Further, the perfect development of the true maxillaries, indicated by the invariable presence of the canines, is significant of the lesion being one chiefly affecting or originating in the interposed structures; and in the more characteristic cases the disease no doubt is best marked in its effects on the intermaxillary bones. Without homologating any hypothesis advanced on such subjects, this proclivity to irregular or arrested development in these bones —the hæmal spines of the nasal vertebra, as described by Owen— the hæmapophyses of the catacentric vomerine sclerotome, as described by Goodsir,—seems to afford a confirmation of the theory, that the tendency to return to a manifestation of what have been described as archetypal characters; or, on the other hand, to assume an erratic development, becomes greater as we depart from the vertebral centrum. This part of the subject is one, however, which, without mature elaboration of many as yet undetermined facts bearing on it, cannot be treated in either a positive or an exhaustive manner. But in a further acquaintance with those great principles of morphology, of late beginning to be revealed in the vertebrate skeleton, we may expect that the nature of malformation and metrological disease will be presented in a new and more intelligible light.

5. Notes more especially on the Bridging Convolutions in the Brain of the Chimpanzee. By Wm. Turner, M.B., F.R.S.E.

The late Professor Gratiolet, in his elaborate and beautifully illustrated memoir, "Sur les Plis Cérébraux de l'Homme et des Primates," attaches great weight in his differential diagnosis of their cerebral characters to the presence or absence of one or more members of a series of convolutions, which he designates as the *plis de passage.* When present, these convolutions bridge over the external perpendicular fissure of the hemisphere, and connect the parietal and temporal with the occipital lobes. By various anatomists in this country they are called bridging, connecting, or annectent convolutions. In the brain of the Chimpanzee M. Gratiolet states that the first bridging convolution is altogether wanting; that the second is present, but concealed under the operculum of the occipital lobe; that the third and fourth are superficial.

In his comparison of the brain of the Chimpanzee with the brain of the Orang, he attaches great importance to the absence of the first bridging convolution in the former, and to its presence in a well-marked manner in the brain of the latter ape. In his general *résumé* (p. 98) of the mode of arrangement of the second bridging convolution in the brains of the monkeys of the old world, he states that in them it is constantly concealed under the operculum, and never comes to the surface; whilst the third and fourth connecting convolutions are always superficial.

All anatomists who have inquired into this subject since the publication of M. Gratiolet's memoir agree with him in recognising the superficial position of the third and fourth, and the concealment of the second bridging convolution within the perpendicular fissure in the brain of the Chimpanzee. But with regard to the complete absence of the first bridging convolution in the brain of this ape, evidence has been advanced which proves that M. Gratiolet's statement, although correct in some specimens—as, for example, in the one which he described and figured—yet is not universally applicable.

Thus Professor Rolleston states* that on the right side of the Chimpanzee's brain, in the Oxford University Museum, a well-marked superior bridging convolution came, for a considerable part of its length, nearly or quite to a level with the lobes it connects; and Professor Marshall describes† on the right side of the brain of a Chimpanzee, which he dissected, 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.

Whilst dissecting the brain of a young male Chimpanzee, which was given to me about two years ago by my former pupil, Mr Alfred Pullar, I obtained evidence of a greater extent of variation in the arrangement of the convolutions in this ape than had up to that time, I believe, come under the notice of anatomists. This

* Natural History Review, 1861, p. 211.

† Natural History Review, 1861, p. 309.

brain I shall designate in the following remarks as *A*. By permission of Professor Goodsir I have also had the opportunity of examining two as yet undescribed brains of this animal, both females, in the anatomical museum of the University of Edinburgh. It will be convenient to refer to these as *B* and *C*.

