13. *On some REMAINS of SQUATINA CRANEI, sp. nov., and the MANDIBLE of BELONOSTOMUS CINCTUS, from the CHALK of SUSSEX, preserved in the Collection of HENRY WILLETT, Esq., F.G.S., BRIGHTON MUSEUM. By A. SMITH WOODWARD, Esq., F.G.S., F.Z.S., of the British Museum (Natural History). (Read February 8, 1888.)*

[PLATE VII.]

LAST year, when attempting to elucidate the dentition of the Cretaceous Selachian genus *Ptychodus*, I had the honour of bringing before the notice of the Society an important specimen from the cabinet of Henry Willett, Esq., F.G.S., of Brighton; and in subsequent studies both of this and of contemporaneous ichthyic types I have been favoured by the same gentleman's kind permission to make use of the whole of his valuable collection. Among the fossils there are two, bearing upon the subject of recent inquiries, which seem to reveal points of considerable interest and significance; and of these I propose to offer a brief notice in the present communication. The one specimen adds the "Angel-fish" (*Squatina*) to the list of English Chalk Fishes, and apparently indicates a new species; the other makes known some hitherto unrecognized features in one of the most singular of Cretaceous Ganoids, *Belonostomus cinctus*.

I. *SQUATINA CRANEI*, sp. nov. (Pl. VII. figs. 1-6.)

The remains referable to the Selachian genus *Squatina* consist of a crushed skull, with the mandibular and hyoid arches, and an associated fragment of the pectoral fin, with dermal tubercles. The fossil indicates a small animal, probably not more than thirty inches in length, and the most important of the features it presents are illustrated in figs. 1-6 of the accompanying Plate.

The skull has been crushed somewhat obliquely from above downwards, the jaws of the right side being displaced to a position beneath the middle of the cranium, and the right hyomandibular cartilage, thrown outwards, is completely severed from these. The difficulties of interpretation are, moreover, increased by the unfortunate chance-fracture of the specimen on its discovery. One half of the block of chalk (fig. 1) retains the left hyomandibular (*hm*) and pterygo-quadrate (*ptq*) cartilages, with a portion of the left mandibular (*md*) and ceratohyal (*ch*) viewed from the inner side; in addition to numerous scattered teeth, and the impression of the left half of the cranial roof, to which some of the cartilage adheres. The counterpart block shows the remainder of the left mandibular and ceratohyal cartilages, the complete right hyomandibular, and a fragment of the right mandibular; while there are also undeterminable portions of the cranium itself, besides the associated dermal shagreen already referred to.

The form and relative proportions of the cranium and its appended arches are very similar to those of the living representative of the genus, so far as they are recognizable. The antorbital pro-

cess of the skull (*ao*) presents its usual aspect, and there is the same excavation of the middle of the anterior extremity (*ex*) of the cranial "box." The postorbital process seems to be buried in the matrix, but the contour of the postero-lateral angle of the skull (*pla*) is quite normal, and the depression in the roof in advance of the occiput is apparently of its accustomed proportions. The pterygo-quadrate cartilage (*ptq*) is stout and narrow, with the large pterygo-trabecular process; the precise outlines of the mandibular element are not seen. The left hyomandibular (*hm*) is perfect, in position, of the ordinary shape and size; and the large ceratohyal (*ch*) is shown in pieces upon both halves of the fossil, about two thirds the length of the mandible. There are also apparently some obscure remains of the well-developed labial cartilages.

The dentition is not completely preserved, but the anterior teeth of both the upper and lower jaw are exposed to view. Those near the symphysis of the mandible are relatively high and slender (fig. 3), while the opposing teeth attain but small dimensions (fig. 2); more posteriorly, both above and below, the teeth begin to exhibit the usual lateral elongation (fig. 4) characteristic of the sides of the mouth.

The minute dermal tubercles (fig. 5) are mostly of an oval form, having the outer enamelled surface ornamented with longitudinal or radiating ridges. They were probably scattered over almost the entire trunk. The larger tubercles, like those occurring upon the margins of the paired fins of the existing *Squatina*, are also oval in shape, with a slightly crenulated margin (fig. 6). From the middle of each there rises a large backwardly-directed spine, laterally compressed, and well enamelled.

