XXX.—*Notice of the discovery of a new Fossil Animal, forming a link between the Ichthyosaurus and Crocodile, together with general remarks on the Osteology of the Ichthyosaurus;*

from the Observations of H. T. De la BECHE, Esq. F.R.S. M.G.S.

AND

The Rev. W. D. CONYBEARE, F.R.S. M.G.S.

DRAWN UP AND COMMUNICATED BY THE LATTER.

[Read April 6, 1821.]

IN the course of a series of observations on the organic remains contained in the lias in the vicinity of Bristol, my attention was particularly attracted by the numerous vertebræ of oviparous quadrupeds occuring in that formation. Of these a considerable portion obviously belonged to the Ichthyosaurus; the remaining, and larger division, presented vertebræ of forms considerably differing from each other, but which, from some general analogies, I was persuaded had all belonged to different places in the vertebral column of a single species; and I ventured even to point out those places, from a comparison with those of the crocodile to which they bore a strong general resemblance, yet at the same time combined with so many material points of difference, as to prove that the animal from which they were derived must have constituted a separate genus.

At this period, I was fortunate enough to associate in my researches a colleague equally able and zealous, whose name stands at

the head of this paper. The numerous important and illustrative specimens which he placed at my disposal, proved of material aid, and still more so his general acquaintance with the subject, of which I subsequently enjoyed the fullest advantage; so that the facts now submitted to the Society must be considered as the fruit of inquiries prosecuted by us in common.

A skeleton of the animal in question, deficient only in the bones of the head, preserved in the well known collection of Col. Birch, (who most liberally allowed us the full use of the very valuable materials he possessed)* confirmed in a most satisfactory manner most of my previous conjectures, and enabled us to assign to it its true place in the zoological order, and to designate it by an appropriate name. That of *Plesiosaurus* has been chosen, as expressing its near approach to the order Lacerta.

The points of analogy between the newly discovered animal and the Ichthyosaurus are sufficiently numerous and important to evince the propriety of their being referred to the same great natural family, a family on every account highly deserving an attentive examination, its members being not only unknown in the recent state, but presenting many peculiarities of general structure, of which no other examples had been previously observed; and of that most interesting description which affords intermediate forms, and as it were a transition between different races, and adds new links to the connected chain of organized beings.†

* I have also to acknowledge our obligations on similar grounds to Mr. Bright, Dr. Dyer, Messrs. Miller, Johnson, Braikenridge, Cumberland, and Page of Bristol.

† When alluding to the regular gradation, and, as it were, the linked and concatenated series of animal forms, we would wish carefully to guard against the absurd and extravagant application which has sometimes been made of this notion. In the original formation of animated beings, the plan evidently to be traced throughout is this. That every place

The family, then, to which we would thus refer the animals above mentioned, and to which future researches may be expected to add other analogous genera,* may be described as including animals approaching more closely to the Saurian or Lizard family, and especially to the genus Crocodile, than to any other recent type; yet receding from it in many important characters, especially in the form of their paddles, which possess an intermediate structure between the feet of quadrupeds and the fins† of fishes, and have been well distinguished by the above appropriate name. As these

capable of supporting animal life should be so filled, and that every possible mode of sustenance should be taken advantage of; hence every possible variety of structure became necessary, many of them such as to involve a total change of parts, but others again, such as required nothing beyond a modification of similar parts, slight indeed in external appearance, yet important in subserving the peculiar habits and economy of the different animals; in these cases the unity of general design was preserved, while the requisite peculiarity of organisation was superinduced; nor can there be any where found a more striking proof of the infinite riches of creative design, or of the infinite wisdom which guided their application. Some physiologists however (and Lamarck is more especially censurable on this account) have most ridiculously imagined that the links hence arising represent real transitions from one branch to another of the animal kingdom; that through a series of such links, and by means of the constant tendency of the vital fluids, urged by animal appetencies to perfect old organs and develop new ones, that which was once a polypus became successively a mollusca, a fish, a quadruped; an idea so monstrous, and so completely at variance with the structure of the peculiar organs considered in the detail (which is in the great majority of instances such that no conceivable appetency could have any conceivable tendency to produce it) and no less so with the evident permanency of all animal forms, that nothing less than the credulity of a material philosophy could have been brought for a single moment to entertain it—nothing less than its bigotry to defend it.

* I do not intend here to include those fossil animals, which are clearly only distinguished by specific characters from the recent crocodiles, but those which, though approximating more closely to this than to any other type, are yet marked by generic and essential differences.

† The analogy of these paddles to the fins of fish consists in the number, not in the form of the joints composing them. In many respects, as will hereafter be shewn, they approach most nearly to the paddles of the turtle.

animals appear unquestionably to have lived, principally at least, in the sea, and to have received the peculiarities of organisation to which we have alluded, in order to fit them for such an habitation, the term *Enalio-Sauri* may be proposed as a classic appellation to denote the whole order. Of the genera composing it, the Ichthyosaurus recedes most widely from the forms of the lizard family, in order to approach those of fishes; but it is still incomparably nearer to the former; and a careful study of its osteology presents, as will presently be seen, a beautiful series of analogies with that of the crocodile, in all the most essential parts.

The newly discovered animal, named on that account Plesiosaurus, approaches much more nearly to the crocodile, forming in its whole structure, a link between it and the Ichthyosaurus; hence it acquires a high and peculiar interest, as affording a middle term of comparison, illustrating the reciprocal relations of both, and often shewing a real connexion between them, by exhibiting an intermediate gradation of form in parts, which would, at first sight, appear the least likely to be reconciled.

Of these animals, the Ichthyosaurus has already engaged a considerable share of attention among the scientific public, having been illustrated by a writer whose name stands deservedly high among the comparative anatomists of this country. Yet, since the materials from which his descriptions were drawn up came only into his possession gradually, and were with a praise-worthy readiness communicated instantly to the public, the circumstances of the case rendered it impossible to attempt a regular and connected view of the whole osteology of this animal, and a series of detached essays on such individual points of its structure as the specimens happened to present, was all that was practicable; hence many of the most important parts of the skeleton, the whole osteology of the head for

instance, cannot be said as yet to have been in any degree elucidated; the analogies by which its place in the natural kingdom must be determined, though ably pointed out, are far from having been fully unfolded, and a precise anatomical description of its general structure remains a desideratum.

The great subsequent accumulation of materials, which must be doubtless in a great measure attributed to the researches above alluded to, and more especially the numerous specimens contained in the many collections of this neighbourhood (Bristol) and in that of Mr. De la Beche, have afforded me, through the able assistance of that gentleman, the means of filling up the most material of the chasms in our information on the subjects which I have mentioned; and since the points determined are at once in themselves of considerable importance, and promise, from the analogies above stated, to afford considerable assistance in prosecuting our farther observations on the newly discovered animal, we shall preface the details concerning it, which we are about to submit to the Society, by a general and comparative view of the osteology of the Ichthyosaurus.

ICHTHYOSAURUS.

General characters. A marine quadruped, nearly resembling the crocodile, in the osteology of its head, and its mode of dentition. Vertebræ having both faces of their body deeply concave as in fishes. Extremities having no distinct radius and ulna, but the humerus immediately supporting a very numerous series of small polygonal bones, forming a very flexible paddle. Anterior extremities much larger than the posterior.

We have retained in these observations the name Ichthyosaurus, originally applied to this animal by Mr. König of the British Museum, feeling convinced that on a full and careful review of its

whole structure, it will not be found to possess analogies sufficiently numerous or strong with the peculiar organisation of the Proteus to authorise the change of this appellation into Proteosaurus, as subsequently proposed.

Particular Observations.

Osteology of the Head.

a. *Teeth.** These bear a near resemblance in form to those of the crocodile; and the mode of dentition by the young tooth growing up in the interior of the cavity of the old one, and when matured, splitting and causing it to fall, is exactly similar.

The teeth are more numerous than in the crocodile; there cannot be less than 30 on a side in either jaw: but from their irregular growth, their partial concealment in the stone, and difficulty of finding complete jaws, they have not yet been accurately numbered.

They are placed in a long sulcus, formed in the maxillary and intermaxillary bones, like that in the jaw bones of some fishes, not in separate alveoli, as in the crocodile.

b. *Lower Jaws.* In order to demonstrate the close relation between the Ichthyosaurus and the lacerta family, it is necessary to premise, that the lower jaw in that order, instead of having, like other quadrupeds, a single bone on either side, exhibits no less than six of these; one called the dental, which carries the teeth, forms the whole anterior extremity of the jaw, and continues to cover the

* From the different forms of the teeth alone, three species at least of the Icthyosaurus may be ascertained; but they differ only in very slight points, and not in any that very materially affect the general form and structure of parts to which it is our intention to confine ourselves in the present paper. Hereafter we propose a further communication on this subject.

upper portion, and to lap over the exterior; the rest of the outer face is formed, in the posterior part, by a second bone, the coronoid; the bottom by a third, the angular; and the inner face by a fourth, the opercular; in addition to these four bones, the articular, which is placed at the posterior extremity for the purpose which its name denotes, and a small crescent-shaped bone, which sometimes forms the coronoid process, complete the stated number.