In all three specimens the antero-posterior convolutions of the frontal sub-division of the frontal lobe corresponded so generally in their arrangement with each other, and with the brains of the

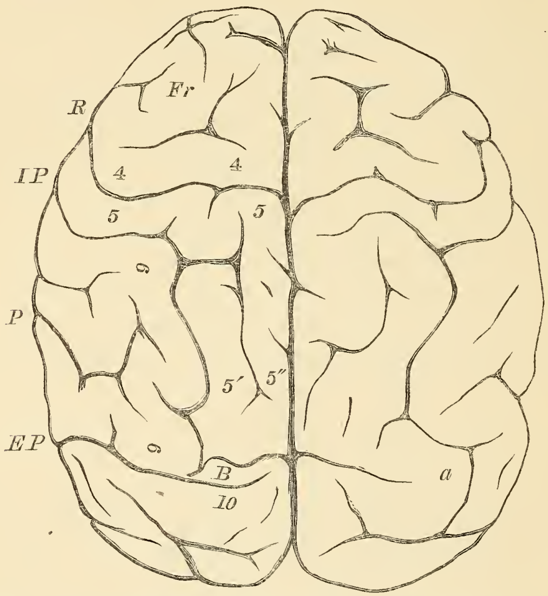

Fig. 1.—Vertex view of the brain *A*. *Fr*. Frontal lobe. *R*, Fissure of Rolando. *I P*, Intra-parietal fissure. *P*, Parallel fissure. *E P*, External perpendicular fissure. 4, 4, Ascending frontal gyrus. 5 5, Ascending parietal gyrus. 5″, Inner, 5′, Outer part of postero-parietal lobule. 6 6, Angular gyrus. 10, Superior occipital gyrus. *a*, Superior annectent gyrus. *B*, Second annectent gyrus.

Chimpanzee figured by Professors Gratiolet and Marshall, that no special description is necessary. In all, the olfactory sulcus was well marked; and in two specimens a triradiate arrangement of the sulci, situated in the outer part of the lobule, was distinct, though in the third specimen (*A*) this regular mode of arrangement did not exist. The ascending frontal (premier pli ascendant) (4 4) and ascending parietal (deuxième pli ascendant) (5 5) convolutions also agreed very closely in their general arrangement;

and in all the specimens the fissure of Rolando (*R*) extended upwards as far as the great longitudinal fissure, and formed with its fellow the sides and apex of a V-shaped figure. The lobule of the second ascending parietal convolution of Gratiolet (postero-parietal lobule—*Huxley*) reached as far back as the external perpendicular fissure (parieto-occipital fissure), and presented a subdivision into an internal (5″) and external (5′) portion; each of which again, though somewhat more strongly marked in *B* than in *A* and *C*, exhibited signs of sub-division into secondary lobules. The bent or angular convolution (pli courbe) (6 6) varied somewhat in its arrangement in the three specimens. In *A* it commenced much lower down in front of the Sylvian fissure than in *B* and *C*. The length of its ascending part, from its commencement to the apex of the fissure, was in the first named $1\frac{1}{10}$th inch, whilst in the others it was considerably less. In all three brains it was partially broken up into smaller convolutions by secondary fissures. In *A* its descending part was directly prolonged into the middle temporo-sphenoidal convolution, as in the brains figured by Gratiolet and Marshall. In *B* and *C* its continuity superficially with this convolution was broken by a cross intersecting fissure. Not only in the brain of the Chimpanzee, but in those of all the apes in which the various parietal convolutions are differentiated, the fissure which separates the angular convolution from the second ascending parietal and its posterior lobule is so clearly marked that it deserves to be recognised by a distinctive term; but as none has as yet been applied to it, I would suggest that it should be called the intra-parietal fissure (*I P*). This fissure commences anteriorly behind the fissure of Rolando, at first ascends almost parallel to it, and then runs backwards and joins posteriorly the parieto-occipital fissure.

In the brain (*C*) the external perpendicular (parieto-occipital) fissure (*E P*) on each side was unbroken by the passage across of either the first or second bridging convolutions, and the opercular edge was as sharp and well-defined as in the brains figured by Gratiolet and Van der Kolk and Vrolik. But in *B*, whilst this arrangement existed in the right hemisphere, the left exhibited an important variation. From the posterior and outer angle of the left postero-parietal lobule a narrow, but clearly-marked convolution (*a*, fig. 2), half an inch long and $\frac{1}{8}$th of an inch wide, arose. It passed almost transversely inwards, and joined the supero-internal angle of the occipital lobe close to the longitudinal fissure. It was superficial in its entire extent, and consequently bridged across the external perpendicular fissure. From its position and connections it must be regarded as the homologue of the superior connecting convolution of Gratiolet. This brain, therefore, furnishes another example to those already recorded by Professors Rolleston and Marshall of the occurrence of this convolution on one side of the brain of the Chimpanzee, though in the opposite hemisphere to that found in their specimens.

