THE
GEOLOGICAL MAGAZINE.

NEW SERIES. DECADE II. VOL. III.

No. X.—OCTOBER, 1876.

ORIGINAL ARTICLES.

I.—CONTRIBUTIONS TO OUR KNOWLEDGE OF THE FISH-FAUNA OF THE
TERTIARY DEPOSITS OF THE HIGHLANDS OF PADANG, SUMATRA.

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(PLATES XV.—XIX.)

THE GEOLOGICAL MAGAZINE for October, 1875 (pp. 477-486), contains an article "On the Geology of Central Sumatra," by Herr R. D. M. Verbeek, Superintendent of the Geological Survey of that island, in which the position of the fossiliferous rocks of the Highlands of Padang is sketched in a manner as clear as concise, and which must be consulted by those who desire to understand the palæontological age of the fossils described in this paper.

The specimens were collected by Herr Verbeek, and transmitted to Prof. T. Rupert Jones, F.R.S., by whom they were placed in my hands for examination and comparison with the materials in Europe. All are from Tertiary deposits; and more especially from the Marlslates, marked 5 a in Herr Verbeek's diagrammatic section, and from the Carbonaceous shale of 5 b. Those from the latter deposit are in a most fragmentary state—only teeth, spines, and some of the harder bones being preserved; and it would appear that the Fishes did not live actually at the locality where this deposit was formed (may be, out of the low vegetation of a bog), but that fragments of them were carried there by some agency. The fossils from the Marlslates, on the other hand, are in a very good state of preservation, most of the bones being in their natural position and connexion, and even tender parts, such as the fin-rays, being still perfect. The incomplete condition of a part of the specimens is due rather to accidents during or after their removal from the deposit, and to the ready exfoliation to which the matrix is subject.

With regard to their systematic position, these Sumatran fossils stand in the same relation to the recent Fish-fauna of the island, as those of the Brown Coal of Bonn to their successors in recent times. The majority are generically identical with the living forms occurring in the island at the present time; some may be referred to genera hitherto not found in Sumatra, but still persistent in remote parts of the globe; whilst others belong to genera not recognizable in our recent fauna. However, we have to remember that the recent Fish-fauna of Sumatra is but imperfectly and partially known; and

that the specimens representing this class of animals in Museums are unsuitable for thorough comparison with allied extinct forms, being generally young and of small size. Sumatra offers, for many years to come, a rich field to the Zoologist as well as Geologist.¹

The following table will show at a glance the geographical distribution in recent times of the fossil Sumatran genera described in this paper:—

1. <i>Auliscops</i> .	1 species is known from N.W. America.
2. <i>Pseudeutropius</i> .	Several sp. from the Continent of India and Sumatra.
3. <i>Bagarius</i> .	1 sp. from the Continent of India and Java.
4. <i>Thynnichthys</i> .	2 sp. from the Continent of India and 2 from Sumatra.
5. <i>Barbus</i> .	Numerous species all over India.
6. <i>Amblypharyngodon</i> .	3 sp. from the Continent of India.
7. <i>Hexapsephus</i> .	Known from Sumatran fossil only.
8. <i>Notopterus</i> .	Several species from the Continent and Sumatra.
9. <i>Chirocentrus</i> .	1 sp. from the Indian Ocean.

I.—FOSSILS FROM THE MARL-SLATES.

Auliscops sumatranus. (Pl. XV. Fig. 1.)

One species only of this genus has hitherto been known. It occurs on the north-west coast of America, and has been found in salt-water; however, it is a well-ascertained fact that the species of *Gastrosteidae*, to which *Auliscops* is allied, readily change their habitat from fresh- to brackish- and even salt-water, and *vice versa*. *Fistularia* likewise enters fresh-water. As far as the characters of the genus *Auliscops* are known, there appears to be no reason why the Sumatran fossils before us should not be referred to it.

