

The sutures presented characters similar to those exhibited by immature birds; and he thought that the separation of the bones in this example showed affinities to the anserine type. He was quite prepared to regard the fossil as that of a bird rather than of an Ornithosaurian. He inquired as to the character of the palatal bones.

Mr. CHARLESWORTH inquired as to the light in which this discovery would be regarded by evolutionists.

Prof. OWEN briefly replied.

3. CONTRIBUTION to the ANATOMY of HYPsilOPHODON FOXII. An ACCOUNT of some recently acquired REMAINS. By J. W. HULKE, Esq., F.R.S., F.G.S.

[PLATE XVIII.]

IN 1849 a block of sandstone containing a considerable portion of a reptilian skeleton was found by some labourers on the south-west shore of the Isle of Wight, near Cowleaze Chine. It was broken in two; and one piece passed into the collection of the late Dr. G. Mantell, the other into that of Mr. Bowerbank. Subsequently both pieces were acquired by the British Museum and reunited. Thus completed, the slab exhibits a continuous chain of some 18 presacral vertebræ, succeeded by the right ilium, the middle of which is crushed and hidden by an imperfect metatarsus. Below this are some long slender bones, which have received different interpretations from distinguished anatomists; and behind these are the left femur and a series of 12 caudal vertebræ. In 1855 a description of this fossil, illustrated by a plate, was given by Professor Owen, in his 'Fossil Reptiles of the Wealden Formations' (vol. 1855, Older Dinosauria, p. 2), where it is entitled "Part of the Skeleton of a young *Iguanodon*, *I. Mantelli*,"—a conclusion towards which the weight of evidence then seemed to incline. In 1867 Prof. Huxley, from a comparison of its vertebræ with those of *Iguanodon*, and from the presence of four metatarsals in the pes, concluded its generic distinctness from *Iguanodon Mantelli*; and in 1870 he made it the subject of a communication to this Society. Prof. Huxley prefaced this paper by a detailed description of a small reptilian skull discovered by the Rev. W. Fox in the same stratum from which the Mantell-Bowerbank fossil had been obtained. It had been previously exhibited by Mr. F. Fellows for Mr. Fox, at the Norwich Meeting of the British Association, 1868, when Mr. Huxley drew attention to the remarkable facts that the teeth contained in the posterior moiety of the premaxilla were quite different in shape from the maxillary teeth, and that the anterior moiety of the premaxilla was beak-like and edentulous. The maxillary teeth, though presenting a general resemblance to those of *Iguanodon*, at the same stage of wear, yet appeared, on close examination, so distinct as not to leave any doubt of the generic distinctness of this reptile; and Mr. Huxley proposed for it the generic name *Hypsilophodon*, and called the species *H. Foxii*, after its fortunate discoverer. The preservation of a vertebral

centrum in the same block of stone with the skull further enabled Mr. Huxley to identify *Hypsilophodon* with the Mantell-Bowerbank skeleton.

In the discussion which followed the reading of this paper I alluded to part of a reptilian skeleton from the same cleavage-bed, shown me by Mr. Fox in 1869, which I considered to belong to *Hypsilophodon*. It consisted of a connected chain of several pre- and postsacral vertebrae, the right ilium with the proximal end of the femur in the acetabulum, and the distal half of the leg with the tarso-metatarsus. The ilium was prolonged forward for a considerable distance in front of the acetabulum. The knee-joint had been worn away; but its position in the block, ascertained by prolonging the directions of the remaining parts of the tibia and femur, made it very probable that the leg was longer than the thigh.

The above are all the published notices of the anatomy of *Hypsilophodon Foxii* with which I am acquainted.

In several visits to the Isle of Wight I have obtained additional evidence of its structure; and having quite recently been so fortunate as to exhume from the same Cowleaze bed great part of a skeleton of this reptile, I am now able to communicate many details respecting its dentition, and also the form of the mandibular symphysis, not illustrated by Mr. Fox's skull, as well as the forms and proportions of several bones of the shoulder and hip-girdles, and fore and hind limbs, before unknown.

Probably the entire skeleton was present; but its immaturity and the fissured state of the clay in which it was lying were so unfavourable to the preservation of the bones, that most of them were too much shattered to bear removal, and of many I could only bring away ideas, the bones themselves falling into numberless small pieces, which no pains or ingenuity could join.