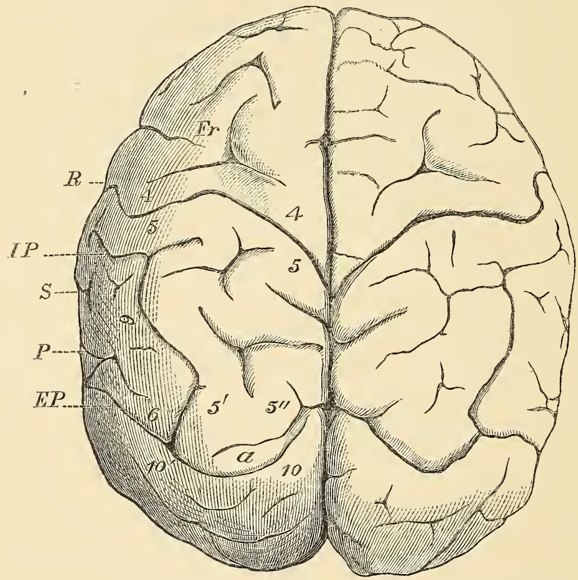

Fig. 2.—Vertex view of brain *B*. The lettering as in Fig. 1, with, in addition, S. Sylvian fissure.

In the brain (*A*) the amount of variation was still more strongly marked. On the right side the postero-parietal lobule gave off from its outer and posterior part a superficial convolution (*a*, fig. 1) $\frac{3}{10}$ths of an inch broad, which was almost immediately joined on its deep surface by a slender process from the superior angle of the bent convolution, the place of junction being concealed by the imperfectly defined occipital operculum. This convolution, then, passed across the external perpendicular fissure, inclined inwards, till it reached the longitudinal fissure of the cerebrum, of which it formed the boundary for half an inch, and then joined the inner end of the first occipital convolution. A secondary fissure passed for some distance into its substance before it joined the occipital lobe. Throughout its entire extent it formed a very distinct, superficial, first connecting convolution, almost as well marked, indeed, as that figured and described by Gratiolet as so remarkable and distinctive a feature of the brain of the Orang amongst the apes.

On the left side no first connecting convolution existed; but from the superior angle of the bent convolution, where it became continuous with the descending limb, a narrow convolution (*B*, fig. 1), $\frac{1}{5}$th of an inch wide, arose. At its origin it was concealed by the occipital operculum; but almost immediately it became superficial in the parieto-occipital fissure, passed almost transversely inwards, and joined the inner angle of the superior occipital convolution close to the longitudinal fissure. The length of its superficial portion was $\frac{3}{5}$ths of an inch. From its origin it was evidently the second bridging convolution, and in its superficial position it exhibited an arrangement such as has not before been recognised in the brain of the Chimpanzee, and which Gratiolet, indeed, had not met with in any of the numerous brains of the Old World apes which he had examined.

The convolutions of the occipital lobe presented no variation in arrangement calling for special remark. They were joined, in the usual way, by the third and fourth superficial bridging convolutions proceeding from the temporo-sphenoidal lobe.

In the disposition of parts about the Sylvian fissure, the brains *B* and *C* corresponded closely to those figured by Professors Gratiolet and Marshall, but in the brain *A* an arrangement prevailed such as has not yet been described in the brain of the Chimpanzee. The anterior lip of the Sylvian fissure was as usual sharp and well-defined, but the posterior marginal convolution (*pli temporal supérieur*), instead of forming the posterior boundary of this fissure in its entire extent, became gradually narrower as it ascended, and at the same time receded from the surface. As a consequence, its upper end was entirely concealed, the Sylvian and parallel fissures became continuous superficially with each other, and the ascending and descending limbs of the bent convolution formed the anterior and posterior lips of the combined Sylvian and parallel fissures. The remarkable superficial continuity of these fissures might be apt, on a hasty glance, to lead to the impression that the Sylvian fissure mounted much higher on the outer surface of the hemispheres than is usual, but what at first sight seemed to be the upper end of the Sylvian was really the upper end of the parallel fissure, as was at once proved by separating the ascending and descending parts of the bent convolution from each other, when the upper concealed end of the Sylvian fissure became visible. A similar arrangement to that just described has been stated by Gratiolet (p. 29) sometimes to occur in the brain of *Cercopithecus Sabœus.*

