41. On *CHONDROSTEUS ACIPENSEROIDES*, Agassiz.

By JAMES W. DAVIS, Esq., F.L.S., &c. (Read March 9, 1887.)

[PLATE XXIII.]

Two species of *Chondrosteus* have been described by Sir Philip Egerton, viz. *Chondrosteus acipenseroides* and *C. crassior*. Both were obtained from the Lias of Lyme Regis. The former species was known to Louis Agassiz, who named, but did not describe it ('Poissons Fossiles,' vol. ii. part 2, p. 280). In 1858 Egerton communicated a paper to the Royal Society (Phil. Trans. vol. xlviii. p. 871) on *Chondrosteus*, in which he described a number of specimens, which he referred to the species named by Agassiz and to the second one named above. The specimen which afforded the most perfect description was in a slab of indurated shale. A part of the head and the tail were missing; the length of the parts preserved was 15 inches, and the total length of the fish was estimated at 24 inches. This, together with examples of the head of *C. acipenseroides*, and a head and a good example of the tail of *C. crassior*, afforded a large amount of detailed information, on which Sir Philip Egerton was enabled to base the description and the determination of the genus. The characters of the species are indicated as follows (*loc. cit.* p. 883):—"The numerous specimens derived from smaller individuals present indications of two species, one having the bones of the head thin and smooth, the other being characterized by stronger cranial plates, having a granulated exterior. The anal fins of the latter are more massive, and have the transverse articulations at shorter intervals. I propose to retain the Agassizian name *Chondrosteus acipenseroides* for the former, and to designate the latter as *Chondrosteus crassior*." In addition to these, mention is also made of a third species, *C. pachyrurus*, a large fish, estimated at 5 feet in length; only fragments were known, the tail being most perfectly preserved. Of the tail, the most remarkable character is "the excessive development of the scales bordering the upper margin. The size and solidity of these scales is such that they more resemble the broad teeth of an *Acrodus* than any dermal development with which I am acquainted." The length of the tail is about 18 inches.

Examples of the fossil fishes of the genus *Chondrosteus*, Agass., are not unfrequently found in the Lias shales of Lyme Regis; but it rarely happens that a specimen is found so well preserved as the one it is now proposed to describe (Pl. XXIII.). The head (with the exception of the snout), the trunk, and the tail are exceptionally complete, and during fossilization have maintained their proper relative position. The bones remaining in their natural position afford evidence, which has not hitherto been available, of the exact size and relative proportions of the fish; and, what is of equal or still greater importance, in addition to the osseous structure of the head and that of the tail, a considerable portion of the elements of the vertebral column is preserved. The dorsal and pectoral fins are

W. H. Cresswell del. et lith.

CHONDROSTEUS ACIPENSEROIDES, Agassiz.
One sixth natural size.

Wideman Bros. imp.

present, and the ventrals are represented by a mass of bony ray broken and fragmentary, but indicating clearly the position of the fins. The anal fin is wanting in this specimen. The length of the fish, from the tip of the upper lobe of the tail to the anterior extremity of the head, so far as preserved, is 44 inches. Of this length, the tail occupies 12 inches; and the head, from the posterior margin of the scapular arch to the anterior extremity of the mandible, is 9·2 inches. The height of the posterior part of the head is 9 inches. The body behind the head decreases rapidly in size; between the dorsal surface and the pectoral fin there is 7·5 inches. At the anterior base of the dorsal fin, ten inches further back, the depth has decreased to 5·5 inches, and this is reduced at the tail to 2·5 inches. The expansion of the caudal fin is very rapid, the extremities of the lobes being 13 inches apart. The single dorsal fin is separated from the occiput by a distance of 11·5 inches; its base extends 6·5 inches, and its posterior extremity is 5·5 inches from the base of the caudal fin. The ventral fin is opposite to the posterior part of the dorsal; its anterior rays are separated from the anterior rays of the pectoral fin by a distance of 13 inches, and from the base of the tail by about 7 inches. Its base was between 4 and 5 inches in extent.

The head in this specimen is proportionately larger and deeper than the body of the fish. This comparative largeness is due, to some extent, to the effects of lateral pressure during fossilization, by which the skull has been squeezed flat on its side. The cranial bones, which covered the surface of the crown, are pressed into a lateral position, dividing down each side from the median suture. The facial and maxillary, the hyoid and branchial elements are also pushed considerably from their proper position, though they still maintain their relative positions with regard to each other.