Skull.—The only remnants of this which I could save were parts of the jaws and of one orbit. In the clay filling the orbit were several small osseous scales, which I judged to be vestiges of a sclerotic ring; and deeper than these was a large and extremely thin bony lamina, apparently an extensively, if not, indeed, completely, ossified interorbital septum.

The largest piece of jaw is the right mandibular ramus (Pl. XVIII. fig. 1). The outer surface and dentary border are laid bare. Its length from the front of the symphysis to the front of the quadratic joint (behind which the bone is defective) is 2·5 inches. The upper border slants from the quadratic joint steeply upwards to the coronoid process, the top of which is wanting; and from here it declines gently forwards through a space of 1·6 inch, which comprises the entire tooth-bearing portion. In front of this, at the distance of ·35 inch from the symphysis, it abruptly falls; and the surfaces, which behind this point look inwards and outwards, acquiring an upward and downward aspect, one half of an edentulous mental interdentary groove (fig. 1, *a*) repeats in miniature the characteristic depressed symphysis of *Iguanodon*. In front of this extremity of the mandible, and quite distinct from it, is a thin triangular plate, which I suspect

to be the edentulous beak-like part of the præmaxilla, known to us by Mr. Fox's skull. That which I judge to be the trenchant border has the same length as the edentulous part of the mandible.

Teeth.—The other remnants of upper and lower jaw, though very fragmentary, throw new light on the dentition of *Hypsilophodon*, so that, with this and several teeth which had fallen out and were recovered from the clay by washing, I can now illustrate nearly every phase in the life of a tooth, from the immature crown, which had not come into use, to the worn-out stump.

The right mandible just described had at least ten mature teeth in use, of which the crowns of four only remain; and these exhibit the characters of the maxillary teeth of Mr. Fox's skull. The last tooth is smaller than those immediately before it. The 2nd–6th, counted from behind forwards, were larger than the four next preceding them. The crowns of three of these are broken off and lost; but one remains. It is worn nearly to the root; and a young unused crown rising up at the inner side of this stump shows these teeth to have corresponded in shape and size to the anterior smaller maxillary teeth in Mr. Fox's skull. Between the foremost of these teeth and the edentulous extremity of the jaw, the outer parapet of the dentary bone has been broken away: no teeth remain here; but I fancy I can discern traces of three alveoli suitable for the reception of the roots of teeth of the cylindrical form, such as are present in the hinder part of the præmaxilla. In the clay, at a short distance, lies one such tooth; and near this is the impression of another. As in Mr. Fox's skull, so here, there are two forms of tooth—one simple and cylindrical, the other ornate and strongly compressed.

Cylindrical teeth (fig. 7).—A perfect, mature tooth of this sort measured $\cdot 4$ inch; of this, nearly $\cdot 15$ belong to the crown, which is separated from the root by a slight constriction or neck. The root is slightly contracted towards each end, and dilated in the middle; its cross section is nearly circular, and its surface is smooth. Two, which I slit longitudinally, had a very large pulp-cavity filled with spar. The crown is slightly and unequally compressed, the inner contour of its cross section being slightly more convex than the outer. Its apex is acuminate, and is slightly inflected, which renders the outer longitudinal outline convex, and makes the inner one sinuous, concave near the point, and convex towards the root. The outer and inner surfaces meet angularly, making a low wing, within which and parallel with it, upon the inner surface, is a minute shallow longitudinal groove. In very perfect unworn crowns, the marginal wing bears a row of minute tubercles, just visible in a strong light to the unaided eye. Both surfaces are highly polished and smooth; upon the outer a few very minute longitudinal striæ are discernible. Towards the neck the surfaces are beset with excessively minute tubercles (not recognizable as such without a magnifier), the collective effect of which to the unaided eye is an extremely fine wrinkling.