The median or central lobe (Island of Reil) consisted on the left side of five short and almost straight convolutions, none of which possessed any great size, but on the right side only four were visible. The fissures which separated these gyri from each other were short and shallow. The gyri radiated outwards and backwards from the locus perforatus anticus. The most anterior joined superficially the inferior frontal gyrus ; the rest were separated by

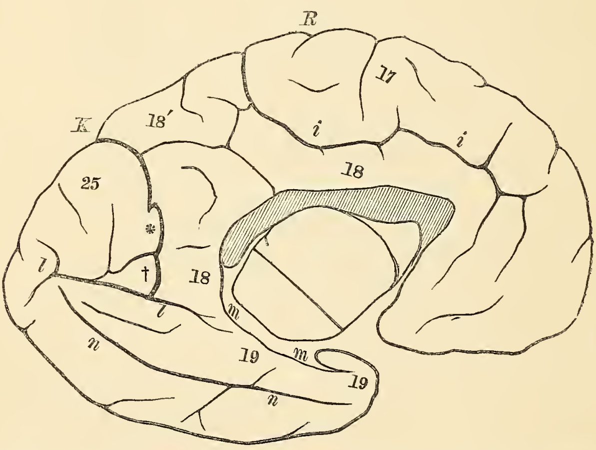

Fig. 3.—View of the inner face and postero-inferior surface of the Brain *A.* In my explanation of the arrangement of the sulci and gyri of the inner face of the hemisphere, I have adopted the terms with the letters and numerals employed by Mr Huxley in his "Memoir on *Ateles Paniscus*" (*Proc. Zoological Soc.* 1861), and by Mr Flower, in his "Memoir on the Posterior Lobes of the Cerebrum, in the Quadrumana" (*Phil. Trans.* 1862).

a deep groove from the convolutions, which formed the anterior lip of the Sylvian fissure. The island was deeply situated within the fissure of Sylvius, and excepting a small part of the most anterior gyrus, where it joined the inferior frontal, was completely concealed so long as the lips of the fissure were *in situ*.

The brain *A* is the only specimen on the inner and tentorial surfaces of the hemisphere of which I have been enabled to study the arrangement of the fissures and convolutions. The calloso-marginal sulcus (*i i*) commenced anteriorly in front of the anterior end of the corpus callosum, and extended uninterruptedly backwards. When opposite the commencement of the posterior third of the corpus callosum it bifurcated,—one branch ascended and reached the margin of the great longitudinal fissure, the other ran backwards and joined the internal perpendicular fissure. From the calloso-marginal sulcus a few secondary fissures extended upwards and downwards into the marginal (17) and callosal (18) convolutions.

The internal perpendicular (occipito-parietal) fissure (*K*), slightly convex forward, was continuous at the upper margin of the inner face with the external perpendicular fissure, whilst inferiorly, it joined the calcarine sulcus (*l l*). Proceeding from its posterior lip, two connecting convolutions ran at once into the fissure; one, (*) deeply placed, except at its origin, mounted upwards and outwards, and joined the deeper aspect of the postero-parietal lobule. Its concealed part exhibited an indication of subdivision into two gyri. The other, or inferior annectent gyrus (†) partly projected into the perpendicular, and partly into the calcarine fissure, and joined the lower portion of the quadrate lobule. The dentate sulcus (*m m*) was well-marked, and at its lower end was prolonged into the recurved part of the uncinate gyrus (19). The calcarine sulcus (*l l*), which possessed great depth, commenced posteriorly in a bifurcated extremity, the two limbs of the forks being almost equal in length. It extended forwards close to the dentate sulcus, but did not quite join it, so that the callosal (18) and uncinate (19) gyri were continuous with each other in front of its anterior extremity. Within the calcarine sulcus two small gyri were found. One sprang from the floor of the fissure, and evidently corresponded to the calcarine gyrus, described by Mr Flower as so well developed in the brain of *Cercopithecus ;* the other and larger arose from the internal occipital lobule (25) which formed the roof of the sulcus ; it projected towards the calcarine gyrus : anteriorly it became continuous with the quadrate lobule, and the inferior annectent gyrus, and posteriorly it turned round the upper branch of the sulcus, and joined the supero-occipital gyrus. The collateral sulcus (*n n*) reached almost the entire length of the tentorial aspect of the hemisphere, and although neither so deep, nor extending so far back as the calcarine sulcus, yet reached in front almost as far as the tip of the temporo-sphenoidal lobe. Some small secondary fissures proceeded from it. The internal occipital (25) and quadrate (18′) lobules were well seen, and the latter was considerably larger than the former.