The head, as preserved in this specimen, has an almost circular outline, with a diameter of about 9·0 inches (see diagram, p. 607). The anterior termination of the snout is absent, and no evidence is afforded as to the length to which it may have extended forward, this part of the specimen having been most unfortunately broken and lost during its extraction from the matrix.

The cranium was protected by dermal bones or scutes. The upper surface was enveloped by large plates, which extended downwards so as to encircle the orbit, and the postero-lateral surfaces were covered by a large expansion of the opercular apparatus. The anterior portion of the head beneath the orbit does not exhibit any traces of external defence. In this respect the fossil *Chondrosteus* differs materially from the existing Sturgeons, in which the whole of the superior surface of the head is enveloped in osseous plates. The opercular apparatus is large and well developed; its posterior margin rests on the depressed anterior surface of the scapular arch. The operculum (28*) is 3·5 inches in height and 3·0 inches in breadth; its anterior margin is somewhat angular, and the inferior one forms a concavity fitting to the upper convex margin of the

* The numbers thus given in brackets are those employed by Sir Richard Owen to indicate the bones of the head.

suboperculum (32). The latter is 2·0 inches in breadth and 1·0 inch in depth, ovoid in outline, with an acute angle behind and an obtuse

Diagram of the Bones of the Head of Chondrosteus acipenseroides
(One third natural size.)

pf, postfrontal.

fr, frontal.

pa, parietal.

ma, mastoid.

so, supraoccipital.

ex, exoccipital or petrosal.

ss, suprascapular.

hm, hyomandibular.

bs, basisphenoid.

sc, scapular.

op, operculum.

c, coracoid.

sop, suboperculum.

r, radius.

u, ulna.

br, branchiostegal
rays.

ch, ceratohyal.

ht, hypotympanic.

mt, mesotympanic.

mx, maxilla.

md, mandible.

p, palatine.

as, alisphenoid.

ps, presphenoid.

io, infraorbital.

o, orbit.

one in front. The external surfaces of the opercular bones are rudely punctate, and exhibit a series of lines or striæ radiating from the upper anterior surface towards the margin. To the lower concave

anterior margin of the operculum there was, probably, attached an inter-operculum; but though its place appears to be indicated, there is no trace of the bone remaining.

The frontals, postfrontals, parietals, mastoid, and some of the occipital bones are present. There is indication of an extension of the frontals on a portion of the matrix, which extends about an inch forward from that part of the dermal bones actually preserved. All the bones are united by sutures. The frontals are 2·5 inches in length and 1·0 inch in breadth; they are broadest posteriorly, where they join the parietals and mastoid. Attached to the inferior margin of the frontal is the postfrontal (sphenotic of Parker), shorter than the frontal, and extending downwards so as to embrace the upper margin of the orbit; its posterior margin articulates with the mastoid. The mastoid is a large plate, with a length of 3·0 inches; it is 1·3 inch in width near the posterior extremity, diminishing forward to 1·0 inch. The centre of the plate is considerably raised and forms a ridge; from this the surface declines to the extremities, which are much thinner and are jagged and uneven where attached to the neighbouring plates. The external surface of the mastoid is coarsely striated or ridged. The ridges radiate, for the most part, from the centre towards the margin; the surface of the ridges is covered by strips of ganoine, apparently thin, and not extending to the base of the intermediate striations. The parietal plates are equal in size to the frontals; they are rhomboidal in outline, roughly striated on the surface, the striæ radiating from a slight elevation of the median portion. Connected with the posterior margin of the parietal plate there is a long and narrow bone. It extends backwards 3·0 inches, and is 0·5 inch in width. It presents the appearance of being a lateral bone, having a complementary one on the opposite side of the head, to which it is ankylosed or joined by suture. In the recent Sturgeon a single median bone terminates the cranial covering, and is succeeded by the closely-imbricating series of scutes, which extend along the dorsal surface of the body. In the fossil there is no evidence of such a series of dermal scutes, and this posterior portion of the dermal covering of the cranium is proportionately much elongated; the lateral surfaces of the combined plates are produced along the median line, and form a raised and acutely angular ridge. The posterior surface of the plate is covered with coarse pustulations of enamel; its anterior portion envelopes, and apparently affords attachment to, the upper extremity of the suprascapular. The bones occupy the position, and are probably the equivalents, of the supraoccipital (8). Another bone, thin and widely expanded, whose posterior margin is overlain by the suprascapular, whilst its anterior one lies hidden by the dermal bones of the postorbital region of the skull, from its position must represent either the exoccipital or the petrosal portion of the base of the cranium, and may have been connected with the basisphenoid by cartilage when living, though now separated by a distance of 0·25 inch.