Of these bones, we have succeeded in demonstrating the five first on the Ichthyosaurus, occupying situations closely corresponding to those which they possess in the crocodile. The crescent-shaped bone is the only one of the series which we have not yet detected; and this probably arises from our never having seen the part of the jaw in which it occurs fairly exposed.

Almost the only differences from the lower jaw of the crocodile are, 1st, the apparent absence of the oval hole* just behind the termination of the dental bone, which characterises the latter, but which is however not to be found in others of the lacerta family; and, 2dly, which is more important, that the bones are not connected by common but squamous sutures, forming plates folding over one another, as in fishes.‡ This structure, which combines

* In one beautifully perfect specimen of Ichthyosaurus, belonging to Mr. de la Beche, a sulcus communicating with a small foramen may be seen in a similar situation. We have not however traced it as yet in others; but it is so situated as to be readily concealed, by being filled up with the stony incrustation.

‡ This overlapping mode of application, or as it is technically termed, squamous suture, occurs also in most of the bones of the head; since by the accidental removal of portions of the external bones, more or less of the internal, against which they are in consequence of this structure applied, is often exhibited in different specimens, a correct idea of their outline can only be obtained by the careful collation of several such specimens in their ordinary state of preservation; and a single one can only be relied upon where it appears to be undoubtedly perfect and unmutilated, a circumstance which it requires some practice to ascertain.

The sutures of some of the bones (those particularly of the orbits) are singularly

the greatest solidity and strength with the least weight of bone, is admirably calculated at once to increase the buoyancy of the animal, and to enable it to face the waves of an agitated ocean, and has doubtlessly been given to it to fit it for its marine abode.

The general form of the jaw differs from that of the crocodile in being much more lengthened and acutely angular; its termination is indeed almost as sharp as the beak of a bird.‡

The accompanying figures (plate 40, fig. 1 to 10) will explain the forms and arrangement of these bones better than any verbal description. In order to facilitate comparison with the analogous bones in the crocodile, we have employed the same letters with which M. Cuvier has marked the head of that animal, in his memoir on the fossil remains of oviparous quadrupeds:† viz. *u*, dental; *x*, coronoid; *v*, angular; &, opercular; y, articular.

The appearance and range of the dental, coronoid, and angular bones on the outer face of the jaw, are shewn in the side view of the head (Fig. 9. plate 40.)

The view of the lower jaw, as seen from *beneath* (fig. 10, plate 40) exhibits the course of these bones and the opercular throughout the jaw. The transverse sections numbered from one to eight (plate 40), the position of which is indicated by the dotted lines in the side of the head, fully elucidate the form of the several bones

adapted for strength, being partly squamous and partly dovetailed, so that one bone is partly inserted into the other by a sort of angular process, on either side of which they overlap each other reciprocally. On these points we propose, in a future communication, to speak more in detail.

‡ Specimens exhibiting the termination of the jaw in an unmutilated condition are very rare; we are indebted to the kindness of Mr. Miller for one which displays that of both jaws in a perfect manner.

† Recherches sur les ossemens fossiles, tome 4.

and the changes they undergo in different parts of the jaw, from its anterior to its posterior extremity, and also the manner of their application to each other.

Bones of the upper part of the Head.

These have the same marked coincidence with those of the crocodile which distinguishes the bones of the lower jaw; they are shewn in the accompanying figures (pl. 40) fig. 9, 11, 12, marked by the letters employed by M. Cuvier. Since to describe them at length would be generally to repeat the words of that author, in treating of the structure of that animal (the crocodile), we shall confine ourselves to a rapid sketch, noticing principally the peculiarities of configuration by which the Ichthyosaurus differs from this type, most of which arise from the adaptation of the parts to the narrow and elongated contour of the whole. The eye also is rather lower placed than in the crocodile, the bottom of the orbit being nearly on a level with the line of the opening of the jaws; this produces some very slight changes in the form of the adjacent bones; and perhaps a still more important deviation occurs in the place of the nostrils; but this point still remains involved in some degree of obscurity.

We shall first consider those bones which appear on the sides and inner part of the mouth, as exhibited in figures 9, 11, and 12, plate 40. and in the transverse section fig. 3, of the same plate.

The general outline of the upper, like that of the lower jaw, is much more pointed than in any species of crocodile; its termination resembles that of the porpoise, the bones of the opposite sides opening at the end so as to form a narrow angular slit; this slit requires an attentive examination from the doubts that have arisen

concerning the place of the nostril in this animal; the two openings generally to be traced in front of the orbits were at first thought to have discharged this function, but Sir Everard Home, having subsequently examined a specimen in which these apertures were externally closed, was induced to retract this opinion; and having observed that a passage supposed to form the nasal canal continued to the fore end of the snout, he indicated the propriety of looking for the nostril in that part, as in the crocodile. The examination of a specimen, in which the extremity of the snout is preserved in an entire and unaltered form, enables us to determine positively that the canal in question terminates in the narrow slit above described, and that there is no other opening whatever in this part. We still however feel great hesitation in considering this as the true nostril, since it is so minute as to be out of all proportion with the size of the animal, and we cannot feel quite satisfied that some forced and false position of the bones in the single skull alluded to may not have covered unnaturally the openings before the orbit, at first supposed to be nostrils; since in every other specimen we have examined, amounting to nearly twenty, they appear to be well defined and perfectly open.

The intermaxillary bones, *a*, *a*, run much farther back than in the crocodile; a variation partly arising from the prolonged form of the snout. Owing to their overlying the maxillary bones along the line of their junction, it is often difficult to distinguish them, especially as they leave only a very small portion of the latter exposed on the outer side of the jaw; they have also an overlying application against the nasal bones. These and the maxillary bones, *b*, *b*, further differ from those of the crocodile (in common with those of the lower jaw), by carrying the teeth in an open sulcus instead of separate alveoli. The maxillary bones are also more confined to

the back part of the jaw, and broader and flatter at their posterior extremity, where they underlie the orbit, and are slightly curved to fit them for their situation. In the roof of the mouth, the maxillary bones, receding from each other as they advance towards the posterior parts, exhibit, (as seen in fig. 3 & 12, plate 40.) the palatals, *e*, *e*, which closely resemble those of the crocodile, but are still longer and narrower.

Between the posterior terminations of the palatal and maxillary bones, is an opening, as in crocodiles, but more elongated and narrow; this opening in the crocodile is surrounded on the posterior side by the pterygoid processes, *f*, *f*, and a peculiar bone, *d*, which may be considered as an external pterygoid process intervening between the preceding and the maxillary bone on either side. This structure, considered I believe, as peculiar to these animals, is also to be observed in the Ichthyosaurus, where the peculiar bone, *d*, will be seen resting against the inside of the termination of the maxillary, and extending in a long process to the hinder extremity of the head. Of the pterygoid processes *f*, *f*, traces only have been as yet discovered, too much broken and distorted for representation, but quite sufficient to shew that they nearly agreed with those of the crocodile.

Having thus described such of the bones as occur in the roof of the mouth, we proceed to those which occupy the external part of the face. The nasal bones, *k*, *k*, are placed as in the crocodile. Between the nasal bones and the posterior extremity of the maxillary bones, *b*, *b*, lie the lacrymal bones, *i*, *i*; these form the anterior margin of the orbit in its lower part; in front of these bones are placed the oval openings before alluded to as is generally to be observed in all the skulls of this animal yet found, with a single exception, which at first (and as we still think with much probability)

were supposed to have been the nostrils. We have already stated our reasons for doubting whether the contrary evidence, arising from the single specimen in which these apertures appeared to be closed externally, was quite sufficient to invalidate this supposition. If however it should eventually be proved that these openings are actually closed in perfect specimens, which, although we have yet failed in tracing the fact, may nevertheless not impossibly take place, in consequence of the prolongations of the intermaxillary and anterior frontal bones folding over them; (since the common mutilation of the extremities of those bones might certainly account for the present exposure of these openings: *)—in that case the narrow slit at the fore end of the snout must be the true nostril, and these oval foramina must be the openings of the lacrymal into the interior of the nasal canal, exposed by this accidental removal of their external covering; a supposition which will agree very well with their place in front of their lacrymal bones; they are represented by dotted spaces in the accompanying figures.

We have now described all the bones of that part of the head which is anterior to the orbit, and forms the snout of the animal.

