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ORIGINAL ARTICLES.

I.—ON SOME NEW ZEALAND GRAPTOLITES.

By ETHEL M. R. SHAKESPEAR, D.Sc.

THE New Zealand graptolites which are dealt with in this paper were collected by Mr. E. Douglas Isaacson, mining engineer, New Zealand, for the British Museum (Natural History), South Kensington. Dr. A. Smith Woodward, F.R.S., very kindly gave me the opportunity of examining this interesting collection, which was sent to me in the Autumn of 1907. Shortly after its receipt Dr. Woodward forwarded me a copy of the New Zealand Geological Survey publication entitled "The Geology of the Parapara Sub-division, Karamea, Nelson," by James Mackintosh Bell, Director, 1907, which contains brief descriptions and figures of graptolites collected from the same locality as that from which Mr. Isaacson collected his specimens. Since, however, the records of graptolites from New Zealand are very limited in number, and since Mr. Isaacson's collection contains a greater variety of forms than that of any previous observer, it seems advisable to publish the identifications that I have found it possible to make from an examination of his collection.

In addition to the actual specimens, Mr. Isaacson's maps and notes were placed at my disposal, and from these I have obtained the following facts concerning the occurrence of the graptolite-bearing rocks.

The locality from which Mr. Isaacson obtained his specimens is that of Slaty Creek, not far from Aorangi mine, in the Aorere district of the Karamea division. It is about nine miles south of the southern end of the Wanganui Inlet, which is situated at the extreme north-western corner of the Middle Island of New Zealand. The floor of the country consists for the most part of a series of unfossiliferous blue slates (Aorere Series), but interbedded with these is a "highly carbonised band," only a "few inches in thickness." "The auriferous reefs of the locality are only found in intimate association with this graphitic (carbonised) slate. The reef itself has a thin coating of graphite, and between the graphite and the slate is a block pug seam; while the slate itself is generally in a very crushed condition." The graptolites were "obtained almost anywhere on the line of the reef,

and both on the footwall and hanging wall of the reef itself in the workings." They are confined to the fine textured slates, the coarser ones being quite unfossiliferous.

According to Mr. Bell (loc. cit., p. 34), the Aorere rocks in this district are as a whole "folded into a great synclinalorium," but the "plication of the strata has been enormous, the rocks having been folded into a series of very closely compressed troughs and arches, which have a general trend of about north-north-west, with many variations from regularity." At the locality where the graptolites were obtained the dip of the beds is about 30° to the west.

Mr. Isaacson states that all the graptolites in his collection came from the one band. It is, however, possible to distinguish two main rock types, namely: (a) a somewhat coarse shale with an irregular fracture, and (b) a fine, smooth, well-laminated shale.

In the first of these (a) I have identified the following species:—

<i>Bryograptus Lapworthi</i> , Ruedemann.	<i>Diplograptus</i> sp. (?).
<i>Dichograptus octobrachiatus</i> , Hall.	<i>Goniograptus perflexilis</i> , Ruedemann.
<i>Didymograptus extensus</i> , Hall.	<i>Loganograptus Logan</i> , Hall.
<i>D. gibberulus</i> , Nicholson (<i>caduceus</i> , Salter).	<i>Phyllograptus Anna</i> , Hall.
<i>D. nitidus</i> , Hall.	<i>Ph. ilicifolius</i> , Hall.
	<i>Tetragraptus Amii</i> , Elles & Wood.

In the second (b) I have recognised—

<i>Bryograptus Lapworthi</i> , Ruedemann.	<i>Phyllograptus typus</i> , Hall.
<i>Didymograptus affinis</i> (?), Nicholson.	<i>Strophograptus trichomanes</i> (?), Ruedemann.
<i>D. nanus</i> , Lapworth.	<i>Tetragraptus Bigsbyi</i> , Hall (<i>similis</i> , Hall).
<i>D. similis</i> (?), Ruedemann.	<i>T. cf. pendens</i> , Elles.
<i>Goniograptus geometricus</i> , Ruedemann.	<i>T. quadribrachiatus</i> , Hall.
<i>Phyllograptus Anna</i> , Hall.	