The orbit is oval, 1.2 inch from back to front, and 0.75 inch in height. Its upper margin is bounded by the postfrontal (sphenotic) bone, to the lower anterior extremity of which there is attached a long and narrow bone (100), which bounds the orbit anteriorly and separates it from the nasal orifice. The anteorbital region of the head is, for the most part, lost. Sufficient indication of the arrangement of the bones composing that part is left to show that the nostril was large, and was, in its turn, surrounded by osseous structures forming the anterior termination of the snout; unfortunately the extent to which the latter projected cannot be ascertained, but a comparison of the bones composing the skull of the fossil with those of recent species appears to indicate a short rather than a long snout. The infraorbital margin is occupied by a bone, or series of bones, it is not easy to determine which, extending backwards from the lower part of the one already mentioned as dividing the orbit from the nasal cavity beneath the orbit, forming a semicircular ring, and joining the under surface of the cranium at the point where the postfrontal is attached to the squamosal or mastoid.

The base of the skull is formed by bones more completely ossified than in the existing species of Sturgeons, and forming the roof of the branchial, as well as the buccal cavity. The posterior portion of the basisphenoid (6) extends posteriorly considerably beyond the point of attachment of the suprascapula (post-temporal). It is broadly expanded, thin, and fibrous in structure. Its extension forwards is hidden for some distance by the epitympanic (hyomandibular), beyond which it can be again traced, extending beneath the orbit and the nasal cavity. Lateral expansions of the bone appear beneath the suture joining the mastoid with the frontal, and, in all probability, represent the alisphenoid (prooticum); while the extension further forward may represent the presphenoid or vomerine portion of the roof of the mouth.

The posterior margin of the head is formed by the scapular arch, which extends in the form of a semicircle from the occipital region of the skull, giving attachment to the pectoral fin, and extending as far forward as the anterior margin of the operculum. The upper portion of the arch is formed by the suprascapular (post-temporal, 46), extending from the base of the skull 2.5 inches; it is long and narrow, thick posteriorly, and convex in outline; anteriorly, the bone is thinner and slightly expanded towards its lower extremity. Attached to the suprascapula is the second bone of the series, the scapular (supraclavicular, 47); it is 3.0 inches in length, thick and strong, slightly over 1.0 inch in breadth in the upper part, but becoming narrower towards its lower extremity. The anterior portion of this element of the arch, like that of the suprascapular, is comparatively thin and aliform. The coracoid (clavicular, 48) is a large bone, extending beneath the scapula at its upper extremity, and curving downwards anteriorly beneath the opercular apparatus, by which it is, to a large extent, enveloped. It is thick and rounded, affording a strong support to the large pectoral fin. Its exact form is hidden by the overlapping operculum,