On comparing the fish, thus fragmentarily indicated, with the species of *Squatina* already satisfactorily known, it is readily distinguished by the great relative size of the spinous dermal tubercles. No defences of this character have hitherto been observed in the extinct forms, and those of the living species are considerably smaller in proportion to the size of the fish. The anterior lower teeth are also more slender than in the existing *Squatina angelus*. I would therefore venture to designate the new English fossil *Squatina Cranei*, associating with it the name of my friend Edward Crane, Esq., F.G.S., Chairman of the Brighton Museum Committee, as a slight acknowledgment of the services he has rendered to the cause of Palæontology and the Institution over which he now presides.

II. BELONOSTOMUS CINCTUS, Agass. (Pl. VII. figs. 7-13.)

The lower jaw of *Belonostomus* has already been, to some extent, elucidated by the researches of Otto Reis*; but no specimen hitherto described has revealed the precise characters of the dentition, or the relations of the hindermost bones. Mr. Willett's fine

* O. Reis, "Ueber *Belonostomus*, *Aspidorhynchus* und ihre Beziehungen zum lebenden *Lepidosteus*," Sitzb. math.-phys. Cl. königl.-bay. Akad. Wiss. München, 1887, pp. 169-172, pl. i. fig. 4.

examples of *Belonostomus cinctus* supply this deficiency in our knowledge of the genus to a considerable extent, and explain the peculiarities of the fragmentary fossils described by Agassiz, besides making known more completely than before the largest presymphysial bone recorded in the annals of vertebrate anatomy.

The principal specimen is shown two thirds of the natural size in fig. 7, and exhibits the mandible and dentition tolerably well preserved, except at the anterior and posterior extremities. The two rami occupy only one half the entire length of the jaw, the anterior half being formed by the enormously elongated presymphysial bone. Each ramus is narrow and deep, gradually tapering in front, and the upper border rises behind, immediately beyond the posterior termination of the tooth-bearing portion. The two rami meet in front at a very acute angle, but imperfections in the fossil do not permit of a determination of the precise characters of the union: the symphysis is elongate, gradually diminishing to a thin edge below, and the enormous presymphysial bone is articulated to the sloping triangular surface thus formed (fig. 8). The last-mentioned bone is a median unpaired element, very gradually tapering to a point anteriorly; it is hollow, compressed below (fig. 9a), keeled inferiorly in the anterior portion, and marked by a shallow longitudinal channel above.

As shown both by this specimen and by another less perfect fossil (fig. 9), originally figured by Dixon, the presymphysial bone is provided with a powerful prehensile dentition. There is a median row of large conical teeth, widely and irregularly spaced, but smaller and more closely approximated in front than behind. These teeth are nearly thirty in number, and each has the form of a hollow cone, enamelled to within a very short distance of the base (fig. 10). The greater length of the enamelled portion is delicately striated, but near the tip the tooth suddenly tapers more rapidly and is smooth. A great number of similar teeth of small size—the largest being little more than one sixth the height of the largest of the median series—are placed irregularly upon the lateral margins of the bone; they are closely clustered together in more than one row, and perhaps somewhat more pointed than the median teeth. Like the latter, they are not placed in sockets, but merely ankylosed to the bone.

The large median teeth end abruptly at the posterior extremity of the presymphysial element; but the small lateral teeth are continued backwards upon the rami of the jaw, increasing in size and at the same time becoming relatively shorter and adapted for crushing. Anteriorly, for a very short space, the dentigerous margin is evidently formed by the true dentary (*d*); but this bone is soon excluded from the upper border, and the large splenial element (*spl*) takes its place. The suture between the two bones is well shown in the side view (fig. 8s). Minute teeth extend far downwards upon the inner side of the splenial, and as the dentition becomes still more adapted for crushing behind, the upper margin of the element is considerably widened, until the anterior width of 2·5 millim. has

passed into a horizontal extent measuring 8 millim. across. The teeth upon this surface are quite mamilliform—somewhat suggestive of the tubercles upon the test of certain Echinoids, like *Cidaris*; and some of the stages by which this extreme form is reached are illustrated in figs. 11–13.