Compressed sculptured Teeth (figs. 4, 5, 6).—Both the varieties described by Prof. Huxley from Mr. Fox's skull are amply illustrated by my specimens, the smaller variety occurring in the front of the maxil-

lary series, and the larger form occupying a posterior position. In both varieties one surface of the tooth (that towards the cavity of the mouth in the lower jaw, and the outer in the upper jaw) is exquisitely sculptured by longitudinal ridges passing from a raised cingulum at the junction of crown and root to the free border of the crown. The general outline of the crown is subrhomboidal. Both surfaces, longitudinally and transversely, are convex. In a nearly perfect tooth of the smaller variety (fig. 4), which had only just come into use, the cingulum forms an angle open towards the summit of the crown. The principal ridge runs from the open nearly axial angle to the trenchant border, and it forms the apex of the crown. At each side of it is a small secondary ridge; one of these does not quite reach the cingulum. Between the free ends of these minor ridges, which give this part of the border of the crown a coarse serration, and the lateral terminations of the cingulum, the sides of the crown are very finely serrated, recalling in miniature the marginal serrature of the teeth of *Iguanodon Mantelli*. In the larger variety the ornamented surface of the crown is sculptured by a greater number of ridges; and these are more equal in size (fig. 6). Some of them divide near the trenchant border of the crown, rendering this, when unworn, beautifully crenated; and the sides of these larger teeth are beautifully serrated, as in the smaller variety. The cutting-border of these larger teeth, before it has been worn, is rounder in outline and less angular than that of the smaller ones. The unridged surfaces of the crowns bear a few very minute inconspicuous striæ. All crowns which have risen above the crest of the outer parapet of the jaw bear marks of wear. They are obliquely ground; the sculptured surface remains longest, and it forms a cutting-edge, which is at first serrated by the cross sections of the longitudinal ridges, but later becomes merely sinuous as these grow less prominent in the level of the lateral angles of the crown. The maxillary tooth of Mr. Fox's skull, figured in pl. 1. vol. xxvi. Quart. Journ. Geol. Soc., is thus worn. The worn surface of large crowns is marked by slight elevations not deserving the name of ridges, running between the inner and outer surface; and the attritional striæ, which are discernible in all worn teeth, have the same direction. By the time that the crown has become worn down to the level of the outer border of the jaw, the long cylindroid fang also has nearly disappeared, so that very slight force would detach the remnant of a tooth in this condition. The successional teeth rise at the inner side of the old ones, as in existing lizards.

Attachment of Teeth.—A transverse section through the fang of a cylindric tooth *in situ* shows it to be contained in a distinct, separate socket. With respect to the compressed teeth, I am inclined to think that the same does not strictly obtain. As in *Iguanodon Mantelli*, the outer wall of the tooth-groove sends inwards partitions, which practically separate the teeth from one another, and must have afforded them a very firm support; but I doubt if these partitions actually reached the inner wall and became confluent with it.

The general form and the facies of the cylindrical teeth of *Hypsilophodon* are so like those hitherto generally regarded as Hylæosaurian that I cannot help suspecting that these reputed Hylæosaurian teeth may really be the as yet unknown premaxillaries of Mantell's *Iguanodon*; and the suspicion derives strength from the fact that these teeth are not very rare in those Isle-of-Wight Wealden beds which also yield *Iguanodon* remains, whilst other indisputable remains of Hylæosaurians are extremely infrequent anywhere in the island Wealden formation.

Vertebral Column.—All the vertebræ were crushed and mutilated beyond reparation. A few centra which I recovered show that both articular surfaces are nearly plane; or else the periphery is plane or gently swollen, and the middle is very slightly hollowed. The outer or non-articular surface is smooth. The sides are scarcely convex vertically, and slightly concave horizontally. In all the vertebræ the neurapophysial suture persists, as Prof. Owen found in the Mantell-Bowerbank skeleton; and the neurapophysis had, in most instances, separated from the centrum. The neural canal, in the neck-vertebræ, is very capacious; and the spinous processes are dwarfed here. The neural surface of the centrum has a narrow longitudinal median groove not covered by the neurapophyses, a fact mentioned by Prof. Owen. In some centra this groove has the form of a deep cleft, which sinks below the level of the middle of the centrum.

Two centra from, I think, a little in advance of the sacrum are respectively .7 and .65 inch long, and .4 inch in their vertical diameter. A mutilated sacrum of an older individual consisted of four ankylosed centra, with a small remnant of a fifth.

Ribs.—Associated with the vertebral column of the base of the neck and front of the chest were many fragments of double-headed ribs.

Shoulder-girdle and fore limb.—The scapula, coracoid, and left humerus I found lying close together; and near these, in other blocks of clay (for the cliff was very fissured), was a forearm with its manus, and a flat bone, presumably the sternum.

