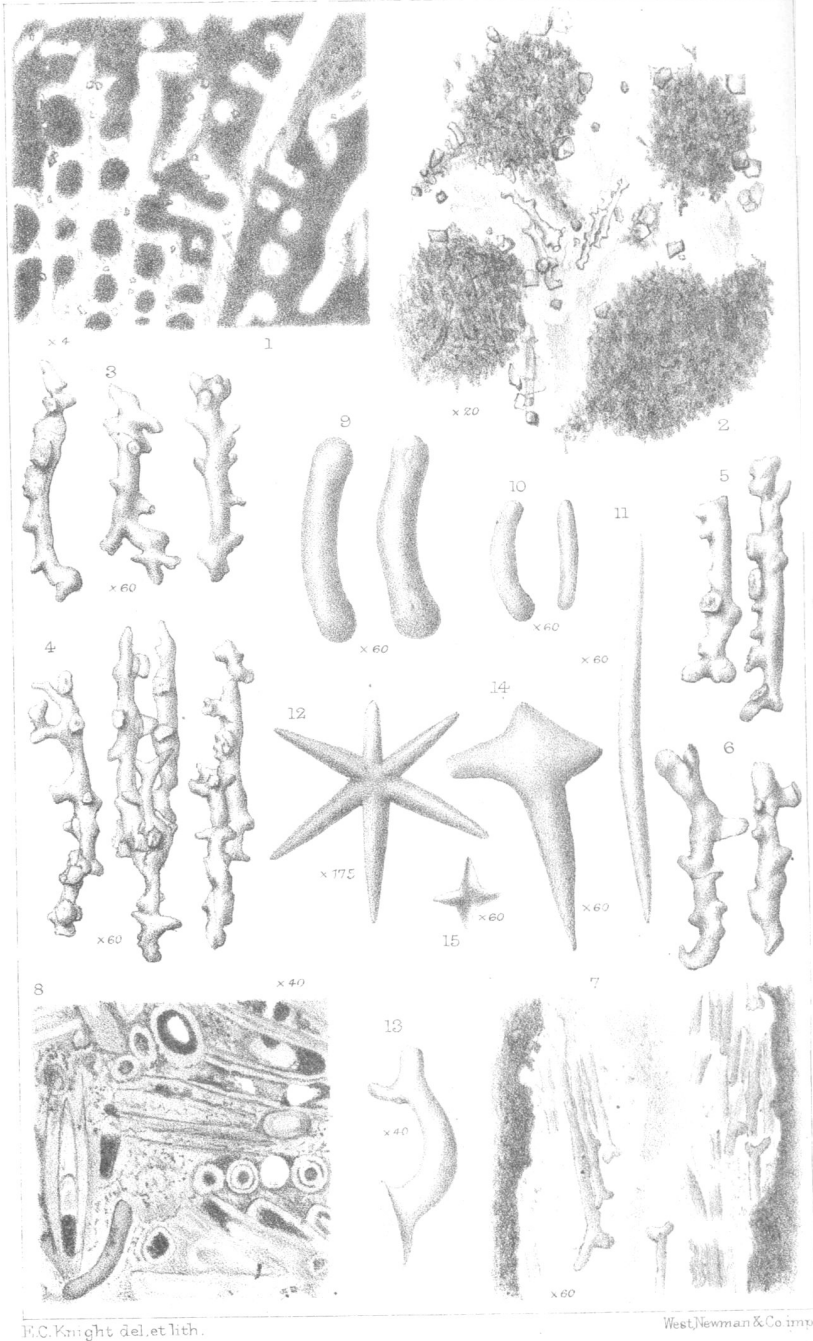

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Spitzbergen Fossil Sponges.

THE

GEOLOGICAL MAGAZINE.

NEW SERIES. DECADE III. VOL. V.

No. VI.—JUNE, 1888.

ORIGINAL ARTICLES.

I.—On the Chert and Siliceous Schists of the Permo-Carboniferous Strata of Spitzbergen, and on the Characters of the Sponges therefrom, which have been described by Dr. E. von Dunikowski.