and the inner extent of the bone cannot be distinguished. Between the coracoid and the pectoral fin there are two bones connecting them together. The anterior one, 0·7 inch in breadth and 0·25 in length, is rounded in front, where it affords a substantial support to the large anterior ray of the pectoral fin; behind it is somewhat attenuated. The second intermediate bone extends from the posterior extremity of the one described to the termination of the base of the fin, and is nearly 2·0 inches in extent; to it are attached the bases of the remaining rays of the pectoral fin. The two bones probably represent the radius and ulna of Owen (coracoid and scapula of Parker and Huxley). Sir Philip Egerton*, in his description of the genus *Chondrosteus*, states that the elements of the bony girdle encircling the thoracic region, which in recent Sturgeons are three in number, in the fossil genus are reduced to two, by the coalescence of the scapula and the coracoid. "The external portion [of the combined scapulo-coracoid] is crescentic, the concavity being anterior for the reception of the opercular flap. At the point of attachment of the pectoral fin the bone is thick and rounded; the upper or scapular portion expands gradually into a triangular plate, thinning off towards the upper extremity for adjustment with the suprascapular bone; the lower or coracoid portion also expands as it descends, sweeping under the thorax, and meeting the corresponding bone of the opposite side on the median line. . . . Anteriorly, each scapulo-coracoid expands into a broad concave plate, directed inwards and forming the platform of the branchial cavity, and partitioning it off from the thoracic cavity." In the specimen now described the great lateral and anterior expansions do not appear to be developed as in the specimens described by Sir P. Egerton; and the scapula and coracoid are separated, the two overlapping midway between the attachment of the pectoral fin and the junction with the suprascapular. The small bones connecting the scapular arch with the pectoral fin in the species already referred to are said to be a series of strong metacarpal bones, of which those supporting the hinder rays are longest. A reference to the plate (*op. cit.* lxix. 57) on which these bones are represented will show that the metacarpals are not similar to the bones existing in this specimen, described as equivalent to the ulna and radius; they have the appearance of being merely fragments of the rays of the pectoral fin which have become detached. This pectoral fin is large and comprises 42 rays. The anterior ray is spinous, thick, with expanded base for attachment; it gradually tapers to a point, terminating 2·5 inches from the base. The succeeding rays are the longest. In this specimen there is preserved a length of 4·25 inches, but the distal extremities are imperfect, and at least one inch more would be required to complete the length of the fin-rays. The base of the fin nearly approaches 3·0 inches in length, and the fin-rays gradually diminish backward; the posterior rays are not more than half the length of the anterior ones. The rays increase, towards the distal end, by

* "On *Chondrosteus*, an extinct Genus of the Sturionidæ found in the Lias formation at Lyne-Regis," Phil. Trans. vol. cxlviii. 1858, p. 871.

bifurcation. A keel extends along the lateral surface of each ray, and a line of pustulations extends along the median surface of the keel. The anterior ray or spine is quite smooth. The fin is capable of wide expansion; as preserved, the breadth of the outer margin of the fin is equal to the length of the anterior rays. The pectoral fins in this species approach the existing forms in possessing a strong, spinous anterior ray, and, to the same extent, seem to differ from the fossil forms described by Sir Philip Egerton from the same locality.

The tympanic arch or suspensorium consists of three parts, each of which is represented by a tolerably complete ossification, and together they connect the cranial bones with the mandible. The epitympanic or hyomandibular (23) is the most prominent bone of the series: it is 3·3 inches in length, the articular surface is 1·2 inch across; it is contracted in the middle, and expands again at its lower extremity to slightly under one inch in breadth. The bone is thick and strong, and has a solid fibrous appearance. Its upper extremity has a double surface for articulation, and was connected with the mastoid, and probably with the postfrontal bone, though the connexion is not quite so clear as that with the mastoid in this specimen. The lower extremity is rounded and thinner than the upper; to it is attached a smaller plate, the mesotympanic or symplectic (31); the latter is partially covered by the operculum posteriorly. Its exposed surface is 0·8 inch across; its lower extremity affords attachment to the hypotympanic or quadrate (26), an ossification of considerable size supporting the posterior extremity of the mandible. Its form is not readily distinguishable. Its posterior margin is covered by the operculum; anteriorly its extent is lost amidst several smaller bones which may pertain to the hyoid apparatus.

The hyoid apparatus is mostly hidden by the bones of the tympanum and the operculum. Between the suboperculum and the mandible, a distance of 2 or 3 inches, the ceratohyal (38) may be distinguished, with six short bones attached to it, the latter evidently bearing some relation to the branchiostegal rays (43); the posterior ray is one inch in length, those succeeding are shorter, and they also diminish in thickness. The anterior bones of the hyoid arch are obscure. In a cavity above the ceratohyal, bounded by the posterior part of the lower jaw and the hypotympanic, three bones are exhibited; the exposed parts are 0·2 inch in thickness at the anterior end, decreasing backwards as they sink beneath the superincumbent bones. These osseous rods represent some part of the branchial apparatus, probably the basal portion of the ceratobranchials.