The three specimens of the brain of the Chimpanzee just described prove that the generalisation which Gratiolet has attempted to draw of the complete absence of the first connecting convolution, and the concealment of the second, as essentially characteristic features in the brain of this animal, is by no means universally applicable. In only one specimen did the brain, in these particulars, follow the law which Gratiolet has expressed. As regards the presence of the superior bridging convolution, I am inclined to think that it has existed in one hemisphere, at least, in a majority of the brains of this animal which have up to this time been figured or described.* The superficial position of the second bridging convolution is evidently much less frequent, and has as yet, I believe, only been seen in the brain (*A*) recorded in this communi-

* But few specimens of the brain of the Chimpanzee have as yet been figured or described. In that figured by Tyson, only the base and an internal view of the brain are given. In the brains figured and described by Gratiolet, and Van der Kolk and Vrolik, and in my brain (*C*) no superior bridging convolution existed. In the brains described by Rolleston and Marshall, as well as in the brains *A* and *B* now described, it is precisely stated that it was present in one hemisphere. In the brain figured by Tiedemann (*Phil. Trans.* 1836), from a specimen in the Hunterian Museum, London, it is apparently present in the left hemisphere, though it is not referred to in the description ; and from the drawing of a careful cast of the brain dissected by Dr Macartney (*Trans. Royal Irish Acad.* 1843), it seems probable that the first bridging convolution existed in his specimen.

Addendum, May 5.—Since the above paper was read, a fine young male Chimpanzee has been purchased by Professor Goodsir for the Anatomical Museum, the brain of which I removed and examined. In both hemispheres the parieto-occipital fissure was unbridged, and the opercular edge of the occipital lobe was as sharp andwell defined as in my brain (*C*), or in the specimen figured by Gratiolet.

cation. The a-symmetrical arrangement of the convolutions in the two hemispheres which previous observers have referred to in their descriptions, is also well illustrated in these specimens. The higher differentiation of the cerebral convolutions in the Chimpanzee over that of the lower apes affords room for a greater amount of variability of arrangement in it than in them. Hence, in depicting the brain of this animal, just as in the representation of its face and figure, every drawing should be a portrait, and every description whilst embracing the great general outlines in which all the specimens probably agree, should yet indicate the special modifications in construction exhibited by the individual.

6. On the Theory of the Refraction and Dispersion of Light. Part I. By Alfred R. Catton, M.A., F.R.S.E., Fellow of St John's College, Cambridge, Assistant to the Professor of Natural Philosophy in the University of Edinburgh.

Supposing the phenomena of light to be caused by the indefinitely small vibrations of a highly elastic medium pervading space, it is a simple problem to determine the motion of such a medium *in vacuo*, or in space, where matter does not exist, as in these cases the problem is reduced to the determination of the motion of a *homogeneous* elastic medium.

On proceeding, however, to investigate the motion of the ethereal medium in crystals, for the purpose of accounting for the phenomena of crystalline refraction, the question arises, whether there is an action between the material molecules and the etherial medium. In other words, are the laws of the refraction of the ether within crystals, independent of the existence of material molecules, so that the ether may be treated as a single elastic medium, or are the phenomena of crystalline refraction produced, wholly or partially, by a direct action between the material molecules and the ether?

It is necessary, therefore, to consider at the outset, whether there are any physical facts which throw light on this question. For this purpose the observations of Sir David Brewster, De Senarmont, Des Cloizeaux, Mitscherlich, and others, are discussed at length in the paper.