By George Jennings Hinde, Ph.D., F.G.S., etc.

(PLATE VIII.)

SHORTLY after the publication of my paper "On the Organic Origin of the Chert in the Carboniferous Limestone Series of Ireland," in the Geological Magazine[1] last October, my friend Prof. G. Lindström, of Stockholm, sent me a hand-specimen of cherty rock from the Permo-Carboniferous strata of Spitzbergen, which, on examination with a hand-lens, could be seen to be nearly entirely composed of spicules of sponges irregularly intermingled together, in the same manner as in the cherty beds of the Yoredale series in Yorkshire, Wales, and Ireland. This striking illustration of the organic origin of chert from a quite unexpected quarter induced me to inquire for further particulars of the nature and thickness of the rocks from which the specimen came, and Dr. A. G. Nathorst, of Stockholm, not only supplied me with the needful information which is given below, but further sent me a box of specimens of the rocks in question, which were for the most part obtained by the Swedish Expedition to Spitzbergen in 1882, under his leadership and that of the Baron de Geer. Prof. Lindström also sent for my examination most of the fossil sponges obtained by this same expedition, which have been described by Dr. v. Dunikowski;[2] and I propose in the present paper first to refer to the extent and the characters of the cherty rocks of Spitzbergen, and next to treat of the fossil sponges from them.

I may premise, however, that the specimens of cherty rock which I have examined have been in no wise selected on account of the presence in them of sponge-remains, since the origin of the rock from these organisms was not at all suspected at the time they were collected. The specimens were procured because they contain certain other fossils, such as Brachiopoda and Polyzoa, which have no special connection with the origin of the chert.

The following sketch of the stratigraphical divisions of the

[1] Dec. III. Vol. IV. pp. 435–446.

[2] Ueber Permo-Carbon-Schwämme von Spitzbergen, Kongl. Svenska Vetensk.-Akad. Handl. Bd. 21, No. 1, pp. 1–18, taf. ii. (1884).

Permo-Carboniferous series on the West and South-west shores of Spitzbergen has been kindly furnished to me by Dr. Nathorst. Some of the particulars were only obtained by the last Swedish Expedition. Dr. Nathorst makes four divisions in the series, which altogether is over 2000 m. in thickness. The lowest of these, which rests on red and green shales, regarded as Devonian, is the *Ursa sandstone*, which contains land-plants and corresponds to the European Culm or Scotch Calciferous Sandstone. In one locality, at Middle Hook in Bell Sound, Dr. Nathorst discovered in this division some intercalated marine deposits, consisting of dark schists with tracks of Annelids ("Fucoids"), Encrinital fragments, and a few siliceous Sponges.

2. *Cyathophyllum Limestone.* — This division comprises impure limestones with thin layers of chert and gypsum, also bituminous limestones with Corals, *Fusulinæ*, etc.

3. *Spirifer Limestone.*—From this division most of the fossils described from the Permo-Carboniferous series in Spitzbergen have been obtained, though it is not more than 10 mètres in thickness.

4. *Productus-chert.*—This division consists mainly of chert and siliceous rocks. Some of the beds are rich in *Producti* and other fossils, and are thus more or less calcareous; other beds are dark siliceous schists or shales, with a few Crinoidal remains and Polyzoa. It will be shown that the cherty beds are in places largely made up of the remains of siliceous sponges. Most of the fossil sponges yet known from Spitzbergen are from the lower beds of this division, which varies from 375 to 400 mètres in thickness.

A section of this division, exposed on the North Axel's Island in Bell Sound, was measured by de Geer in 1882, and the result has been communicated to me by Dr. Nathorst. It is of interest as showing the thickness of the different chert beds, and is reproduced below.