The frontal part of the head consists of five distinct bones; the middle frontal, H, which extends between the orbits, the anterior frontals, *h*, *h*, which form the upper anterior portions of the orbit, and the two posterior frontals, *h'*, *h'*, which by their post-orbital processes *h''*, *h''*, form the upper and posterior margin of the orbit, and complete it by uniting with the jugals, *c*, *c*, which form its lower part.

* Since this paper went to press we have seen specimens which decide that this aperture was also perforated through the end of the intermaxillary bone, and consequently must have been open externally; the necessary conclusion is, that the appearances in the single skull, described by Sir Everard Home, must have been deceptive, and that the only objection to considering these apertures as the nostrils is removed.

The only difference in these respects is, that the post-orbital process *b''*, *b''*, in the Ichthyosaurus, does not, as in the crocodile, bend inwards, but meets the jugal *c*, in the line of the general curvature of this part of the face, so that the margin of the orbit is nearly of the same curvature throughout, and the jugal bone *c*, in consequence of the lower situation of the eye, is much reduced in size.

We have now arrived at the bones which are behind the orbits and over the summit of the cranium, corresponding in situation to the parietal bones of other quadrupeds.

Here again the crocodile has a peculiar structure, this part of the head being distinguished by two large oval openings not unlike those of the orbits, but rather smaller, which may be called from their situation the super-parietal cavities. Between these cavities is the bone *m*, answering to the single parietal of ruminants, the bones marked *n*, *n*, considered as answering to portions of the temporal bones form their posterior angles, and by uniting with the lateral frontals *b'*, *b'*, complete the enclosure.

All these strongly marked characters occur without any material deviation in the Ichthyosaurus.

The last bones of the head we shall describe are those which interpose between the jugal *c*, and the last mentioned bone (*n*), and which together with it, are considered as making up the remainder of the temporal; the first of these, *o*, which bears at its inferior and hinder extremity the condyle for articulation with the lower jaw, may be observed placed in the Ichthyosaurus, as in the crocodile, namely, extending from the lateral frontal *b'*, towards *n*, to a process of which it joins; *p* is interposed between this and the jugal bone *c*, and thus completes the enclosure of the temporal fossa, which seems to have been narrow in this animal.

We have not yet been fortunate enough to find a specimen which would permit us to examine the bones of the hinder and inferior portions of the skull; but the osteological details we have already submitted must be considered as placing in the fullest light of demonstration the near alliance of this animal, and its almost identical structure, with the crocodile.

The eye of this animal has its sclerotica, as is well known, composed of a long or rather scaly substance subdivided into thirteen plates. I have now before me the eye of a middle sized lizard from Germany, which has a structure exactly similar, excepting that the plates are more numerous.* The chamelion, iguana, and tupinambis, have similar osseous laminæ, as has the tortoise, but in this latter animal they form, as in birds, the anterior disk.

A fossil animal found at Milenhart, near Dettingen, in the district of Manheim, and described in the Munich transactions under the name Lacerta gigantea, which closely resembles, if it be not identical with, the Maestricht animal, has evidently the same structure.

Vertebræ.

Although throughout the bones of the head, so close an analogy has been found to prevail between the Ichthyosaurus and Crocodile, the vertebræ are widely different, and much more analogous to those of fishes, having, like them, in consequence of the double concave form of their bodies, the inter-vertebral joint deeply cupped

* This was pointed out to me by Mr. Miller, to whose assistance I have otherwise been much indebted, and who by the scientific spirit and unwearied perseverance which he has applied to the illustration of the comparative anatomy of organic remains, promises to accomplish many interesting discoveries in that branch. His work on Encrinital remains, when submitted to the public, will form a model of sagacious, patient, and successful research.

as Sir E. Home has well observed: he has also fully described the peculiarity of their spinal canal, the annular part not being consolidated with the body, as in quadrupeds, or connected by a suture as in Crocodiles, but remaining always distinct and united by a peculiar joint. The figures will sufficiently explain the form of the annular part and the joint in question; this structure is believed to be peculiar to the Ichthyosaurus.*

The absence of transverse processes, and the consequent articulation of the ribs to the body of the vertebræ by double lateral tubercles is another important distinctive feature.

Their narrow form, or in other words, the small proportion which the length of the side of their body bears to the diameter of its articulating surface, is another good and ready criterion. In the Ichthyosaurus, the length of the side is less than half the diameter; in the vertebræ of a true fossil Crocodile found at Gibraltar in Oxfordshire (the same apparently with the 2.d fossil species of M. Cuvier,) it slightly exceeds the diameter; and in the Plesiosaurus, which holds an intermediate place in this respect, the ratio of the length of the side to the diameter is never so small as one half, and never so great as equality. Although the proportions may slightly vary in different parts of the column, the change is not sufficient to affect this general expression.

The total number of vertebræ has not been ascertained, but it

* This mode of articulation of the annular part of the vertebræ with their bodies, by a regular joint, was necessary to cooperate with the cupped form of the intervertebral joints, in giving that flexibility to the vertebral column which the vibratory motions necessary in the mode of progression, which seems to have been common to this animal and fishes, required: for had these parts been consolitated as in quadrupeds, their articulating processes must have locked the whole column together so as to render such a motion of its parts impossible, but by means of this joint every part yields to that motion.

cannot be less than between eighty and ninety, that number being exhibited on the specimen figured in the Phil. Trans. for 1819, and as several are there displaced, it is probable that some are missing.

The changes in their structure corresponding with and indicating their places in the vertebral column, are represented in the accompanying figures from a nearly entire column in the possession of Colonel Birch.

The atlas and axis* have not yet been clearly ascertained; but there seem to be traces of them in the first bones of the column in question. At any rate, it is highly improbable that more than one or two of the anterior vertebræ can be missing (if any are so) in that specimen. The numbers attached to the figures (fig. 12, plate 41,) indicate their place in that series.

The seventeen first have but one tubercle; they are farther distinguished by the broader and peculiar form of the sockets into which the annular part articulates, which in all the remaining ones is straight and narrow. The third vertebra has been selected as a specimen of these, and the seventeenth or last of them to shew the transition to the next form; these are evidently cervical and anterior dorsal.

The false ribs and ribs connected with these vertebræ must have articulated by a double head, partly against the tubercle, and partly

* We have seen only the inferior piece or body (if it can be so called) of the atlas; and the odontoid process (which as in all the reptiles forms a distinct piece) of the atlas; they very nearly resemble those of the turtle; but we refrain from figuring them till we shall have seen the parts entire. There seem to be some specific differences in the form of the tubercles in different vertebral columns of the Ichthyosaurus, perhaps they may also be affected by age; they are not however such as to affect the general arrangement and position of them as described in the text; all the small specimens which we have seen, which are generally the most sharply marked, agree with those we have figured.

against the cavity left by the prolonged lip of the socket into which the annular part of the vertebræ is set.

The twenty succeeding vertebræ have two articulating tubercles to support the ribs, and must be assigned to the middle and posterior dorsal and lumbar. The upper of these tubercles is at first placed close to the lip of the annular socket, and thence assumes gradually a lower and lower position on the side, so as to approach more nearly to the inferior; at length near the fortieth the two tubercles run together and form a single ridge.

The 18th, 25th, and 38th, have been selected for representation, as exhibiting the mean form of these vertebræ and their passage into the adjoining forms on either side.

The changes of position in these points of articulation at once affected the sweep of the ribs in forming the cavity of the thorax and abdomen, and their motion in opening it in respiration.

The vertebræ hence to the extremity of the tail have no material change, excepting that the ridge formed by the union of the two tubercles, which at first stretches across the body obliquely, at length becomes horizontal. There are also two ridges across the bottom.

The ridges on the side appear to have supported those horizontal processes, which will be better seen in the caudal vertebræ of the plesiosaurus as analogous bones are usually found lying by the side of these vertebræ. The two inferior ridges probably supported the fork of the chevron-shaped bone which occurs in the tail of all the lizard tribe, though we have not yet actually seen it in this animal. The character of these vertebræ is represented by the forty-sixth of those from Col. Birch's specimen, and by one from the extremity of the tail exhibiting the annular part attached, belonging to Mr. Johnson.

Concerning the ribs, we have no new remark to offer, with the exception that a careful examination of many specimens has convinced us that they did not form a single continuous arc, as the appearance of a single specimen induced Sir Everard Home to believe, but consisted of separate ribs on either side with intercostal bones lying between them and attached to them by cartilages.

*Bones of the Sternum and anterior extremities.**

These have been most correctly and beautifully represented in Phil. Trans. for 1817 and 1820, but it is with great diffidence that we venture to differ from Sir Everard Home in the analogies and names ascribed to the several parts.