The scapula (fig. 2, *a*) is a long thin slightly recurved blade, a little expanded at the vertebral end, and widening considerably towards its articular extremity. Its anterior margin, in the middle two thirds, is nearly straight; towards the ventral end it bends forwards and includes an acute angle with the coracoid border, whilst dorsally it curves backwards. The expansion of its dorsal and ventral ends renders the posterior border concave. The articular border is divided into two facets, of which one is longer, straight, anterior, for union with the coracoid; and the other, shorter, stouter, and posterior, forms half of the glenoid fossa (fig. 2, *b*). These two facets, in my specimen, include an angle of about 125°. A larger scapula, of a probably mature individual, had a longer and narrower blade, and what seemed to me a short precoracoid process.

Compared with the scapulæ of other Dinosauria, that of *Hypsilophodon* (particularly when fully grown) resembles that of *Iguanodon Mantelli* in the length and narrowness of the blade, and, unless appearances have misled me, in the presence of the precoracoid pro-

cess; from that of *Scelidosaurus Harrisoni* it differs in the smaller expansion of its dorsal end; and from that of *Hylæosaurus* in the absence of the stout acromial ridge which marks the bladebone of this reptile; whilst to the stupendous scapula of *Ceteosaurus oxoniensis* my immature bone has a general likeness.

The *Coracoid* (fig. 2, *c*) is a thin, flat, subsemicircular bone. It touches the scapula, but it has slipped a little backwards from it. Its scapular border is straight. The glenoid border is the stoutest part of the bone. Between it and the longer straight scapular border is a small notch, and between the posterior glenoid lip and the sternal margin is a large deep incurve. The sternal margin is thin, and its outline is an arc. In an older individual, the bones of which were harder and the matrix better adapted to preserve them, this arc in curve and in length agreed with the corresponding border of an adjacent sternum. The coracoid of this individual was also pierced by a foramen near the union of the glenoid and scapular borders, of which only a trace is discernible in my squeezed immature bone.

Sternum.—A thin shield-like bone, pressed quite flat, lying close to the coracoid, was probably the sternum. It broke to bits with the block of clay in which it was imbedded, during my efforts to extract it from the cliff. The same bone, or rather its anterior moiety, in another individual, here also associated with the coracoid, had a semirhomboidal form. The front or intercoracoid angle was truncated and emarginate; I roughly judged its length to nearly equal one third of the width of the coracoid, measured between the sternal and glenoid borders. The coracoid margin of this sternum agreed in the form and extent of the curve with that of a near-lying coracoid. Mesially, the lateral halves of this sternum included a large angle, the ventral surface of which was smooth and keelless.

Humerus (fig. 2, *d*).—The left arm-bone lies parallel with the front border of the bladebone, and partly hidden by it. Its length, 3·4 inches nearly, equals that of the bladebone. The proximal end bears a subhemispherical articular head (*e*), placed nearly in the middle, and prolonged upon the dorsal or anconal aspect of the bone. A large crest marks the radial border of the shaft near the proximal end. The shaft itself is somewhat twisted. The ventral surface of the distal end is hidden.

Forearm.—The greatest part of both bones of the forearm could not be preserved. The ulna, for its size, has, I think, as large an olecranon as that represented in Prof. Owen's plate of this bone in *Iguanodon*, issued by the Palæontographical Society last year. The radius is much broader at the wrist than the ulna, and it forms the principal support of the manus. The radius of a mature individual I found to be 4·87 inches long, the ulna slightly more; and the humerus was 5·75 inches in length.

Manus (fig. 3).—The bones of the fore foot, together with the distal ends of the radius and ulna much crushed, were lying disconnected and confusedly in the clay, near the larger mass containing the shoulder-blade and coracoid. Two carpals are discernible, one of

which may be a lunare, and the other, from the coaptation of one of its articular surfaces, may be the corresponding ossicle in the second row. Two metacarpals and the proximal end of a third are recognizable. Their lengths are $\cdot 67$ and $\cdot 7$ inch. The proximal ends are squared and stout, the diaphysis is slender, and the distal end pulley-shaped. Seven digital phalanges remain, of which three are ungual. Of the four others, the two larger are respectively $\cdot 3$ and $\cdot 25$ inch long, which is nearly twice their transverse diameter taken midway between the articular ends. The two smaller phalanges are $\cdot 5$ and $\cdot 2$ inch long; and even these, relatively to their width, are longer than corresponding phalanges in the manus of Mantell's *Iguanodon*. The unguals (*a, b*) are nearly straight, sharply pointed, and they are not depressed and flattened as those of *Iguanodon*, from which they also differ in the presence of a conspicuous claw-groove, which runs inside the upper surface of a slightly projecting border that separates the upper from the under surface of the phalanx.