Intermediate in character between these two extreme rock types there are a few slabs of shale, readily distinguishable by the mode of preservation of their contained graptolites, which have yielded *Didymog. nanus*, *Phyllog. angustifolius*, *Phyllog. Anna*, and *Tetrag. Bigsbyi*. These, however, may be grouped with (b).

Thus the two types of rock are distinct, not only lithologically, but also palaeontologically, and in this one collection there are represented two different graptolitic zones or sub-zones. Either, then, these two graptolitic zones occur within the one carbonaceous band of a few inches in thickness, or there is more than one graptolitic zone in the neighbourhood of the reef. Without further information it is impossible to decide between these two suggested alternatives, but the evidence brought forward by Mr. Isaacson and Mr. Bell as to the movement that the rocks have undergone, and the occurrence of the graptolites both on the walls of the reef itself and in its neighbourhood, seems to be in favour of the possibility of there being two distinct graptolitic zones present.

The fauna of the band (a) is characterised by the abundance of the species *Didymog. gibberulus*. It is undoubtedly the same fauna as that described by Mr. Bell; and if we except his identification of *Rastrites* (which may be a fragment of *Goniograptus perflexilis*) the assemblage of graptolites is that which one might expect. The forms which he doubtfully refers to *Climacograptus* and *Diplograptus* may belong to one and the same species; and from an examination of the one or two

specimens which occur in the present collection it appears that they belong to a primitive type of *Diplograptus* allied to *Diplograptus inutilis*, Hall. It may be a new species.

The fauna represented in the second band (b) seems not to have been detected by Mr. Bell and his assistants, though its previous recognition in New Zealand is evident from the figures of graptolites given by the late Sir James Hector (Handbook of New Zealand, 1886, p. 82). In this band the most characteristic species are *Didymograptus nanus*, and *Tetragraptus Bigsbyi*, while *Didymog. gibberulus* appears to be entirely absent.

Below is a table showing the distribution of these New Zealand graptolites in America and Great Britain; and an examination of this brings out clearly the great similarity between these two New Zealand faunas or sub-faunas and those of corresponding age in the Northern Hemisphere.

	SLATY CREEK, NEW ZEALAND.		DEEP KILL, STATE OF NEW YORK.				WALES.			LAKE DISTRICT.	
	Band (a).	Band (b).	Zone of <i>Tetragraptus</i> .		Zone of <i>Didymog. bifidus</i> .		Zone of <i>Didymog. extensus</i> .	Zone of <i>Didymog. hirundo</i> .	Zone of <i>Didymog. bifidus</i> .	Upper <i>Tetragraptus</i> Beds.	Ellergill Beds.
			Bed 1.	Bed 2.	Bed 3.	Bed 5.					
<i>Bryog. Lapworthi</i> ...	?	r	c	cc	...	...	...	...	...	1	...
<i>Dichog. octobrachiatus</i> ...	fc	...	rr	cc	r	...	...	...	...	1	...
<i>Didymog. extensus</i> ...	c	...	...	cc	...	...	1	...	...	1	...
<i>D. gibberulus</i> ...	cc	...	...	...	...	?	1	...	...	1	...
<i>D. nitidus</i> ...	r	...	c	c	...	...	1	1	...	1	...
<i>Diplograptus</i> sp. ...	r	...	...	...	...	...	...	...	...	...	...
<i>Goniog. perflexilis</i> ...	fc	...	...	cc	r	...	...	...	...	...	...
<i>Loganog. Loganii</i> ...	c	...	...	cc ?	...	...	...	...	...	1	...
<i>Phyllog. Anna</i> ...	r	fc	...	r	cc	c	...	...	...	1	...
<i>Ph. ilicifolius</i> ...	r	...	r	cc	...	r	...	...	...	...	...
<i>Tetrag. Amii</i> ...	r	...	...	c	...	...	1	...	...	1	...
<i>Didymog. affinis</i> ?	...	r	...	...	...	...	...	...	...	1	1
<i>D. nanus</i> ...	...	cc	...	...	...	x	...	r	1	...	1
<i>D. similis</i> ?	...	fc	...	...	r	c	...	...	...	...	...
<i>Goniog. geometricus</i> ...	...	c	...	r	cc	...	...	...	?	...	...
<i>Phyllog. angustifolius</i> ...	...	fc	rr	r	c	...	...	...	...	1	1
<i>Ph. typus</i> ...	...	r	...	...	c	cc	...	...	...	1 ^p	...
<i>Strophog. trichomanes</i> ?	...	r	...	...	...	...	...	...	...	...	...
<i>Tetrag. Bigsbyi</i> ...	...	cc	...	cc	c	...	...	...	1	1	1
<i>T. cf. pendens</i> ...	...	fc	...	...	r	...	...	...	...	...	1
<i>T. quadribrachiatus</i> ...	...	rr	...	cc	r	...	1	...	...	...	1

