

taining shells about midway between the Bay and Bryn Gosol, not far from the turnpike-road. Whilst referring to this district, Mr. Mackintosh's paper suggests my pointing out an example of a higher coast level, as indicated by Pholas-borings. A friend informs me that he has seen these markings high up on the mountain to the west of Conway, but I have no record of their exact altitude.

Referring to Mr. Green's letter, I would remark that the Llandudno district affords clear evidence of the superposition of Glacial drift on the white sands or clays resting on the Carboniferous Limestone; though, it must be admitted, this is not so obvious in Staffordshire. Regarding the source of materials, the broken chert beds that are near Llandudno associated with these deposits, seem to indicate a derivation from the Millstone Grit which, along the north coast of Wales, contains extensive beds of chert. The Bunter beds in North Wales are so invariably red that I scarcely think it probable they can have supplied any materials for the white beds underlying the Boulder-clay drift in that district.

GEORGE MAW.

BENTHALL HALL, BROSELEY,
July 2nd, 1867.

SOME REMARKS ON THE REPORT OF PROFESSOR OWEN'S PAPER
ON FISH REMAINS FOUND IN THE NORTHUMBERLAND
COAL-FIELD.¹

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—I beg to be allowed to make a few remarks on the Report which appeared in the July number of the GEOLOGICAL MAGAZINE of Professor Owen's paper, "On the Dental characters of Genera and species, chiefly of fishes, from the Low Main Seam and shales of coal, Northumberland," (read before the Odontological Society on the 3rd of June last).

I have been engaged for many years in collecting fish and other remains from the Northumberland Coal-field, and have obtained a vast number of specimens, both entire and fragmentary, from the shale in connection with the Low Main Seam at Newsham, West Cramlington, and other places. Mr. T. Craggs, who was cognizant of my operations, gathered, a short time ago, a few specimens of fish-remains, principally teeth, from the same localities; and sent prepared microscopical sections of some of them to Professor Owen, who has, from these materials, described twelve or thirteen new genera, several of which I believe to be founded upon remains previously described, while others are, apparently, the result of an examination of the varied sections of the same forms.

I believe there are no remains noticed in Professor Owen's list, so far as the concise account in the Report enables me to judge, of which there are not numerous specimens in my collection; and as I have had the advantage of examining these under varied conditions—not merely of sections—I am in a position to speak with some degree of

¹ See GEOL. MAG., July, p. 323.

confidence on the subject, having made numerous sections of them in well-determined planes. The specimens submitted for examination appear to have been all very minute examples of their respective kinds, or Prof. Owen would not, I feel sure, have asserted that these "minute fishes" were "of the size of minnows or stickle-backs." Most of these remains have belonged to fishes of no inconsiderable size, some of them, I believe, to the largest fishes of the Coal-measures. The following genera, proposed by Professor Owen, seem to require particular notice:—

Genus I. *Dittodus*.—This is undoubtedly *Diplodus* of Agassiz, and is not a tooth but a dermal spinous tubercle.—I have in my collection vast numbers of such, some detached, others in connection with a thin layer of granular matter, which there can scarcely be any doubt is the skin of some fish. One of these patches in my possession is fifteen inches long and about seven wide. On this the tubercles are comparatively few, and are scattered far apart from each other. But on another patch, measuring fifty-six inches square, they are very numerous, and are crowded together without any apparent order.

These tubercles are analogous to the spinous dermal tubercles found on some of the Rays, only in the Ray there is but one spine, while in that under consideration there are usually three, sometimes two, and rarely only one; when three are present, one is always much smaller than the other two, and rises from the common bony base behind them and opposite to the space between them. So that in making a section to exhibit the two principal spines it is almost impossible to preserve the small posterior one; consequently it happens that only the two large spines are seen united at the base—"the two crowns" as Professor Owen expresses it, being "organically connected together, like the Siamese-twins."

Diplodus varies very much in size, being occasionally quite microscopic, and not unfrequently measuring nearly three-quarters of an inch in length. It also varies considerably in character, the spines, or 'crowns' being frequently long, nearly parallel, and comparatively slender; occasionally they are found diverging, short, stiff, and much bent; numerous specimens occur having characters intermediate to the two extreme forms; there can, therefore, be no doubt that *Dittodus parallelus* and *D. divergens* are mere varieties, the one of the other.

Genus II. *Mitrodus*.—This, I believe, will also prove to be a dermal tubercle. There are occasionally found in the Low Main shale thin layers or patches almost entirely composed of minute compressed bodies, having rising up from their upper or free margin from two to seven conical denticles, which answer very correctly to the account given of this form. I possess such a patch measuring 20 inches long and 13 inches wide. It is spread over with vast multitudes of these tubercular bodies, which are crowded together in a confused manner. Detached specimens of the tubercles also occur.