Haunch and hind limb.—I did not recover the ilium; but three from two other individuals were strikingly like those displayed in the familiar *Iguanodon*-slab from Maidstone, preserved in the palæontological gallery of the British Museum. The upper border, which is rather stouter than the broad plate below it, is prolonged forwards above and beyond the acetabulum as a long, slender process, which I have not seen complete, but which, in a nearly perfect specimen, was about as long as the postacetabular part of the bone. In these three examples the lower preacetabular, or pubic process, was well marked. It was directed downwards and forwards when the axis of the ilium was placed parallel with that of the vertebral column. The ischial articular facet was a slightly swollen eminence, not deserving, any more than in Mantell's *Iguanodon*, to be called a process. Behind the acetabulum the lower border of the bone is directed almost horizontally backwards, and it makes a blunt angle with the upper border, which bends downwards and meets it. The postacetabular part of the broad plate, or body of the ilium, at the level of about two thirds of its depth from the upper border, is angularly inflected towards the mesial line beneath the sacrum. The inner surface is stamped, as in *Iguanodon*, with a sinuous impression of alternating elevations and depressions corresponding to the shape of the outer surface of the confluent sacral transverse processes. The pubes and ischia are known to me only in the Mantell-Bowerbank skeleton.

Femur.—The thigh-bone has a general resemblance to that of *Iguanodon*; but it may easily be distinguished from this by the form, relative size, and the position of its inner trochanter. This, when perfect, is a large triangular wing pointing downwards, and situated nearer the proximal end of the thigh-bone than in Mantell's *Dinosaur*. The head is subglobular, and it is borne on a distinct neck, which makes almost a right angle with the axis of the shaft. In two very perfect and undistorted examples, the proximal end of the shaft was laterally compressed in such a way that its surfaces looked outwards and inwards when the neck was supposed to be directed ver-

tically to the plane of the ilium. A thin, slender, outer trochanter, separated from the upper end of the shaft by a narrow fissure, strongly recalls the similar process in the thigh-bone of *Iguanodon*. The shaft has an outward twist, larger, I think, than in *Iguanodon*. The femoral condyles are strongly developed, and they project very strongly backwards, separated here by a very deep intercondyloid groove. The anterior intercondyloid groove is worn away in the Mantell-Bowerbank femur, and it is effaced by squeezing in my specimen; but I have seen it a well-marked deep groove, differing, however, from the groove in the femur of *Iguanodon* by the absence of overhang, the lips of the groove in *Hypsilophodon* not being inclined towards each other, and not forming the tunnel which marks the thigh-bone of the great Dinosaur. The length of my femur cannot now be ascertained; but those of three others were 7, 7, and 5.12 inches.

Tibia (fig. 8, *a*).—I have secured in one block the distal end of the tibia with the pes. The length of this shin-bone cannot be learned; but that of a beautifully perfect example from another individual was 9.25 inches, the femur of the same being 7 inches long. The proximal end of this bone was divided into two condyles, answering to those of the femur, but not so strongly marked as these were; and beyond the outer condyle a large crest projected forwards and outwards from the front of the upper part of the shaft. The axis of the shaft has a strong twist in the same direction as that of the femur. The distal end is transversely expanded, and it closely repeats that of the *Iguanodon*.

The fibula is very imperfectly known to me; I believe it to be rather shorter than the tibia.

Pes (fig. 8).—The astragalus is disconnected from the tibia in my specimen; but in two other examples I have seen it attached to it. Its lower surface is pulley-shaped, convex from back to front, and sinuous transversely, being in this direction convex laterally and hollow mesially. The upper surface is concave from back to front, and in this direction it is subdivided by a ridge which marks off two facets answering to those on the distal articular surface of the tibia. The anterior margin is a very thin lip; in my specimen the extreme edge has been broken off; but its thinness is such that it cannot have here been produced into a bird-like ascending process. The posterior border is stouter.