In the first place, we may observe an arched bone having a flat process proceeding from the bottom of the arch. The whole form and apparent position in the skeleton is very analogous to that of the bone commonly called the merry-thought, and technically, the furcula, in birds,† but its inferior process is parallel instead of being

* In the text the appellation of clavicles has been assigned to those bones in the skeletons of the Orders, Reptiles and Birds, which are so denominated by M. Cuvier, in his memoir on fossil crocodiles, by Blumenbach, and the more common treatises on comparative anatomy. It has been suggested to me however that more recent observations seem to demonstrate the analogy of these bones with the coracoid processes of mammalia rather than with clavicles, and the furcula forms in fact the true representative of the latter. If this view be admitted, as it has successively been by M. Cuvier, it will be proper to substitute in the text the term coracoid bones for clavicles, and clavicular arch for furcula. The arguments on which the above changes are founded proceed from the consideration of the muscles originating in the bones in question.

† It may seem extraordinary to search for an analogy in the structure of animals of so widely different an order as birds, when treating of any part of the skeleton of a species intermediate between crocodiles and fishes; yet the general disposition of the arched bone, the scapulæ, and clavicles, is so very similar that it is impossible not to remark the resemblance; and when it is considered that the employment and motion of the paddle in swimming has many points of agreement with that of the wing in flight, "remigio alarum," we cannot be surprised that nature, ever œconomical in the application of her means, has given a similar structure to the parts adjacent to the anterior extremities in both instances.

at right angles to the lower part of the chest; in the ornithorynchus, however, the form of this bone entirely agrees with that of Ichthyosaurus.

The toad has a similar apparatus, but consisting of three distinct pieces; the inferior process and either arm of the arch forming a separate bone.

This bone alone we consider as belonging properly to the sternum; we shall therefore call it the sternal arch.

The inner side of the scapulæ is attached to the arms of this arch; in this it agrees most nearly with the ornithorynchus, in which however the extremities of the arch do not proceed the whole way behind the scapulæ, but only afford a small articulating face. In the toad, and birds, the extremities of the arch articulate between the scapula and clavicle.

The flattened hatchet-shaped bone, the narrow and excavated end of which unites with the scapula to form the glenoidal cavity, and which has been considered as analogous to the flat bones of the ornithorynchus, and peculiar to these animals, appears very obviously, on comparison with the corresponding parts of the crocodile, to be a true clavicle, differing only in its proportions, being shorter and therefore wider at the flattened end.

In the crocodile, the toad, and birds, the extremities of the scapula and clavicle unite in the same manner to form the glenoidal socket; and all agree closely with the Ichthyosaurus, except, as has been observed, in the shorter proportion and broader end of the clavicle in the latter. The flattened bones of the ornithorynchus should probably be also considered as substitutes for clavicles; but they deviate very widely indeed from the general form, although those of the Ichthyosaurus in some respects present an intermediate gradation.

The whole of this structure, the form of the sternal arch, and the broad surfaces of the clavicles, is such, as to impart great strength to the chest, enabling the animal to breast the most disturbed waters, and affording an extensive surface for the attachment of powerful muscles to assist in moving the anterior extremities.

The glenoidal cavity receives a bone which corresponds at once with humerus, radius and ulna, these parts being shortened in consequence of their adaptation to support an extremity corresponding, in its employment at least, rather to a fin than a foot. Somewhat similar takes place for the same reasons in the humerus, radius, and ulna of the porpoise, which are in like manner shortened and anchylosed; but still in that animal traces of their distinct form may be recognised.

This humero-radius supports the bones of the paddle, in which the first four or five rows may be considered as carpal and metacarpal, and the remainder as phalangic, although all the bones are nearly similar in form, being irregular flattened polygons. They are so disposed that the first row consists of only two pieces; the succeeding rows, as far as the fifth, which thus contains six, encreasing in arithmetical proportion; in some specimens eight may be counted in the succeeding rows; but the exterior pieces are very small and generally removed; in length there are about thirty-five of these rows, decreasing to a very small size near the end: the bones of the exterior series have a more rounded outline than the rest; the longitudinal series of these phalanges proceed in right lines from their base in the carpus; the two first bones of the carpal part much resemble that of the porpoise, and the two succeeding series present an absolute identity of form and arrangement with those of the turtle, to which, as we shall hereafter see, the paddle of the newly discovered plesiosaurus bears also throughout a very close analogy.

Bones of the Posterior Extremities.

Those of the pelvis have not yet been seen in a perfect state; but as Sir E. Home has stated, they closely resemble those of the Crocodile. The femoral bone and posterior paddle are altogether analogous to the humerus and anterior paddle; but, contrary to the posterior extremities of quadrupeds in general, very considerably smaller, nearly in the proportion of one to two; the reasons of this variation are obviously the same which lead to a similar diminution of the analogous parts in seals, and their total disappearance in cetacea; namely the necessity of placing the centre of the organs producing and regulating motion when acting laterally, before the centre of gravity.*

General Remarks.

From the dislocated and imperfect state of the skeletons of this animal, it is not easy to ascertain the relative proportions of the several parts; but from a careful examination of the most entire, it would appear that the head and jaws occupy about one fourth of the total length of the animal.

The size to which the animals of this genus sometimes attained may be inferred from a head in the possession of Mr. Johnson of Clifton, in which the longest axis of the orbit is $14\frac{1}{2}$ inches.

* This remark applies only to animals moving swiftly through a sensibly resisting medium; for the same reason the wings of birds are placed in the fore part of their body; and to turn to works of art, the centre of the moving forces given to ships by their sails is similarly placed; were it otherwise, a slight disturbing force near the head of the moving body, would instantly swing it round. The great organ of motion in fishes, the tail, is indeed posteriorly placed; but this by its mode of action generates a vis a tergo, which can only impel the animal straight forwards; and does not therefore operate under the same conditions with organs laterally applied.

Comparing the proportions of this head with that of the entire skeleton figured in Phil. Trans. for 1819, it must have belonged to an animal exceeding twenty-four feet in length.

The geological seat of these interesting remains is principally in the lias, and in the clay underlying the Portland oolite at Kimmeridge, and on Shotover hill, near Oxford; but they have also been found in some of the intermediate formations, e. g. in the calcareous grit underlying the Oxford oolite at Marcham near Oxford; and again in one instance in a formation still more recent than the Kimmeridge clay, namely in a bed of marle associated with the green sand series at Bensington in Oxfordshire, probably contemporaneous with that of Folkstone in Kent. On the whole, therefore, it appears that the occurrence of these animals is at least coextensive with the whole series of formations intervening between the new red sandstone and chalk: they seem however to be most abundant in the lias. We have seen specimens from numerous localities situated on that formation in Dorsetshire, Somersetshire, Gloucestershire, and Leicestershire.

It has been our object, in drawing up the preceding details on the genus Ichthyosaurus, to establish a firm foundation of anatomical knowledge, which might be applied to the illustration of the newly discovered genus plesiosaurus, to which it is obviously in many respects allied. For since, of the latter, comparatively few specimens have been yet accumulated, and those deficient in many important members, we are not as yet in a state to neglect the aids to be derived from such analogies.

To communicate a notice of the discovery of this new genus was the principal object of the present paper; yet, from the circumstances above mentioned, our details concerning it will necessarily occupy a far less space than those which strictly speaking were

only preliminary. In this, as was strikingly exemplified in the history of the discoveries connected with the former genus, we doubt not but that an early and unreserved communication of materials, which from the circumstances of the case cannot but be imperfect, will soon lead to the removal of the present deficiencies, and for the reasons stated in the beginning of this memoir, we trust that what has already been ascertained, which indeed comprises the most material points connected with the trunk and anterior extremities, will not be found entirely devoid of interest.

PLESIOSAURUS.

General character. A marine animal, intermediate in its structure between the Ichthyosaurus and Crocodile.

Teeth. Not having as yet obtained a head of this animal, we cannot speak with certainty on this subject; but a peculiar tooth, not belonging to any species of Ichthyosaurus, yet evidently of the Crocodilian type, occurs in the lias, and may with great probability be referred to this animal.

Jaw and Head bones. Not as yet discovered.*

Vertebræ. These agree more nearly with the Crocodile than with the Ichthyosaurus; we shall therefore compare them with the former type; stating first their points of agreement, and then of difference.

They agree with those of the Crocodile in having their annular part attached to the body by sutures; those in the younger specimens allow the two parts to separate completely, and form a clean socket not unlike that in the Ichthyosaurus, but in the older specimens they are completely anchylosed: they farther agree in having

* Since this paper went to press a few very imperfect specimens have occurred, which exhibit very little of an illustrative character, excepting that in this animal the teeth were carried in distinct alveoli, and not in a continuous sulcus, as in the Ichthyosaurus.

transverse processes throughout the greater part of the dorsal vertebræ, which, together with the whole of the annular part, very nearly resemble the corresponding forms in the type alluded to. The principal differences are.