These tuberculated patches are usually associated with the spines and other remains of *Gyracanthus*, and are most probably the skin

of that fish. Thus it would appear that *Mitrodus*, instead of belonging to a fish of the size of a minnow, is most likely part of one of the largest, if not the very largest, fish of the Coal-measures. *Dittodus* too—as the size of the dermal patches proves—was an animal of no mean dimensions.

Genus III. *Ageleodus*.—This is the *Ctenoptychius* of Agassiz. It occurs of various sizes, and is sometimes minute; but it is frequently upwards of three-tenths of an inch wide, and is usually found detached, though sometimes two are placed end to end; this form has also much the appearance of being a dermal tubercle rather than a tooth. It is much compressed, and the spines, or “dental crowns,” which vary in number from six to sixteen, give to the upper margin a saw-like denticulation. The bony base, giving support to the denticulated portion is, of considerable extent, and has all the appearance of the basal limb of a dermal tubercle.

Genus IV. *Ganacrodus*.—Teeth tipped with enamel are very common in the shale of the Low Main Seam; they vary greatly in size, though not in other respects, but when seen in section they seem to differ considerably. Their apparent curvature depends entirely on the plane of the section, and the point becomes more or less obtuse as this is further from, or nearer to, the axis of the tooth. The apparent extent and form of the enamel-tip also varies much in accordance with the section. Some specimens are entirely coated with a thin film of enamel; in others, traces of it only can be observed; and in some again, it seems entirely wanting, owing apparently to the state of preservation of the specimen.

I have little hesitation in saying that all these teeth tipped with enamel found in the shale overlying the coal of the Low Main Seam at the localities before-mentioned, belong to *Palæoniscus*—the teeth of which genus are always thus tipped with enamel, as I have satisfied myself by sections of several jaws, with the teeth attached, taken from well authenticated specimens.

That *Palæoniscus* occurs abundantly in this shale I have ample proofs, having taken from it well preserved individuals of this genus, besides numerous fragmentary specimens. The teeth of *Amblypterus* and *Pygopterus* are likewise tipped with enamel, but the latter genus has not yet been found in the localities named. *Amblypterus* is very rare: the tooth of *Pygopterus* is extremely characteristic, and is readily distinguished by the obtuseness of the terminal enamel.

The teeth of *Palæoniscus* vary much in size in the same individual, some being quite microscopic, others comparatively very large. The minute ones are exceedingly numerous, and much crowded; the larger are few in number, and considerably apart from each other.

Genus V. *Ganalodus*.—There are two of this number. Genus 5, *Mioganodus*, and Genus 6, *Aganodus*, are probably all founded on teeth belonging to either *Palæoniscus* or *Amblypterus*, both of which genera occur in the shale connected with the Low Main.

Genus VII. *Pternodus*.—When a single spine of *Diplodus* is observed in lateral section, it has a heeled appearance, and in other

respects agrees with the characters of this genus, so far as they are given in the Report. The variety of *Diplodus* with a single spine also exhibits the same peculiar feature.

The characters of the four other genera, described in the paper, are too concisely given in the Report to enable me to form any decided opinion respecting them, though I venture to think that more than one are apparently only varieties of previously described forms.

THOMAS ATTHEY.

GASFORTH, NEWCASTLE-ON-TYNE,
July 15, 1867.

THE WEAVER CLAYS.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—When I paid my first visit to the Ribden Fire-clay Pit several years ago, I formed pretty much the same opinion as that now held by Mr. Green, viz., that the deposit consisted of local washings from surrounding strata, gathered into a wide fissure. I have since then, however, made many journeys to the district, and I have convinced myself, from a leisurely examination of *all* the openings which have been made in search of “clay,” that the deposit is a very extensive one, and *truly of marine origin*. The beds extend over an area of nearly two miles in length, with a width varying from a quarter of a mile to a mile and a half.

Mr. Green is in error in attributing the parentage of the sands and clays to the Bunter. The greater portion of the deposit has certainly been derived from the Millstone grit strata that still prevail so largely to the westward of Weaver. Immense blocks of grit, of different degrees of hardness and coarseness, are thickly embedded in the sands at Caldon Low, and they are to be seen in every state of degradation, from the hard unperished stone to incoherent sand, that merely shows where the blocks previously existed, by a slight difference of tint from that of the sand of the matrix. A very small percentage only of the sands of the deposit have been derived from the Bunter.

The sands in some parts of the deposit are as white as the best Alum Bay sand. They are so free from iron that, at my recommendation, they have been tried lately for glassmaking, and they have been found to answer very well. Bunter sand could scarcely, under any circumstances, have been washed sufficiently free from iron to stand this manufacturing test.

With regard to the “Boulder-clay Drift,” I must state it to be my firm conviction that the red bed which overlies the “Weaver Clays,” in some parts to the thickness of from twelve to fifteen feet, does really belong to that formation. It lies in many places where it could not have been deposited by subaerial action; it contains rounded and subangular masses of stone of many formations, and it has itself been subjected to after-denudation. It is also of similar character to the red clay that is seen to fill the fissures in Caldon Low, at a height of twelve hundred feet; and to be piled on the