Under the distal end of the tibia, and partially hidden by it, are two small bones, probably tarsals; the larger and outer one may be a calcaneum.

There were certainly four (if not five) toes, of which the outer three are well preserved; their ossicles still maintain, with only slight disturbance, their proper relations. The metatarsals are long and stout; their proximal ends have been flattened by a hard sandstone nodule. The middle one (the longest) measures 2.8 inches long; the outer one is 2.3 inches, and that on the inner side of the central one is 2.5 inches long. Displaced, and lying beneath these three, athwart them, I discovered an ungual phalanx, and not far

from it a fourth and smaller metatarsal. I have extricated them from the matrix, and placed them at the inner side of the pes, as the form of the metatarsal plainly indicates it to have had this position. The three toes following this inner one, counted from the tibial to the fibular border of the foot, have respectively 3, 4, 5 phalanges. They answer therefore to the 2nd, 3rd, and 4th toes in the foot of existing lizards; and I assume the small displaced toe to be the 5th; in which case it wants the basal phalanx. The other basals and the intermediate phalanges are stout, moderately long, and their distal, pulley-shaped, articular surfaces are strongly marked. The unguals are large, long, straight, and sharply pointed. They have a very conspicuous marginal claw-groove. The third is the stoutest toe; and although it has one phalanx less, it is longer than the 4th, the basal 2nd, 3rd, and 4th phalanges of which are shorter than any others, in which respect they somewhat resemble those of the corresponding toe of the *Iguanodon*.

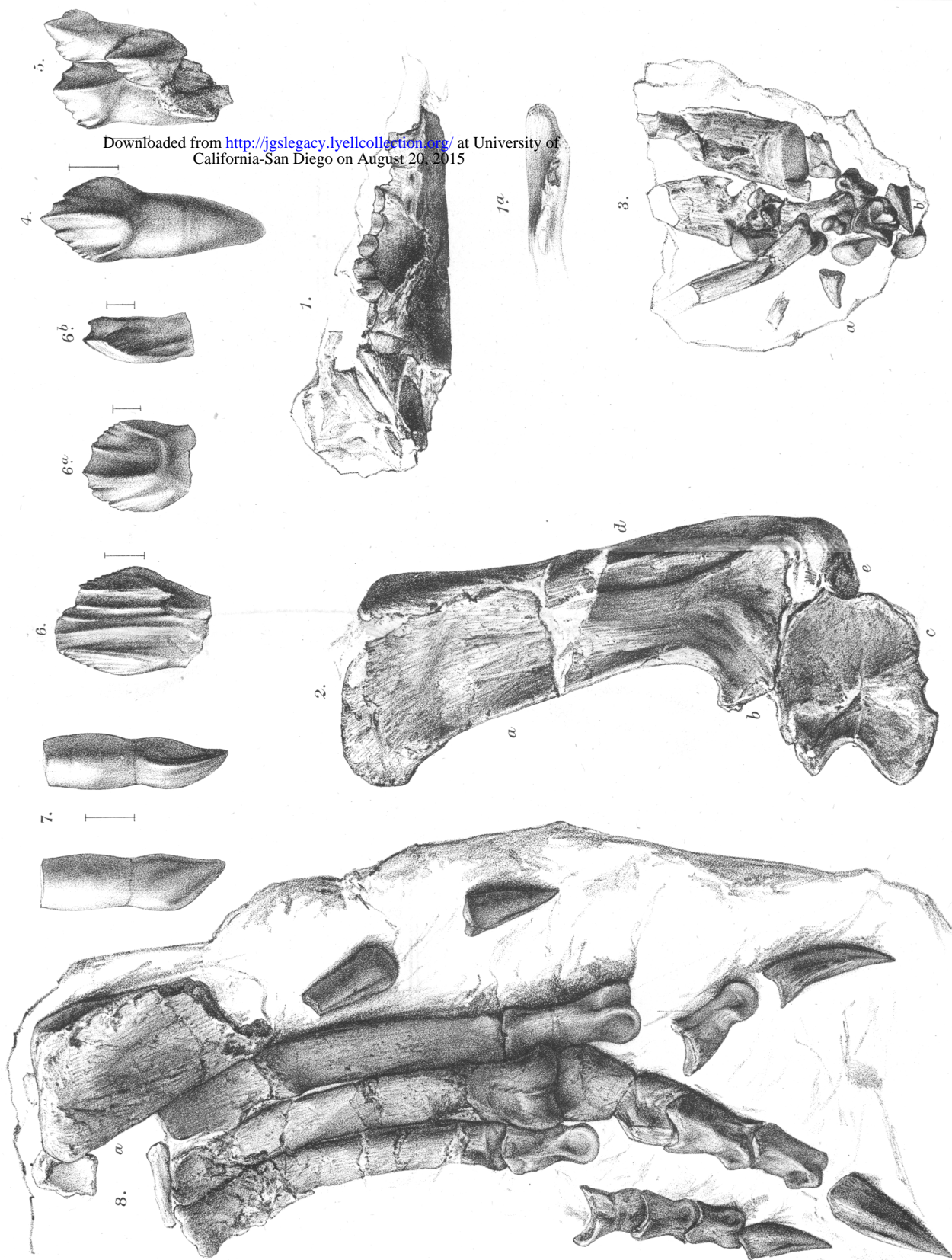
Comparing *Hypsilophodon* with what is known of *Iguanodon* (for its anatomy has still many voids), the following seem to me to be some of the most striking resemblances and differences. *Hypsilophodon* resembles the larger Dinosaur in the peculiar form of the anterior extremity of its mandible, in the general facies of its compressed sculptured teeth (longitudinally ridged and marginally serrato-lamellated), in the form of the bones of the shoulder-girdle and also in that of the haunch-bone, in the greater size of the hind limb, the greater length and stoutness of the third toe (which corresponds in the number of the phalanges to the middle toe of *Iguanodon*). It differs from *Iguanodon* in having four toes*, in the absence of that extreme shortness which marks the phalanges, especially of the outer toe of *Iguanodon*, and in the form of the unguals, which are long, tapering, and pointed—in the tibia being longer than the femur, the reverse of which obtains in *Iguanodon*—in the inner femoral trochanter being nearer the proximal end of the thigh-bone, and in the want of overhang of the margins of the anterior intercondyloid groove which marks the thigh-bone of *Iguanodon* and of *Hadrosaurus*—and particularly, as regards the manus, in the straight, symmetrical, distinctly claw-grooved unguals, which are wholly unlike the shapeless depressed unguals of *Iguanodon*, devoid of distinct groove for attachment of claw.