The mandibles and the maxillaries in this species are large and well ossified; in this respect differing considerably from the existing species. There is no evidence of teeth, and the inference naturally arises that the fossil, like its recent representatives, was devoid of teeth. The mandible (34) is 4·5 inches in length, to the extent preserved; but it is probable that a little more must be added, because the bone ends abruptly; its anterior termination is wanting. The external

surface of the jaw is strong and rounded, 0.5 inch in diameter. Posteriorly it becomes thinner and assumes an expanded form; the inferior margin is also rounded, whilst the superior extremity is produced to form a styliform process extending backward quite half an inch. It was probably by this process that the mandibular bone was connected with the quadrate or hypotympanic, with which it is in close proximity. The part preserved may be equivalent to the dentary element in the lower jaw of the Teleosteans; and the posterior articular portion which connected the jaw with the hypotympanic, in this specimen defective, may have been mostly cartilaginous, with a thin osseous structure, of which there is a trace extending over the ceratobranchials. The maxillary bone (18) is large and crescentic in outline; its anterior portion, like that of the mandible, is thicker and stronger than the posterior. It commences in front in connexion with the premaxillary; the upper margin of the former is overlain by the lower portion of the latter. The total length of the maxilla, allowing for its curvature, is 4.5 inches; its height at the anterior part is 0.5 inch. The upper surface is deeply concave, the lower one angular; the depth at 2.0 inches from the anterior extremity is increased to 1.0 inch; thence it decreases towards the upper posterior extremity to 0.35 inch about half an inch from the end. The latter again expands and is more or less rounded.

The posterior expansion of a large bone midway between the orbit and the maxilla is the palatine (22). It is 1.3 inch in breadth, the length of the part preserved is 2.0 inches. It has a fibrous structure radiating from the anterior extremity of the broken bone. Its posterior margin is rounded, the anterior part is constricted to 1.0 inch in breadth. The remaining part of the bone has disappeared with the whole of the anterior extremity of the head, by the loss of a portion of the slab on which the fossil is exposed. The posterior margin of the palatine is in close contact with the tympanic elements and with the posterior extremity of the upper jaw. Between the palatine and the epitympanic bone there are a few small bones or fragments, of an indefinite character, which cannot be localized with any amount of certainty.

Osseous neurapophyses are preserved in the anterior portion of the body. There is no trace of the vertebral column nor of ribs or hæmapophyses, except in the caudal fin, where hæmapophyses support the lower lobe, as will be mentioned hereafter. The neurapophyses extend from the occipital region of the skull, situated high in the body, to the base of the dorsal fin, a length of 13.0 inches. In this length there are preserved 35 neurapophyses representing the same number of vertebræ. The first ray of the dorsal fin is inserted above the 30th vertebra. The total number of vertebræ comprised in the spinal column would in all probability be from 80 to 85. The anterior neurapophyses are 0.7 inch in length, divided at the base for the passage of the spinal cord, somewhat constricted mesially, and expanded at the upper extremity to afford attachment to a second series of interspinous bones, 1.25 inch in

length, extending diagonally towards the dorsal surface of the body. The interspinous bones are more slender than the neurapophyses; they are forked at the base, and may afford protection to a second canal. Sir Philip Egerton* cites the description by Prof. Owen of the vertebræ in the existing Sturgeon as composed of "two superimposed pieces on each side, the basal portion bounding the neural canal, the apical portion the parallel canal, filled by fibrous elastic ligament and adipose tissue; above this is the single cartilaginous neural spine"†. Of the fossil examples described by Sir Philip Egerton, it is stated that the neurapophyses appear to be composed of two elements, corresponding to the basal and apical cartilages of the Sturgeon; but whether they embraced a second canal, running parallel with the spinal cord, could not be ascertained. The divided base of the apical neurapophyses or spines of the specimen now described affords conclusive evidence that a second canal did exist in the fossil *Chondrosteus*, as in the recent Sturgeon. In addition to the two sets of basal and apical neurapophyses, the dorsal fin is supported by an additional double series of bones. Connected with the apical neurapophyses there is a series of interneural spines, more or less pointed at their lower extremity, exceeding an inch in length, and with their upper extremities expanded so as to afford attachment to a second range of interneurals, to which the rays of the dorsal fin are attached. Between the expanded and rounded extremities of the two rows of interneural spines there is a continuous space which indicates a cartilaginous attachment of no small size and strength; its decay has left the two sets of bones separated by 0·3 of an inch. The interspinous bones are strong, and would afford a firm base of attachment for the rays of the large dorsal fin.