1st In place of being concave at one extremity, and convex at the other end, thus articulating by a species of ball and socket-joint, they are slightly concave at both extremities of their body, but again slightly swelling in a contrasted curve near the middle of the circular area. In these features however, though they differ from recent Crocodiles, they agree with one species, at least, of those found in a fossil state in England, France, and Germany; and all the fossil species appear to have this structure in the posterior part of the column.—(See Cuvier O. F. T. 4, and the description of Crocodilus priscus, in the Munich Transactions.)

2. They differ from both the fossil and recent species of Crocodile in much narrower proportions; though far less so than do those of the Ichthyosaurus. The proportion of the diameter to the length of the side being nearly as 5 to 4 in the cervicals, in the middle dorsals a little greater, and in the caudals nearly double; whereas, the mean proportion in the fossil Crocodiles we have examined is nearly an inversion of the above, the diameter being always less than the side.

3. The number of cervical and dorsal vertebræ in this animal appears to be 46; a number almost double that of any recent Saurian animal, and greater than even that of the Ichthyosaurus, which does not seem to possess above 41.

4. They farther differ from both recent and fossil Crocodiles in having the ribs through the greater part of the dorsal series articulated only to the end of the transverse processes; at least, 28 appear to be thus circumstanced; whereas this takes place in the three last

of the Crocodile only; in the other Saurian animals, however, all the ribs are thus borne.

Colonel Birch's specimen exhibits a series of 63 vertebræ; but as they were dug loosely out of the lias marle in which they lay, several appear to be missing, and it comprises only the first 12 of the tail. Mr. De la Beche has a continuous chain of 18 middle dorsal; and, in the late Mr. Calcott's collection, preserved in the city library of Bristol, there is another continuous series of 9, the 8th of which carries the last short rib; this specimen seems fortunately to have succeeded almost immediately to the former.

From these materials we are able to give a tolerably complete account of this part of the skeleton.

Our figures are taken, unless where it is otherwise stated, from Col. Birch's specimen, which being a young animal, has the annular part still separate, the sutures not having yet anchylosed, and on this account exhibits this part of their structure, which we shall designate as the annular suture, more distinctly; but in other points there is no variation in older specimens.

The atlas and axis we have not seen.

The cervical and first dorsal vertebræ appear to have possessed similar forms. The character of these, which extend to the 12th in Col. Birch's series, is represented in fig. 1, 2, 3. plate 41.

They have no transverse processes; the line of suture with the annular part is angular, and they have on either side of the body a double notch, into which appears to have been inserted, by a double stem, a tubercular process corresponding to the inferior tubercle in the cervical and anterior dorsal vertebræ of Crocodiles, and, like it, bearing the false ribs which protected the neck and the first true ribs.

The position of this double notch is near the bottom of the side in the first vertebra, and gradually ascends till it almost rises to, and

runs into the annular suture in the 12th. Fig. 1 represents the earliest form; fig. 2. the same, with the tubercular process attached, but from another skeleton; fig. 3. the 12th vertebra; fig. 4. the 13th.

In the course of the succeeding four vertebræ the upper of the two notches runs into and extends the margin of the annular suture; and in the next, (the 18th) the lower notch becomes a distinct tubercle; thus two articulating surfaces are afforded, one on the tubercle, and a second on the cavity formed by the prolongation of the lip of the suture, of which the former must receive the head, and latter the tubercle of the anterior ribs. It will be remembered that a structure exactly similar was pointed out in the cervical and anterior dorsal vertebræ of the Ichthyosaurus; and it corresponds also in some degree, at least, in the office of these parts, with the first dorsal vertebra of the Crocodile, in which the transverse process is not yet fully developed, and remains only a tubercle. Fig. 5 A, and fig. 5 B, represent the 18th vertebra in two points of view.

At length the lower tubercle also disappears, and is swallowed up in a still longer prolongation of the margin of the annular suture; at the same time the stems by which the annular part was attached to the body expand their bases laterally, so as to form incipient transverse processes: these at first point downwards, and are close to the middle of the side, but as they become longer they rapidly ascend and point upwards; this character extends through the middle of the dorsal series; thence they again begin to incline downwards in the posterior dorsals, and in the last, which bears a very short rib, become very much reduced. All the vertebræ from the first developement of the transverse process (27 in number) carry the ribs on a single articulating surface at the end of that pro-

cess, like the three last dorsals in the Crocodile and the whole series in most other Saurians. The pointing upwards of the transverse processes in the middle of the series seems intended to give a wider sweep to the ribs flanking the thorax and abdomen.

All the changes last described are represented in the accompanying figures, of which fig. 6 represents the form of the vertebræ from the 18th to the 22d, where the margin of the suture forms a remarkably prolonged sinus. Fig 7 A, and fig. 7 B, represent the incipient appearance of the transverse process about the 22d vertebra. The body of this vertebra is shewn first separately, and then with the annular part attached. Fig. 8 shews three vertebræ nearly succeeding this, but from another more perfect and aged specimen. Fig. 9 A, and fig. 9 B, exhibit the middle dorsal vertebræ with and without the annular part, to shew the form of the suture and its different contour from that in the cervical and first dorsal; the posterior dorsals differ only in having the transverse process less elevated, and did not therefore require representation.

The lumbar and caudal vertebræ appear to differ in form from one another only in a less inflection of the lower margin, for the purpose shortly to be mentioned; they are however very distinct from all the others; they have no regular transverse processes, but, instead of them, two separate bones flattened at the extremities, and articulated into a socket near the upper part of the sides of the bodies of the vertebræ; their position is exactly horizontal. We have before observed that the Ichthyosaurus appears to have had similar bones. The lower margin of these vertebræ on the posterior extremity is inflected so as to form two regular indentations, exactly as in the Crocodile, for the reception of the chevron-shaped bone beneath the tail. All these circumstances are represented in fig. 10 A, 10 B, 10 C, which exhibit one of the early caudal ver-

tebræ in three points of view; and fig. 11, which represents one farther in the series, to shew the change in the socket for the articulation of the lateral bones, which is much narrower, and is higher placed.

We have as yet no means of even surmising the number of caudal vertebræ.

The middle dorsals are considerably larger than those of the extremities of the column; the measures of three from different parts of Col. Birch's were:

	Diameter of Articulating Surface.	*Length of Side.*
Cervical	1 inch	$\frac{6}{8}$
Middle Dorsal	$1\frac{1}{2}$	$1\frac{1}{8}$
Caudal	$\frac{7}{8}$	$\frac{5}{8}$

The largest vertebra of Plesiosaurus we have yet seen was $2\frac{1}{2}$ inches in diameter.

On the whole, then, it appears from these remarks, that the vertebral column of the Plesiosaurus recedes from that of the Ichthyosaurus in all the points in which the latter approaches to the fishy structure; that the intervertebral substance must have been disposed much as in the Cetacea, and that on this account, as well as because the annular parts were firmly attached to the bodies, and therefore, by the locking into one another of their articulating processes, must have given a considerable degree of stability to the column, it must have possessed in a much less perfect manner the flexibility which facilitates the peculiar motion of the Ichthyosaurus and of fishes. But it will be presently seen that this was much less necessary to these animals, in as much as the structure of their extremities rendered them much more powerful instruments of progression.

To the description of these extremities we next proceed, premising, that we have never seen the bone which we have called in the

Ichthyosaurus, the furcula or sternal arch, which we yet think it most probable, from the form of the scapula, must have existed in this animal also.

*Anterior extremity.** It is proper that we should begin by stating, that all the bones composing this part of the skeleton were, in Col. Birch's specimen, loose and detached. The determination of their exact situation may therefore be considered as in a certain degree conjectural; but we trust that the reasons we shall alledge will prove satisfactory, and leave little if any doubt on the subject.

The scapula and humerus represented by *c* and *b*, in the figures of plate 42, have their relations positively determined by a specimen in the Bristol library collection, in which they occur together. This also shews the form of the latter bone more completely, which in Col. Birch's collection is much compressed. The scapula, *c*, is still smaller than in the Crocodile, but generally resembles it in form; its back is slightly excavated, which gives it a figure proper for attachment, as in the Ichthyosaurus, to the sternal arch; its upper extremity also forms a concave triangular articulating face, which probably received a process from the sternal arch.

The humerus, *b*, requires no description; it could only be confounded with the femur, and its association with the scapula removes this suspicion.

The flat clavicles, *a*, *a*, are so exactly similar to those of the Ichthyosaurus, that no one familiar with the latter bones could hesitate in assigning their place. Their articulating surfaces moreover (although much compressed in Col. Birch's specimen), clearly coincide with those of the scapula, in forming the glenoidal cavity;

* If we follow the views suggested by the late observations on the muscles attached to the analogous bones in birds and reptiles, we must here, as in the Ichthyosaurus, consider what has been termed in the text the clavicle as rather answering to the coracoid process.

more especially is this coincidence visible in the scapula which has a narrowed articulating face towards the clavicle, and a broader towards the humerus. The whole evidence then stands thus: some bone having a certain articulating surface was requisite to complete, together with the scapula, the glenoidal cavity; these bones exactly possess the requisite form; they agree exactly with the bones holding the same place in the Ichthyosaurus; and there is no other place in the skeleton which they can be supposed to have occupied, except perhaps that of ossa ilia, with which however they will not be found, on careful examination, at all to agree.