Hypsilophodon resembles *Scelidosaurus Harrisonii* in the number of the pedal digits, and, superficially, in the facies of the compressed teeth. This last resemblance, however, is weakened by a critical examination of the specimens themselves. In both the crown is separated from the root by a cingulum, the sides of which run out on the lateral margins of the tooth; but in *Scelidosaurus* no ridges pass longitudinally from the cingulum to the trenchant edge of the crown†, and the serration has quite a different shape.

* *Iguanodon* has three functional toes only, the splint-like bone, thought to represent a first toe, not being segmented into phalanges.

† The artist has not been so successful as usual in the figure of a tooth which illustrates Prof. Owen's memoir on the skull of *Scelidosaurus* in the Foss. Rept.

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EXPLANATION OF PLATE XVIII.

All the figures, except those of the teeth, are of the natural size. The size of the teeth is indicated on the plate by lines.

Fig. 1. Outer surface of right ramus of mandible.

1 *a*. Its edentulous anterior extremity viewed obliquely from above.

2. *a*, scapula; *b*, its humeral articular surface; *c*, coracoid; *d*, humerus; *e*, its proximal articular head.

3. Manus. *a*, *b*, claw-bones.

4. A perfect tooth of the smaller compressed form.

5. Two worn teeth of this kind, upon which lies a young tooth.

6 and 6*a*. Two of the larger compressed teeth. 6*b*, a side view of 6*a*.

7. Two views of a cylindrical tooth.

8. The pes. *a*, distal extremity of the tibia.

DISCUSSION.