The dorsal fin extends along the back 6·5 inches, and its longest rays are fully 6·0 inches in length. It is composed of 66 rays, of which the anterior 15 are short and more or less rudimentary; they occupy 1·75 inch of the base of the fin. The first rays are short, thick, and imbricating; they gradually increase in length to about an inch. All are simple. The succeeding rays are transversely jointed, and increase rapidly in length to the seventh; the twenty-second from the anterior extremity of the fin is the longest, the succeeding rays gradually diminish to the posterior extremity of the fin. All the rays, except the anterior fifteen, are jointed quite from the base. The longest anterior rays bifurcate three inches from the base, and the division is repeated nearer the distal extremity. The bifurcation commences in the posterior rays nearer the base in proportion to the length.

The ventral fin is much disturbed. The fin-rays are numerous, many of the fragments are thick and strong, and indicate somewhat large and powerful fins. There is no appearance of ordinary pubic bones; but the anterior origin of the fin is marked by a V-shaped bone 1·2 in length; it apparently forms a single piece for 0·5 inch,

* *Op. cit.* p. 879.

† Hunterian Lectures, 8vo, vol. ii. p. 53 (1846

beyond which it bifurcates, possibly to support the two ventral fins. The bone is opposite to the anterior insertion of the dorsal fin.

The anal fin is not represented.

The caudal fin is very large, and a most powerful organ of propulsion. The upper lobe, as in the recent Sturgeon, is the longer of the two, and its extremity is more pointed than that of the lower one. The length of the upper lobe is 12·0 inches, that of the lower 10·5 inches, and the terminations of the two are 13·0 inches apart. Along the median portion of the upper lobe there is a series of dermal scales or scutes; at the basal part of the tail they cover about an inch in breadth and extend almost to the termination of the tail, gradually diminishing in area until they end in a point. The scales at the base of the tail are of an elongated oval form; posteriorly they are greatly elongated and assume a rod-like form pointed at each end. The upper external margin of the fin is formed of a series of large, sigmoidally-curved, imbricating, fulcral scales. Those attached immediately behind the pedicle of the tail are about 1·0 inch in length, 0·2 inch in thickness in the middle; the basal and distal extremities are somewhat spatulate and thin. Succeeding scales become more attenuated, and midway their length has increased to 2·5 inches, with a medium thickness of 0·1 inch; thence to the end they diminish both in length and thickness. The strong basal fulcral scales are directly supported by a series of short but thick neurapophyses. The latter do not appear to extend more than two inches beyond the base of the tail. The lower lobe of the tail is supported by hæmapophyses of larger size and more solid construction than the neurapophyses; they are expanded at the base, and have evidently been firmly attached to a powerful vertebral axis. The latter was entirely cartilaginous and has disappeared. The hæmapophyses can be distinguished a distance of six inches from the base of the tail; they gradually diminish in length, but become broader and spatulate as they approach the termination of the vertebral column. Attached to the hæmapophyses there is a long series of interhæmal bones, which form the base of attachment for the rays of the fin. The latter are strong and jointed from the base. A few short rudimentary rays are followed by others which extend to the extremity of the lobe; they are divided towards the extremity of each ray, the divided portions again bifurcating until the external margin of the fin has assumed a more or less filamentous condition. The rays decrease in length and thickness as they are successively attached to the fin, extending quite to the extremity of the upper lobe. From the base to a point halfway towards the termination of the upper lobe 72 rays may be counted; beyond this point there are many others, but the actual number is not easy to determine.

The specimen of *Chondrosteus* described in the preceding pages is nearly twice the length of those described by Sir Philip Egerton (excluding *C. pachyurus*, which is only mentioned incidentally), whilst the depth of the body, taken in front of the dorsal fin, is 6 inches, the same as that of *C. acipenseroides*, so that this species approaches

much more nearly to the existing types. In this specimen the length of the body from the base of the pectoral fin to the pedicle of the caudal fin is 24 inches, the length of the caudal is 12 inches; in Egerton's specimens the proportions are as 15 inches to 9 inches; though it is possible that as the caudal fin was not attached to the body in the latter instance, the estimation of the proportionate lengths of the body and tail may have been exaggerated in the case of the latter. The ventral and dorsal fins are described as being midway between the base of the pectoral and that of the caudal; in this specimen the distance between the pectoral and ventral is 14 inches, and between the latter and the caudal 10 inches. The dorsal fin of this specimen is readily distinguished by the large number of short rudimentary or accessory rays forming its anterior portion; and the pectoral fin is possessed of a strong anterior spinous ray very similar to that of some recent Sturgeons.