It thus becomes evident that the original specimens described by Agassiz as portions of the mandibular rami of *Belonostomus cinctus* are really fragments of the presymphysial bone of this species.

In the closely allied genus, *Aspidorhynchus*, a relatively small, dentigerous, presymphysial bone has been known for some years, and its homologies have already been discussed, in conjunction with the corresponding element in certain Dinosaurs, by Messrs. Dollo* and Hulke†. It is only lately, however, that the same bone has been discovered in *Belonostomus*. A specimen of *B. speciosus*, Wagn., from the Lithographic Stone of Bavaria, described last year by Otto Reis (*loc. cit.*), reveals a presymphysial bone of considerable size, articulating with the mandible by a <- shaped suture; and a detached example of the same bone of the Liassic *B. Anningiae*‡, in the British Museum (no. P. 513), exhibits the same peculiarities (fig. 14). In *B. cinctus*, as described above—and as is especially well shown in the original of fig. 9—the surface of sutural union with the symphysis is one plane without angulation; and the presymphysial element itself may perhaps be relatively larger than in the earlier species. It may also be added that the mandibular rami of *Aspidorhynchus* present a very close approximation to those of *Belonostomus*, although the splenial, in the last-named genus, assumes greater importance as a dentigerous element, and the teeth it supports appear to be more adapted for crushing.

Some interesting general considerations are suggested by the foregoing brief study of the detached mandible, when taken together with certain other known points in the skeletal anatomy of *Belonostomus*; but these questions have been so recently discussed in the memoir by Otto Reis already quoted, that it will suffice in conclusion merely to note that he has treated the subject in detail.

EXPLANATION OF PLATE VII.

Fig. 1. Crushed head of *Squatina Cranei*, A. S. Woodw., natural size. Lower Chalk, Clayton, near Brighton: *ao*, antorbital process of cranium; *ch*, portion of ceratohyal; *ex*, excavated anterior extremity of cranium; *hm*, hyomandibular; *md*, portion of mandibular ramus; *pla*, postero-lateral angle of skull; *ptq*, pterygo-quadrate.

2. Anterior upper tooth of ditto, side view, twice natural size.

2a. Base of another, under view.

3. Anterior lower tooth of ditto, inner aspect, twice natural size.

3a. Base of another, under view.

* L. Dollo, "Quatrième Note sur les Dinosauriens de Bernissart," Bull. Mus. Roy. d'Hist. Nat. Belg. vol. ii. (1883), pp. 226–229.

† J. W. Hulke, Presidential Address, Proc. Geol. Soc. 1884, pp. 47–51.

‡ Since the reading of this paper I have discovered that this species is truly referable to *Belonorhynchus*, Bronn, and is not improbably identical with *B. acutus*, Agass. sp.

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Fig. 4. Posterior side teeth of ditto, twice natural size.

- 4 *a.* Base of another, under view.
- 5. Minute dermal tubercles of ditto, four times natural size.
- 6. Large spinous dermal tubercle of ditto, twice natural size.
- 7. Mandible of *Belonostomus cinctus*, Agass., viewed from above, two thirds natural size. Upper Chalk, Brighton.
- 8. Side view of portion of ditto, natural size: *d*, dentary; *prs*, presymphysial bone; *s*, sutures; *spl*, splenial.
- 9. Another presymphysial bone of ditto, showing suture, natural size. Upper Chalk, Brighton.
- 9 *a.* Transverse section of presymphysial bone.
- 10. Median presymphysial tooth of ditto, twice natural size.
- 11. Lateral presymphysial tooth of ditto, thrice natural size.
- 12, 13. Teeth of splenial bone of ditto, side view, thrice natural size.
 - 13 *a.* The second, viewed from above.
- 14. Presymphysial bone of *Belonorhynchus Anningiæ*, Ag. sp., natural size. Lower Lias, Lyme Regis. [Brit. Mus. no. P. 513.]

The originals of all the figures, except the last, are in the collection of Henry Willett, Esq., F.G.S., Brighton Museum.

DISCUSSION.

The PRESIDENT spoke of the clear manner in which the Author had laid before the Society the salient points of his paper, with the conclusions of which there appeared to be general agreement.