cc = very common ; c = common ; fc = fairly common ; r = rare ; rr = very rare.

Especially close is the comparison between the two New Zealand faunas and those of the beds 2 and 3 of Ruedemann in his Deep Kill section (Graptolites of New York, part 1, 1904, pp. 504–507). Some of the new species described by Ruedemann in this great work, which have not hitherto been recognised in other parts of the world, are to be found in Mr. Isaacson's collection. The fauna of the band (*a*) corresponds to that of bed 2, and the fauna of (*b*) to that of bed 3, and this fact gives additional support to the assumption that in the Aorere Series of New Zealand two graptoliferous zones are represented.

With Great Britain the comparison, though close, is not so striking. This is mainly due to the fact that in Britain the rocks at this horizon are not so rich in species as they are in America. So far, however, as the range of the species which are common to both Great Britain and New Zealand is concerned, it is clear that the fauna (*a*) corresponds to that of the zone of *Didymograptus extensus*, and the fauna of (*b*) to that of the zone of *Didymograptus hirundo*. In Wales the *Didymograptus hirundo* zone is extremely poor in species, and the zone fossil has not yet been recognised from New Zealand. In Britain *Didymograptus nanus* makes its first appearance in this zone, though it is very rare; probably, therefore, the fauna of (*a*) corresponds to that of the highest beds of the *D. hirundo* zone and to that of the base of the overlying zone of *D. bifidus*.

In the Lake District the New Zealand faunas find their representatives in the Middle Skiddaw Slates, and probably also in the lowest beds of the Ellergills.

Mr. Isaacson's present discovery shows indisputably that the association of forms in the part of New Zealand which he has investigated is practically the same as that in the Northern Hemisphere; and it may be anticipated that further work will result in proving that the zonal succession of graptolites so well established in the Northern Hemisphere prevails in New Zealand also.

II.—MARINE BEDS IN THE YORKSHIRE COAL-MEASURES ABOVE THE BARNSELY COAL.

By H. CULPIN.

IN Green's "Geology of the Yorkshire Coalfield" (Mem. Geol. Surv., 1878, p. 471) reference was made to the occurrence below the Ackworth rock of a band of black shale, which it was said "contains *Aviculopecten* in plenty, and shows that incursions of the sea continued to occur even up to these comparatively late portions of the Coal Measure period."

A recent sinking for coal at Brodsworth, about four miles north-west of Doncaster, gave an opportunity, which the Colliery Management kindly facilitated, for a search for the above and other marine beds above the Barnsley Coal, with the result that four such beds have been noted there, one of which has markedly distinctive lithological and faunal characters.

Taking the beds in descending order, the *first* was found in some 32 feet of 'blue bind,' the base of which was 106½ feet below the