Some differences in the cranial anatomy have been already mentioned. The division of the scapular arch into three parts—the suprascapula, the scapula, and the coracoid—in this specimen appears to be undoubted, whilst in those previously described the scapula and coracoid are said to be united. In the existing Sturgeons the two latter ossifications of the shoulder-girdle are separate*, and in the Ganoid fishes generally this is also the case.

The mandibular suspensorium, in the examples described by Sir P. Egerton, is stated to consist of a large epitympanic bone connected with the tympanic pedicle; the succeeding cartilages, the mesotympanic and hypotympanic, which are represented in the recent Sturgeon by two cartilages, are united to form one bony plate. This united bone is very small and feeble as compared with the epitympanic, and is considered ill-adapted, either in form or dimensions, to afford an articulation strong enough to support the mandibular and maxillary organs. Dr. Günther† states that the suspensorium in the Sturgeon is movably attached to the side of the skull, and consists of two pieces, a hyomandibular (epitympanic) and a symplectic, which now appears for the first time as a separate piece, and to which the hyoid is attached; as regards the second part of the suspensorial apparatus the Sturgeons are distinctly in advance of the palæoniscoid Ganoids, in which Dr. Traquair has seen no trace of symplectic‡.

A careful comparison of the numerous specimens of the genus *Chondrosteus*, at present located in the New Natural History department of the British Museum, has led to the conclusion that there is no specific difference between the species *Chondrosteus acipenseroides*, Agassiz, and *C. crassior*, Egerton. The characters separating the two, as stated by Sir Philip Egerton, are slight, consisting in the relative thickness of the cranial bones and the position of the anal fin. The former difference can scarcely be maintained, because the specimens merge gradually the one into the other, and

* Prof. W. K. Parker, "On the Shoulder-girdle and Sternum."

† 'Study of Fishes,' 1880, p. 76.

‡ Palæoniscidæ (Palæontographical Soc., vol. xxi. 1877, p. 17)

the thicker ossification appears to depend more on the age of the fish than anything else. The evidence of the anal fin is derived from very fragmentary specimens. The anal fin of *C. crassior* is described as more massive and having the transverse articulations at shorter intervals than the anal fin of *C. acipenseroides*—the latter being represented in the specimen depicted on plate lxxvii. (Phil. Trans.), and the former, in conjunction with the caudal fin regarded by the author as belonging to the species *C. crassior*, on pl. lxx. It was unfortunate that no specimen was known to Sir Philip Egerton having the body sufficiently well preserved to show the actual relationship of the caudal fin with the remaining constituents. The specimen herein described proves that there is no difference between the tail described as belonging to *C. crassior* and the one actually attached in this specimen to the body of *C. acipenseroides*, so that the former must be united with the latter species. It is very probable that better preserved specimens will exhibit an equal similarity in the anal fins; and until such are found it must be remembered that the anal fin on which Sir Philip Egerton based his determination is the one attached to the caudal fin mentioned above, and which is undoubtedly the tail of *C. acipenseroides*, Ag.

EXPLANATION OF PLATE XXIII.

Specimen of *Chondrosteus acipenseroides*, Ag., from the Lias of Lyme Regis, one-sixth natural size. *op*, operculum; *p*, pubis (?); *v*, ventral fin.

DISCUSSION.

The PRESIDENT observed that the subject was one to which the Author had devoted much labour, and that the comparison of such fossil forms with existing ones was of the greatest importance.

Mr. SMITH WOODWARD regretted that there was no specimen to verify the drawings, which seemed to show the bones with unusual clearness. A figure of so instructive a fossil would be especially valuable; but he advocated a more modern nomenclature than that of the Author. He considered the absence of an anal fin accidental. These *Chondrostei* of the Lias formed the connecting-link between the old *Palæoniscidæ* and the living Sturgeons, notably *Polyodon*, and any contribution to their anatomy was thus very welcome to ichthyologists.

Mr. NEWTON remarked on the fact that the tail alone was all that Agassiz had to work upon. In 1858 Egerton gave further descriptions, including parts of the head, but his specimens were crushed. Mr. Davis's specimen was more perfect, and for the most part the bones of the head appeared to be in the position they ought to occupy. He criticized the position of the coracoid with reference to the scapula, the line between them being, as he thought, due to a break in the stone. The appearance of the mouth might also be due to breakage. He referred to the absence of the anal fin and to the apparently disjointed condition of the vertebral column.

The SECRETARY observed that the Author expressly noted the absence of the anal fin.