The snout is comparatively short; the centres of the vertebrae are not grooved on their abdominal surface, as in *Fistularia* and *Aulostoma*; the dorsal and anal fins are short; the caudal is rounded, without prolonged central ray; there is a series of anterior dorsal spines; the interneurals are horizontally situated, forming together one continuous bony strip; and there are no external pubic shields.²

Five specimens of this fish are in the collection.

a. The largest is 14½ inches long, showing scarcely more than the general outline of the fish. The interneural strip is well shown, likewise the number of the neural spines, but the centres of the vertebrae of the abdominal portion are destroyed.

b. This specimen (which is figured) is 11 inches long, and is

¹ The manuscript of this paper had been delivered to the Editor, when Mr. Griesbach drew my attention to a paper on "Fossile Fische von Sumatra" by Dr. W. v. d. Marek, Palæontograph. 1876, April, pp. 405-414, pls. 23 and 24. As the materials in the British Museum were much richer than those at the disposal of that author, I had nothing to alter in my manuscript, with the exception of the specific name of the most common fish of this formation, viz. *Thynnichthys amblyostoma*. Through Dr. v. d. Marek's paper I became acquainted with Prof. Rüttimeyer's "Bemerkungen zu den fossilen Fischen von Sumatra" (Abhandl. Schweiz. palæont. Ges. i. 1874). To judge from his description, I think that the fish named "*Smerdis*" by him, will prove to be an *Ambassis*, a genus very common in the fresh-waters of the Indian region. The so-called *Dussumierina* appears to me to be fry, and, at present, indeterminate.

² We may remark here that the skeleton figured by Agassiz, in Poiss. foss. vol. iv. tab. xxxv. fig. i., under the name of *Aulostoma chinense*, is not that species or even genus, but *Fistularia tabaccaria*.

the best preserved of all. The snout lies on the side; behind the eye the skull is twisted, so that its base is visible. Also the abdominal column of vertebrae shows its ventral aspect, the neural spines being so bent as to lie in the same plane as the parapophyses. The right and left series of parapophyses have become detached from the vertebral column, both lie along the right side of the specimen; and still more outwards, towards the left, a series of 21 dorsal spines has left a somewhat faint impression. The caudal portion, with the fins, lies on its side.

We see from this specimen that the snout was not much longer than the remainder of the head ($1\frac{3}{4}$ inches). Some of the foremost vertebrae were confluent into one piece, equal in length to the three following vertebrae. The abdominal portion consists of 27 vertebrae, with compressed centres, not grooved along their ventral surface. The caudal portion consists of 31 vertebrae, much shorter than those of the abdominal portion; 12 of them are in front, 5 below, and 14 behind the dorsal. The soft dorsal consists of 9 or 10, the anal of 8 or 9 rays. The caudal is short, with feeble rays and rounded posterior outlines. The dorsal and anal are highest in front.

On the left-hand side of the posterior part of the head there is visible a flat, sub-crescentic bone, anteriorly with a projecting articular process, from which a gently curved ridge runs along the whole length of the bone. The surface is finely granulated, the granules being partly arranged in radiating striæ. I consider this to be the operculum.

c. The impression of the anterior half of the body of a specimen smaller than the preceding.

d. The anterior portion of the specimen, of about the same size as specimen a.

e. The impression of a fish six inches long.

This fish is probably the one determined by Prof. Geinitz as *Fistularia kœnigii*, Agass. (see GEOL. MAG. 1875, p. 481); but our fish has the central caudal ray not prolonged, and therefore does not belong to *Fistularia*.

This is evidently the same fish which has been described and figured by Dr. W. v. d. Marck as *Protosyngnathus sumatrensis*. The specimens in the British Museum appear to be in a better state of preservation than those examined by that palæontologist, and, therefore, better adapted for the determination of the affinities of this fish.

Pseudeutropius verbeekii. (Pl. XV. Fig. 2.)

The following description is chiefly taken from two specimens in the collection, of which one, if complete, would have been about nine inches long; only a very indistinct impression of a part of the head is preserved. From the dorsal fin backwards this specimen, which lies on its side, is in tolerably good condition. The second specimen lies on its back, and is only $6\frac{1}{2}$ inches long. Other larger examples are more fragmentary, and do not assist much in the examination of this species.

Nothing can be said of the form of the head, except that it appears

to have been rather elongate, with the upper surface of the snout granular. The caudal portion of the vertebral column consists of 27 vertebrae; of the abdominal portion 11 can be distinguished—the entire number consisting probably of about 14.