The bones *d*, *d*, we have assigned to the office of radius and ulna, because their articulating surfaces at the one end agree with those of the humerus, and at the other with those of the three which obviously form the carpal series in the paddle, and because we cannot discern any other equally probable place in the arrangement of the skeleton.

Of the paddle, the three first or carpal bones marked *e*, *e*, *e*, are well characterised; of these the central has a form not unlike that of the phalanges of reptiles, but more flattened; and with articulating extremities, forming a smooth and gentle curve; the exterior bones have a general texture like that in the paddle bones of the Ichthyosaurus, but have a reniform outline, and are much flattened.

Of the succeeding bones of the paddle, Col. Birch's specimen exhibits two fragments; one (fig. 1, plate 42) exhibiting three rows of phalangic bones, to which the description already given of the central carpal bone would equally apply, and which (except that they are shorter) closely resemble those of the sea turtle, mingled with bones exactly resembling the round bones, which

form the external series in the paddle of the Ichthyosaurus. The other specimen (fig. 2) exhibits these phalangic bones in a longitudinal series, containing traces of at least eleven rows counting lengthwise. From these specimens we may draw the following conclusions:

1st. That the series of small bones forming the paddle was very numerous, approaching in this respect to the structure of the analogous part of the Ichthyosaurus; and secondly, that there were a series of round bones like those which form the external bones of the Ichthyosaurian paddle, and probably holding a like place; for some of those in fig. 1 have a lateral situation (which would be required in this conformation).

Thus, therefore, a general similiarity of organisation between this important member in the Plesiosaurus and Ichthyosaurus appears to be established. On the other hand, a comparison with the paddles of the sea turtle will exhibit such fresh analogies as to indicate that in respect of the various forms of animal extremities, the Plesiosaurus holds as it were a middle place between it and the Ichthyosaurus; for we may remark in the first carpal series of the turtle three bones not unlike those of the Plesiosaurus; these are succeeded by two rows exactly corresponding, as we have before observed, to those holding a similar place in the Ichthyosaurus. The corresponding bones in the Plesiosaurus we have not yet seen (unless indeed those of a rounded form not placed laterally, and therefore forming the exterior series, but at the end of fig. 1, may be accounted such); but the double analogies above stated scarcely leave a doubt that they likewise had a similar form. The succeeding and phalangic series in the turtle exactly agree with those of the Plesiosaurus in form, excepting that they are individually longer, and, as in quadrupeds, exhibit only a few joints,

whereas in the Plesiosaurus the comparative shortness of the individual joints is much more than compensated by their exceedingly greater number, and a much greater flexibility is thus imparted to the whole paddle.

Here then we may trace a series of links between the extremities of land and sea animals. The sea turtle will form the first term of these, in which the arrangement and form of the carpal, metacarpal, and phalangic bones, will be found to differ from other quadrupeds, and approach to the Plesiosaurus in many points, while yet their number and general appearance more nearly resemble the usual quadrupedal type. In the Plesiosaurus these peculiarities have added to them that of a much greater number of joints, and an external series of rounded bones. In the Ichthyosaurus the usual phalangic form is completely abandoned, and all the bones become irregular polygons or trapezoids, thus admitting a still greater number of separate joints into the same space, and proportionally encreasing the flexibility. In the fins of regular fishes, flexibility is also the object apparently aimed at, and produced by the number of joints and their cartilaginous substance, but their form more nearly resembles that of ordinary phalanges. We have ventured to add a figure of the paddle of the Plesiosaurus, as conjecturally restored from the two fragments, and the analogies alluded to, fig. 5, plate 42.

The general arrangement of the whole extremity is also important, as exhibiting a similar gradation of arrangement; for with the flat clavicular bones of the Ichthyosaurus, and with the intermediate species of paddle above described, we find the distinct form of humerus, radius, and ulna, belonging to quadrupeds generally.

Of the posterior extremities, we have seen some imperfect bones of the pelvis and femora; but we postpone any attempt to describe this part of the animal, till future opportunities shall have provided us with more illustrative specimens.

Geological Seat of the Remains of the Plesiosaurus, and other Saurian Remains found in this Island.

We are as yet acquainted with no instance of the occurrence of the remains of the Plesiosaurus in any other formation than the lias, where they have been found in Dorsetshire, Somersetshire, Gloucestershire, and Leicestershire, in the same localities with those of the Ichthyosaurus.

In conclusion, we shall submit, in order to attract more general notice to the enquiry, a short list of the other varieties of Saurian animals, which, as far as our knowledge extends, have been found in a fossil state in this island.

We have never seen any genuine remains of the crocodile in the lias of the southern counties; those which have been usually considered as such really belonging to the Plesiosaurus. This also is the case with the specimen discovered by Stukely at Newark in Nottinghamshire, and described in the Philosophical Transactions, which, from the imperfection of the plate there given, M. Cuvier was led to consider as a crocodile. We have not however, as yet, had an opportunity of examining the bones from Whitby.

Remains of an undoubted species of crocodile, somewhat resembling the Gavial, have been found in the upper beds of the great oolite, or in the Cornbrash, for the distinction between these beds cannot in that part of the country be ascertained, at Gibraltar, eight miles north of Oxford, on the river Cherwell; the vertebræ of this variety agree with the second species from Honfleur, described by M. Cuvier, in having both faces of the vertebræ slightly concave like the Plesiosaurus; but their proportions, articulating surfaces for the ribs, &c. agree closely with the crocodile, as does the head, which has also been found.

Another head, but apparently of a different species, has been found in the Portland limestone in the Isle of Purbeck, and is now in the possession of Mr. Johnson of Clifton.

An immense Saurian animal, approaching to the characters of the Monitor, but which, from the proportions of many of the specimens, cannot have been less than forty feet long, occurs in the great oolite at Stonesfield, near Oxford. Professors Kidd and Buckland have been long engaged in the study of these interesting remains, and it is hoped may soon communicate the result of their observations to the public. Vertebræ and phalanges of another animal, apparently allied to the Enalio-Sauri described in this paper, but clearly of a distinct genus, occur in the Kimmeridge clay in the pits at the foot of Shotover hill near Oxford.*

* In Whitehurst's Theory of the Earth, p. 184, it is mentioned that the impression of a crocodile was found at Ashford, in the first bed of the mountain limestone of Derbyshire, by Mr. Henry Watson of Bakewell. As this is very important in indicating the traces of these animals in an older formation than those above mentioned, and one indeed in which the very existence of Vertebral animals has been denied, (although certainly only in consequence of a very partial acquaintance with the organic remains it affords, among which the palatal tritores of fishes, the incisores of the shark, and the radii of Balistæ, are not very uncommon), it is very desirable to obtain further information concerning this specimen, if it be yet in existence, and particularly (since the term Crocodile has often been very vaguely applied) a precise account of its specific characters. With the view of leading to such a result, we have added this note.

The following article, extracted from the prospectus of Mr. Mantells' expected work on the Geology and Fossils of Sussex, contains another interesting notice connected with this subject. "41 Lower jaw of an animal of the Lizard tribe, in chalk, containing twelve teeth. Two Vertebræ in chalk, of the celebrated fossil animal of Maestricht." I am also indebted to him for the following communication on this subject.

In the limestone of the Oak Tree Clay, or Weald Clay of Sussex, numerous remains occur of an animal of the Lizard tribe. Fragments of the ribs, clavicle, radius, pubis ilium, femur, tibia, metatarsal bones, vertebræ, and teeth, have been discovered; and although the specimens are, for the most part, exceedingly mutilated, yet the structure of the original animal is very clearly indicated. From an attentive examination of these remains, there can be no hesitation in considering them as belonging to the same un-

P. S. While this paper was passing through the press, the author has received a communication from a friend resident in Paris, in which it is stated, that the discovery of the composition of the lower jaw of the Ichthyosaurus in a manner analogous to that of the animals of the Saurian family, had been anticipated by Mr. Cuvier, and communicated in the autumn of 1820 to Messrs. Leach and Clift, although it appears that the general fact only had been observed, and that the details of the structure of this part had not been fully examined.

The author is happy to have an opportunity of making this acknowledgment; he was entirely ignorant of this anticipation until his own observations had been committed to the press.

known species of Crocodile, as the osseous remains discovered at Honfleur and Havre, with which they also accord in their mode of petrifaction, and in the nature of the stratum in which they are entombed. Vide Cuvier, Animaux Fossiles, Tom. IV. p. 17, 18.

Crocodiles.

Tab. XXXIII.—All the specimens delineated in this plate are from the upper chalk.

