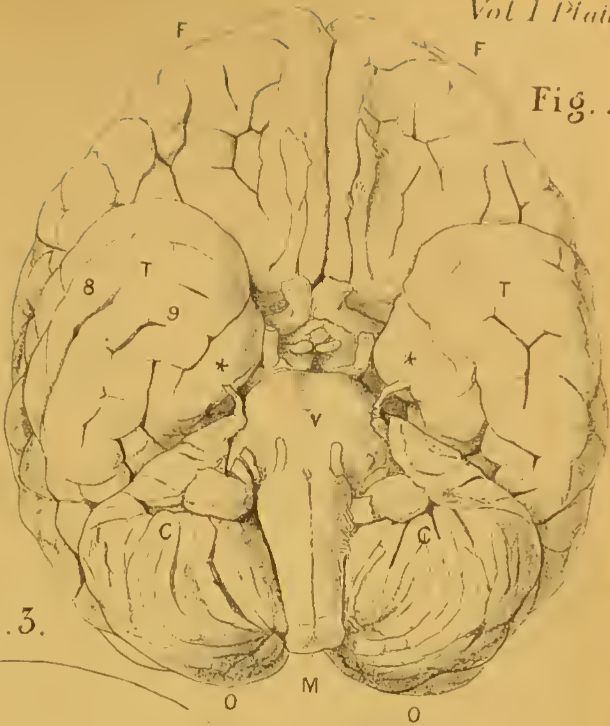

Fig. 3.

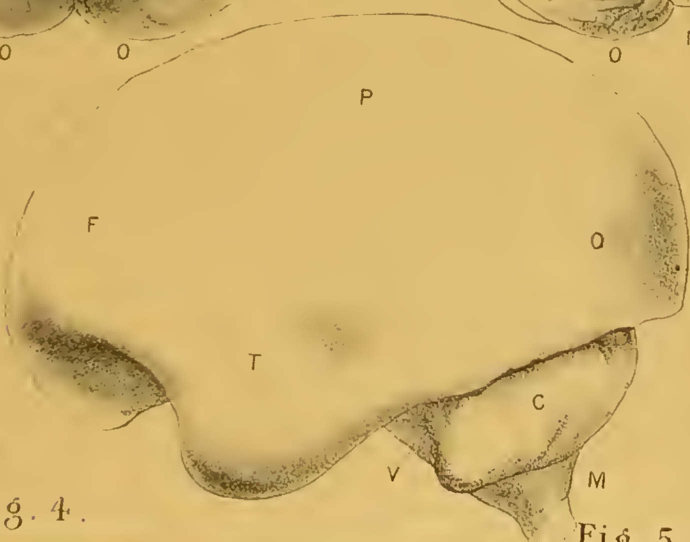

Fig. 4.

Fig. 5.