The dorsal fin consists of a strong, smooth spine, and seven rays. It is inserted at a short distance behind the head, opposite to the fifth to eighth vertebrae. The length of its spine is equal to the length of the thirteen last vertebrae.

The anal fin is low, consisting of twenty-eight short rays. It is supported by interhæmals, which are longer than the fin-rays, and attached to the hæmals, so that two always correspond to one hæmal. Caudal very deeply forked, the length of one of its lobes being equal to that of the nineteen last vertebrae.

Pectoral spines about as long and strong as that of the dorsal fin, strongly serrated. Ventral fins inserted immediately behind the dorsal, consisting of seven rays.

An example in a very fragmentary condition, figured by Dr. W. v. d. Marck under the name of *Brachyspondylus indicus*, probably ought to be referred to the present species. A glance at the geographical distribution of the species of the genus *Pseudentropius* will account for my retaining the specific name given by me, in the place of that of *indicus*.

Bagarius gigas. (Pl. XVI. Fig. 1.)

A large siluroid of the group *Bagarina*, and probably belonging to the genus *Bagarius*, is represented by some remnants of the humeral arch, and a nearly perfect pectoral fin; other portions of the skeleton, such as the branchial apparatus, ribs, etc., being too much broken and confused for more detailed description. The pectoral fin is sickle-shaped, apparently consisting of eleven rays, the first of which is extremely strong and long; rather more than its terminal half is closely articulated, and indistinctly denticulated behind. It is $5\frac{3}{4}$ inches long, and $\frac{1}{2}$ inch broad in its widest part. The humerus is distinguished by the absence of prominent ridges, and of the granulation on the more superficial parts, which evidently were covered by skin. Its symphyseal portion is tapering, showing that the union with its fellow must have been short and loose.

Thynnichthys amblyostoma. (Pl. XVII.)

The remains of this fish appear to be very common in this stratum. There are four apparently adult examples, three of middle size, and three young ones. The largest has a length of $12\frac{1}{2}$ inches. All lie upon their sides, the head being so much crushed, that only a few of the opercular bones and fragments of one or two of the others can be recognized *in situ*. Of the vertebral column nearly the whole (with the exception of the foremost portion) can be made out distinctly, the ribs and scleral spines being rather confused. The fins are sufficiently well preserved to ascertain their structure and position.

The genus *Thynnichthys* is characterized by a peculiar shape of the head, the eye being far below the upper profile and the opercles;

large and firm opercular bones; a short dorsal fin, without osseous spines, and opposite to the ventral fins; a short anal; compressed pharyngeal teeth in three series, and truncated at the top. Such are the characters of this genus which we may expect to be visible in fossil remains, and in which, indeed, the fossils before us agree with the recent species of *Thynnichthys*. The peculiar shape of the mouth of the latter is, however, entirely destroyed in the fossils.

The following parts can be more fully described. The head was large, its length being considerably more than one-half of the length of the vertebral column. The lower jaw was obliquely directed upwards. The margin of the præoperculum, which was not covered by the skin, is wide, deeply ribbed with muciferous channels, radiating towards the edges. The upper and lower limbs of this bone are equal in length, and meet at a right angle, which, however, is rounded off. Operculum very large, striated in its lower half.

As regards general structure, the vertebræ do not differ from those of the genus *Barbus*, those in the middle and posterior portions of the column being rather deeper than long. Fifteen or sixteen belong to the caudal portion of the column; thirteen or twelve may be counted between the first attachment of the interhæmal of the anal and that of the first interneural of the dorsal fin; the foremost part of the column apparently consisting of seven or eight vertebræ, so that the total number of vertebræ does not seem to have exceeded thirty-six. The neurals of the anterior vertebræ were of moderate strength and height (18 millimetres), equal in length to three and a half of the middle vertebræ. The scleral spines were numerous, forming bundles attached to the middle of the neurals and hæmals of the caudal vertebræ, and lying in the direction of the longitudinal axis of the body. The ribs do not show any peculiarity as regards form or size.

The dorsal fin consists of three simple and nine branched rays, the third and fourth rays being the longest, about two-thirds the length of the head; its origin falls vertically before that of the ventrals, nearly midway between the end of the snout and the root of the caudal rays. Anal very short, and only about two-thirds as high as the dorsal; it consists of three simple and five branched rays. Caudal fin deeply forked; the length of the upper lobe being not much less than that of the head. The pectorals appear to have extended to, or nearly to, the root of the ventral fin.