Fig. 1. Conical striated tooth. Mr. König supposes it to belong to the Ichthyosaurus, others that it resembles the incisor teeth of Anarrhicus lupus.

Fig. 10. Vertebræ of the Ichthyosaurus?

Fig. 13. Certainly the vertebræ of a species of Crocodile.

Tab. XXXIX.—Dorsal fin of a fish of the genus Balistes? in chalk.

Tab. XLI.—Fig. 1. "Very like in miniature the large amphibious animal of Mæstricht in our Museum: I should not hesitate to consider it as a species of lacerta."—Mr. König.

Fig. 2. Front view of the two anterior teeth. I do not think that this specimen may not have been the jaw of a fish.

Fig. 3. Two vertebræ of the celebrated animal of St. Peter's mountain: these certainly resemble the specimens in the British Museum, and also those figured by Faujas St. Fond.

Tab. XLII.—The whole of the specimens figured in this plate were discovered in one block of chalk. The remains of an unknown fish? some say Lacerta?

On the same authority it is suggested that the humero-sternal part of the Ichthyosaurus and Plesiosaurus, viz. the furcula, coracoid processes, &c. bear a greater analogy to the Monitor Iguana, and others of the Lacertæ than to the Crocodile. The present writer however is still inclined, from the comparison of the osteology of the head, to approximate the Ichthyosaurus rather to the latter than the former.

Since the completion of the press, I have received from Mr. De la Beche the following particulars of a specimen of Ichthyosaurus lately discovered at Lyme, which I am anxious to subjoin, as they shew the total number of vertebræ and ribs in this animal.

The specimen (I. communis) lately found, is very interesting; it consists of the head, with all, or nearly all, the vertebræ *in place*, with the exception of two. The total number of vertebræ amounts to 104, not including the atlas and axis, which are also *in place*; diameter of the largest dorsal vertebræ $1\frac{1}{8}$ inch. This specimen contains 31 ribs on each side, which I take to be the real number of ribs that the Ichthyosaurus possessed, as none appear to be wanting; length of the largest rib $11\frac{1}{2}$ inches; the lower jaw 1 foot $6\frac{1}{2}$ inches long, is in tolerable condition; the other bones of the head, with the exception of the maxillary and intermaxillary bones, are much crushed. The chevron bones come in beautifully after the ribs cease. The vertebral column increases (as in the Proteosaurus) from the atlas and axis to the middle dorsal, and then decreases to the extremity of the tail. There are traces of the pelvis in this specimen; it must have been very simple, as after a careful examination I could not detect any difference in the vertebræ about the place where it ought to be attached.

Fig. 8.

Fig. 7.

Fig. 6.

Fig. 5.

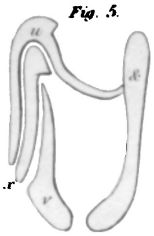


Fig. 4.

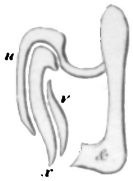


Fig. 2.

Fig. 1.

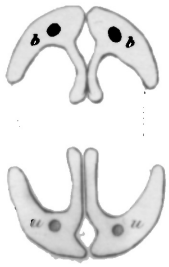
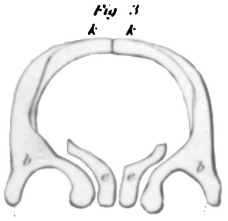


Fig. 3



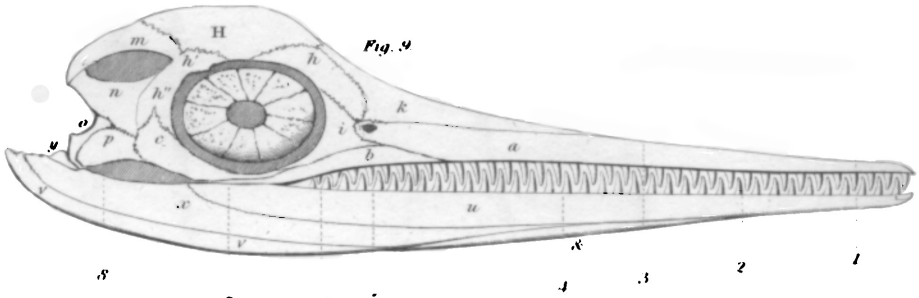


Fig. 9.

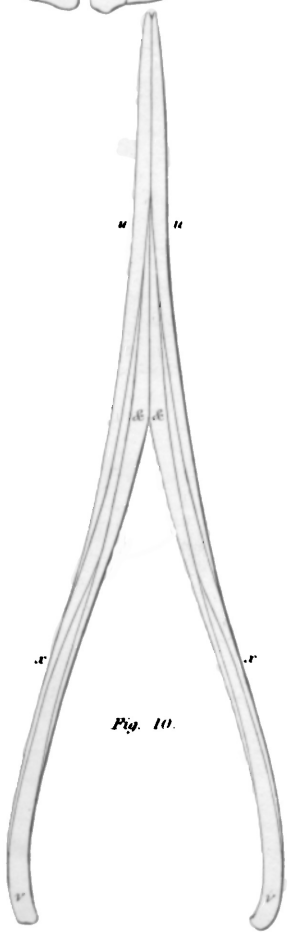


Fig. 10.