Prof. OWEN remarked that palæontologists generally were interested in obtaining such additional evidence of the generic characters of *Iguanodon* as Mr. Fox's valuable discovery of the skull and other remains of the small species in the Isle of Wight Wealden might supply; but such desirable information, especially as regards the cranial structure of the herbivorous Dinosaurs, is shut out if those remains are shown to belong to a distinct genus. In the paper to that end in the 'Quarterly Journal' for 1870, p. 3, the only teeth of the so-called *Hypsilophodon* known to the writer were those of the upper jaw, and these were not entire; the portion of crown answering to the serrated portion in *Iguanodon* was worn away. Mr. Fox was therefore justified in rejecting Prof. Huxley's genus *Hypsilophodon*, although he might believe the statement that such serrations were characteristic of the teeth of *Iguanodon*, especially when emphasized by the phrase "so characteristic"—the fact being, however, that marginal serrations characterize the apical half of the crown in the Dinosaurian genera *Scelidosaurus* and *Echinodon* as in *Iguanodon*. What are truly characteristic of the upper molars of that herbivorous Dinosaurian are the ridges on the outer surface of the crown, which ridges, being also present in Fox's *Iguanodon*, and supposed to be peculiar thereto, suggested to Prof. Huxley the term *Hypsilophodon*. But the lower molars of *Iguanodon* are equally ridged, but on the opposite side to those above, viz. the inner side; and the marginal serrations extend nearer to the base of the crown. Now the lower molars of the small *Iguanodon*, also found, with the mandible, by Mr. Fox, show this generic character, and vindicate the taxonomy of their discoverer. We may rest assured, therefore, that the sloping edentulous symphyseal part of the mandible of the great *Iguanodon* had a downbent edentulous part of the premaxillaries applied to it, such as the fore part of the skull of *Iguanodon Foxii* exhibits. Without a knowledge of the

of the Lias. A stout median ridge is depicted going from the retiring angle of the cingulum to the apex of the crown, which I fail to find: to me it appears that a transverse section of the crown would have its outer contour a simple unbroken curve, having its maximum excursion at the middle line of the outer surface, but uninterrupted here by any angle or bend marking the cross cut of a ridge.

characters of both upper and lower molars of this small *Iguanodon*, no one in quest of the truth of the matter could affirm "that the teeth of this reptile were perfectly distinct from those of *Iguanodon Mantelli*." In the last plate of Prof. Owen's 'Monograph' for the forthcoming volume of the Palæontographical Society, the mandible and mandibular teeth are figured; and he had hoped to receive a proof to show to the Meeting. The mandibular teeth exhibited by Mr. Hulke were identical with those previously discovered by Mr. Fox. In the 'Monograph' the evidence will be found of the specific, but not generic, distinction of Mr. Fox's small *Dinosaur* from the large *Iguanodon Mantelli*.

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4. *On the GLACIAL PHENOMENA of the LONG ISLAND or OUTER HEBRIDES.*
By JAMES GEIKIE, Esq., F.R.S.E., of H.M. Geological Survey of Scotland.

FIRST PAPER.

I. *Introduction.*

THE detailed observations of the Geological Survey having led my colleagues and myself to conclude that the great *mer de glace* which enveloped the south of Scotland during the intensest cold of the Glacial Epoch was so extensive as entirely to fill up the basin of the Clyde, and all the sea between Ailsa Craig and the mainland, I became curious to ascertain what the islands of the Outer Hebrides had to tell us in regard to the extension of the old ice-sheet in that direction. My brother had in 1865 shown that the island of Bute was glaciated from end to end by the ice that streamed outwards from the mountain-glens of Argyllshire; and subsequent observations by myself in Ayrshire had proved that the rocky coasts between Lendalfoot and Glen App were striated in a direction parallel to the shore-line by glacier masses which flowed south-west upon what is now the bed of the sea. My colleague, Mr. D. R. Irvine, had also found that ice from the southern uplands had swept across the Rinns of Galloway from the interior of the country—the whole coast between Portpatrick and Corsill Point exhibiting numerous rock-striations and glaciated surfaces, whose prevailing direction is towards south-west. Thus it would appear that an immense mass of glacier ice, derived partly from the Highlands and partly from the Southern Uplands, set towards the north coast of Ireland. Moreover the position of the striæ and the whole character of the glaciation of that south-west part of Scotland induces the belief that the Scottish *mer de glace* became confluent with that of Ireland, splitting upon the northern coasts of Galway and flowing south into what is now the Irish Sea, and west into the Atlantic. But to what extent that ice-sheet stretched seaward, it would be premature at present to offer even a conjecture. That we shall yet be able to form some approximately true estimate of the depth and breadth of the *mer de glace* can hardly be doubted. Towards this end, it obviously becomes important to trace the direction of