In one specimen only remains of the pharyngeal apparatus could be found. They are *in situ*, and consist of three polished closely adpressed laminæ, in which the crown is still cutting, not worn down by use.

This fish has been described and figured by Dr. W. v. d. Marck as a Clupeoid, *Sardinioides amblyostoma*. However, there can be no doubt as to its belonging to the *Cyprinidæ*.

Barbus megacephalus. (Pl. XVIII.)

This fish is represented by a single specimen, 23 inches long. It is sufficiently well preserved to ascertain the general form of the head

and body, the position of the fins, the structure of the mouth, and the number of fin-rays and vertebrae. With regard to its generic affinity, I am guided in its determination chiefly by the form of the head, and by consideration of the generic composites of the recent fauna of Sumatra. All trace of barbels has disappeared; and the pharyngeal teeth are hidden in the confused mass of the crushed bones of the head.

The head is very long (7 inches), about $\frac{2}{3}$ of the length of the vertebral column, formed of strong massive bones. The snout was particularly long; the eye being situated nearer to the posterior than to the anterior end of the head, close below the upper profile. The maxillary, inter-maxillary, and mandible are strong bones; showing that the cleft of the mouth was of considerable width, but did not extend to the eye.

The vertebrae are higher than long, in fact, short. Eighteen belong to the caudal portion of the column; thirteen may be counted between the attachment of the first interhæmal of the anal, and that of the first interneural of the dorsal fin; the foremost part of the column apparently consisting of ten vertebrae; so that the total number of vertebrae seems to have been about forty-one. The processes and bony appendages of the vertebral column do not show any peculiarity requiring detailed description.

Neither the dorsal nor the anal fins are armed with an anterior thickened spine. The former consists of three simple and nine branched rays; the longest of which is not quite half as long as the head. The origin of this fin is considerably nearer to the root of the caudal, than to the end of the snout, but little in advance of the root of the ventral. Anal fin very short, about $\frac{2}{3}$ as high as the dorsal, consisting of three simple and five branched rays. Caudal deeply forked; the length of its lower lobe being about $\frac{2}{3}$ of that of the head.

The pectorals are not well enough preserved to allow us to judge of their length; but the ventrals were evidently very well developed, the length of their outer ray being nearly equal to that of the largest of the anal fin.

Amblypharyngodon, Blkr. (Pl. XV. Fig. 4.)

It seems that the existence of a large species of this genus is indicated by a pair of pharyngeal bones, armed with globular molar teeth in small number. On one of the bones three teeth are still *in situ*, in a single series, the anterior being the largest, the middle about half as large, and the posterior minute.

Chirocentrus (?) *polyodon*. (Pl. XV. Fig. 3.)

Owing to its fragmentary condition, the determination of this fossil is very uncertain. It appears to come nearest to *Chirocentrus*, on account of the great development and form of the teeth of the lower jaw, those of the upper jaw being much smaller. The whole of the mandibular series of teeth is preserved, with the anterior half of the bone. Of the upper jaw only a fragment and an incomplete impression of the remainder is preserved. The mandibular

series is 45 millim. long, and consists of twenty-three closely-set conical slender teeth, of which the two foremost and the twelfth and thirteenth are much stronger than the rest, 10 millim. long. The greater portion of the maxillary was armed with a single series of conical teeth of about the same size as the small posterior teeth of the mandible.

Common as *Chirocentrus* is on the coasts of the Indian Ocean and Archipelago, I cannot without hesitation refer our fossil to this genus, which, as far as I know, is a marine form.

Notopterus primævus. (Pl. XIX.)