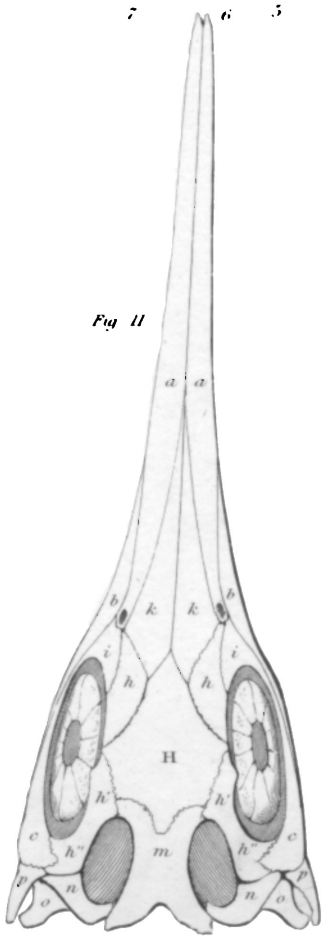


Fig. 11

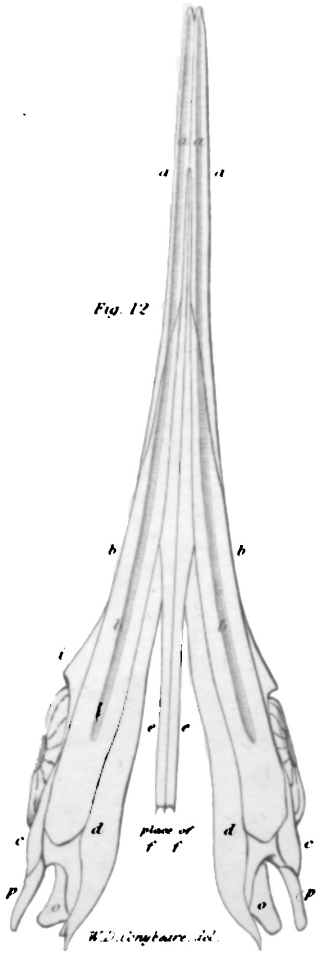


Fig. 12

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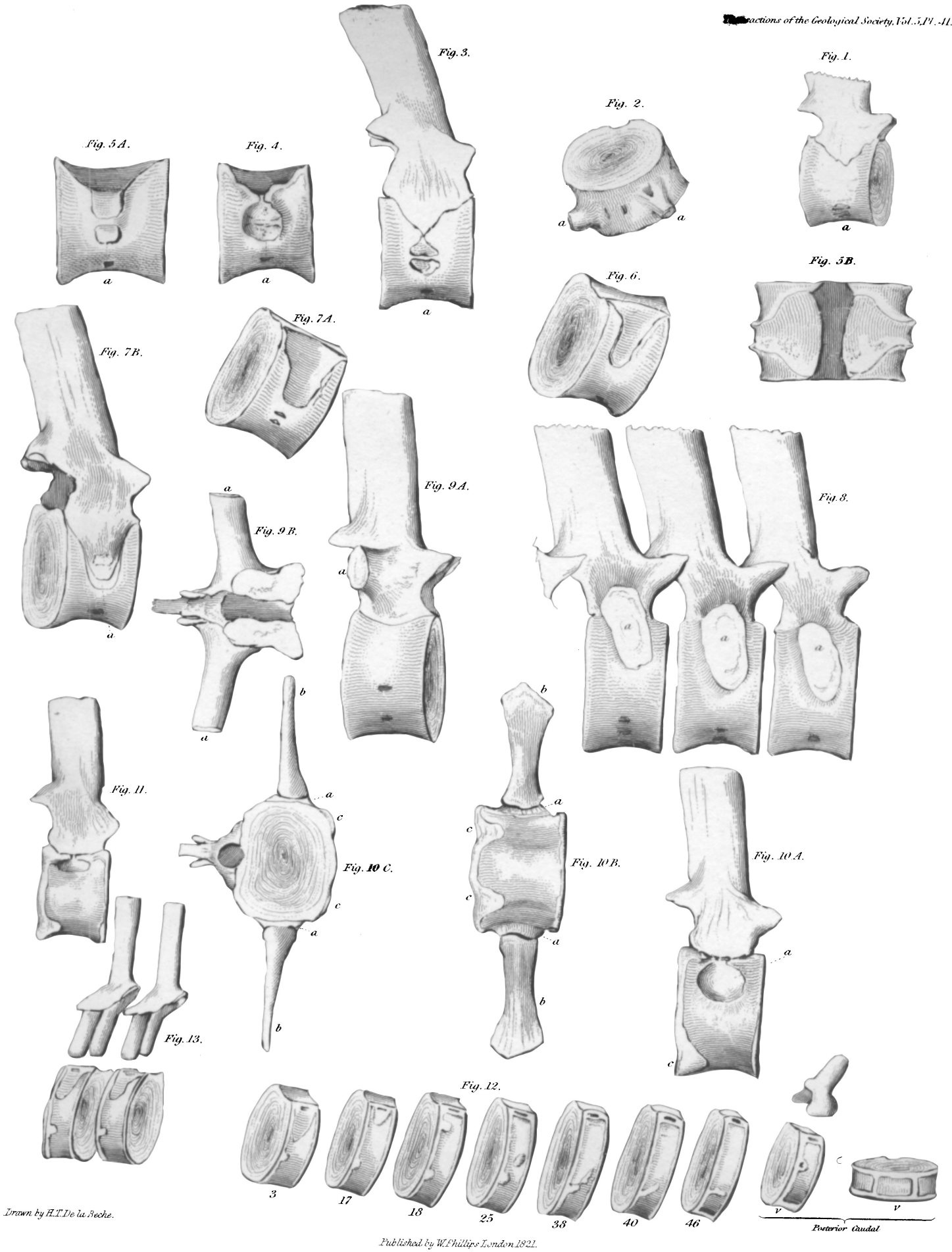

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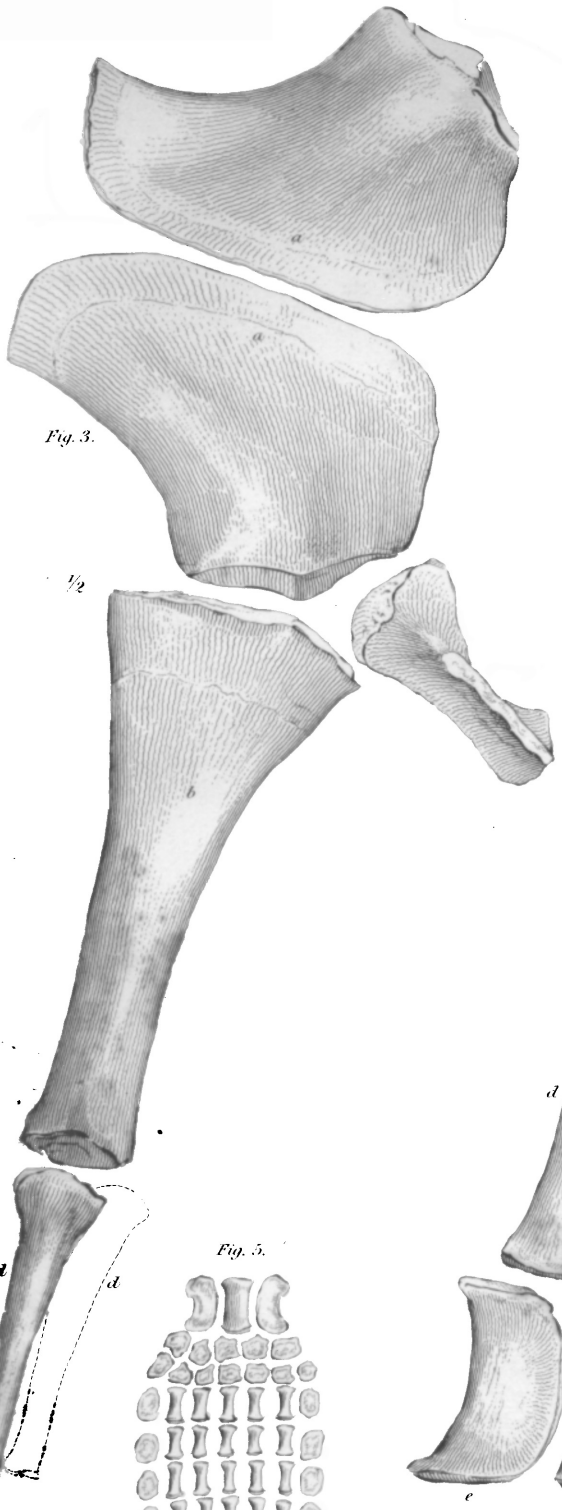

Fig. 3.

½

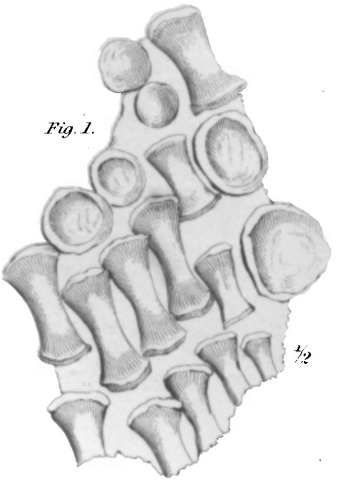

Fig. 1.

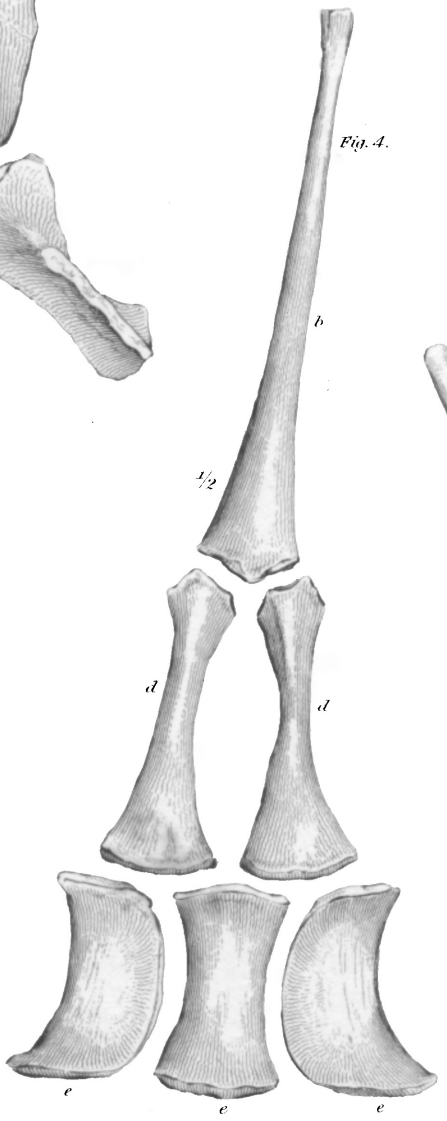

Fig. 4.

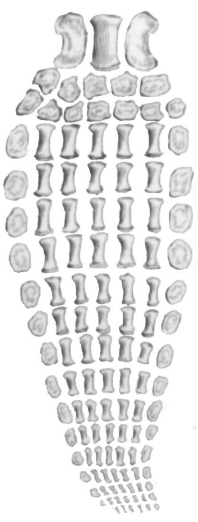

Fig. 5.

Fig. 6. ½

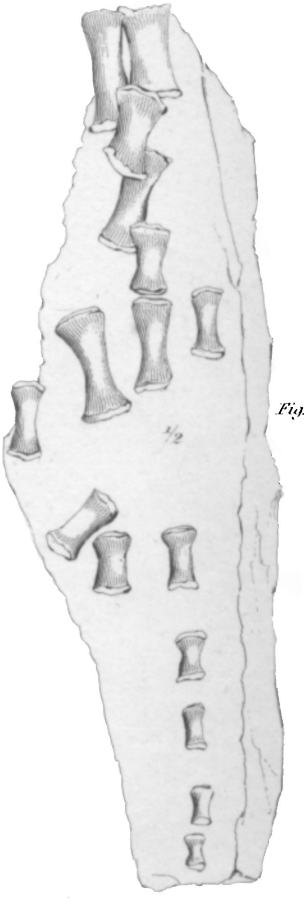

Fig. 2.

n. by H.T. De la Beche.

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