Although no doubt whatever can be entertained as regards the generic affinities of this fish, the specific characters unfortunately can be given but very incompletely; the single specimen before us being mutilated in front and behind. It is evidently most closely allied to the species now living in Sumatra. The lower part of the præoperculum and some ridges of the mandible are distinctly serrated; the abdominal portion of the vertebral column is short, much shorter than the head, formed by about 13 short vertebræ. Forty-one vertebræ of the caudal portion are preserved. The neural and hæmal spines are of moderate strength and length, directed backwards. The interhæmals are about twice as numerous as, and much longer than, the hæmals, generally two of them being attached to one hæmal. The first hæmal and interhæmal are exceedingly strong, firmly wedged together, and forming the posterior boundary of the abdominal cavity. Ribs well developed, extending nearly to the lower part of the abdominal cavity. From their extremities are suspended the scleral bones, which terminate below in a spine, the spines forming the external double serrated edge of the abdomen in this genus. The anal rays are not directly articulated to the interhæmals, but a series of shorter and thinner additional bones is intercalated between the rays and spines, the number of the additional bones being considerably increased above that of the true interhæmals, and equal to that of the fin-rays.

The dorsal fin is short and small, its position corresponding to the fourteenth and fifteenth caudal vertebræ. Pectoral fin moderately, ventral but little developed—as usual in this genus. Scales very small.

The specimen, in its present mutilated state, is $9\frac{1}{2}$ inches long, and may have measured $11\frac{1}{2}$ inches when perfect.

II. — FOSSILS FROM CARBONACEOUS SHALES.

Hexapsephus. (Pl. XVI. Figs. 2 & 3a, b, c.)

In the Tertiary coal-beds of Padang, conical or mammilliform teeth, up to the size of a large pea, are of not uncommon occurrence; their determination would have been a matter of great difficulty; but, fortunately, one or two slabs have been preserved, showing these teeth in their serial connexion, and attached to a bone, which, without any doubt, is the pharyngeal bone of a Cyprinoid fish. Not knowing of any living Cyprinoid with teeth of similar

form and arrangement, I am obliged to refer these remains to a distinct genus.

The pharyngeal bone is of the usual shape, 26 millim. long, armed in its concavity with a single series of three large teeth, each of which differs from its fellows in form. As isolated teeth, but of much larger size and more perfect, are available for examination, I take the description from them.

The hindmost tooth is of conical shape, with the apex excentric, directed towards the second or middle tooth. The greatest diameter of its base is 10 millim. long, the transverse diameter 8, and this is also its height. It reminds us in its general form of that common shell, *Lepeta cæca*. The second tooth has more the shape of the molar of a carnivorous animal. On its crown it is provided with three tubercles, or rather with two longitudinal ridges, of which the outer one is divided by a notch into two tubercles, the more prominent of which is that nearest to the first tooth. This tooth is 9 millim. broad, 6 long, and 9 high. The last tooth is the smallest, much compressed in the longitudinal axis of the dental series. Its upper surface is much ground down, it is only 5 millim. high and 4 wide. A comparison of these large teeth with those attached to the pharyngeal, shows that this Cyprinoid must have attained to as great a size as any of the living species; the pharyngeal may have belonged to a fish 10 inches long.

Besides this fish, there are from the same deposits several dorsal and pectoral spines, evidently belonging to the Siluroid described above as *Pseudeutropius verbeekii*; also some isolated Cyprinoid bones, which, however, are of too general a type to be specifically determined, or to require more than this passing notice.

Finally, I have to add that Dr. W. v. d. Marck describes and figures the posterior portion of a vertebral column under the name of *Brachyspondylus saropteryx*. It appears to me to have belonged to a Cyprinoid fish, but I would not venture to define more nearly its affinities. The presence of nine branched rays in the anal fin may serve as a guide as regards the group, to which this fish ought to be referred.

EXPLANATION OF PLATES XV.-XIX.

- PLATE XV. FIG. 1. *Auliscops sumatranus*, Günther.
 „ 2. *Pseudeutropius verbeekii*, Günther.
 „ 3. *Chirocentrus* (?) *polyodon*, Günther.
 „ 4. *Amblypharyngodon*, Blkr.
 „ XVI. „ 1. *Bagarius gigas*, Günther.
 „ 2. *Hexapsephus*, sp. nat. size, pharyngeal bone, with three teeth *in situ*.
 „ 3a. *Hexapsephus*, pharyngeal teeth.
 „ 3b. „ „
 „ 3c. „ „
 „ XVII. *Thynnichthys amblyostoma*, Marck, sp. (This figure is drawn from two examples as indicated by the line of fracture.)
 „ XVIII. *Barbus megacephalus*, Günther.
 „ XIX. *Notopterus primaevus*, Günther.