SUMMIT—PERMIAN SHALES, MARLS, AND SANDSTONES—300M.

		mètres.	
1.	Black siliceous schist	8·9	Productus-Chert Division.
2.	Black chert (? not exposed)...	5·1	
3.	Black ,, ...	22·0	
4.	Yellow ,, ...	12·5	
5.	Black ,, ...	12·8	
6.	Yellow ,, ...	21·4	
7.	Black ,, ...	23·2	
8.	Yellow ,, ...	71·9	
9.	Dark siliceous schist...	·9	
10.	Yellow chert...	25·8	
11.	Dark gray siliceous schist	·6	
12.	Yellow siliceous schist	47·8	
13.	Black ,, ,, ...	4·2	
14.	Yellow ,, ,, ...	46·3	
15.	Black ,, ,, ...	9·5	
16.	Yellow chert...	12·5	
17.	Dark ,, ...	14·0	
18.	Yellow ,, ...	4·2	
19.	Black ,, ...	58·5	
		402·1	

Owing to a slight dip in the strata, these measurements are a little in excess of the true thickness, which is estimated at 376m. Making this allowance, this division consists of 111m. of siliceous schists and 265m. or 870 feet of chert rock. The base of the division rests on the *Spirifer* limestone, whilst at its summit are the shales and marls of the Permian series, discovered for the first time by Nathorst and de Geer in 1882, the fossils in which, exclusively Permian in character, have lately been described by Prof. Lundgren.[1] The siliceous schists and cherts, therefore, known under the collective name of the Productus-chert division, constitute the summit of the Permo-Carboniferous series in Spitzbergen.

Most of the specimens of cherty rock forwarded to me by Dr. Nathorst are from the *Productus*-chert beds exposed on the eastern coast of Icefjord at Tempelberg and at Green Harbour and from Axel's Island in Bell Sound. The following are the salient characters of the principal specimens.

1. Specimens of white cherty rock at Templeberg, from near the summit of the Productus-chert and probably upon the same horizon at Angelinsberg, or Lovénsberg, in Hinlopen Strait. The rock is compact, of a greyish or milky-white tint, hard enough to scratch glass, and it gives in places slight ebullition with acid.

The Tempelberg specimens contain some grains of glauconite and quartz, but these are not present in the Hinlopen Strait example. The specimens also contain numerous shells and casts of *Productus*, and possibly also of *Spirifer*, the shells still retaining in part their normal structure of carbonate of lime. The matrix of the rock (if so it may be termed) in which these shells are imbedded, and of which their casts are composed, is a mass of closely-packed sponge spicules, chiefly linear or rod-shaped, either lying parallel to each other, or more frequently crossing one another irregularly (Pl. VIII. Fig. 8). These spicules are of chalcedonic silica; in microscopic sections by transmitted light they show an outer ring of a brownish yellow tint, whilst the central or axial portion is either of transparent silica, or of an opaque material. In some parts of the Hinlopen specimen the spicules gradually pass into a nearly pure translucent chert, in which their forms have, for the most part, disappeared, and only the solid casts of their axial canals can be distinguished.

The spicules in these rock-specimens are generally imperfect and fragmentary; the only recognizable forms are small curved cylinders with slightly inflated extremities (Pl. VIII. Fig. 9), similar to those of *Reniera clavata*, Hinde, which are very common in the cherty sponge beds of the Yoredale Series of Yorkshire and North Wales (Brit. Pal. Sponges, pt. ii. p. 143, pl. ix. figs. 5 *a*, *b*, Pal. Soc. vol. for 1887). Most of the detached spicules are apparently simple monaxial forms, and may perhaps belong to monactinellid sponges. Dr. Nathorst informs me that the bed of white chert at Tempelberg is only about three feet in thickness, but that further to the north-east it gradually

[1] Anmärkningar om Permfossil från Spetsbergen; Bihang till K. Svenska Vet. Akad. Handb. Bd. 13, Afd. iv. No. 1, pp. 1-26 (1887). *Cf.* GEOL. MAG. March, 1888, p. 131.

increases in thickness. The thickness of the white chert bed in Hinlopen Strait is not known. No corresponding bed of white chert occurs in the section at Axel's Island.

2. Specimen of bluish chert from Bell Sound, probably from Axel's Island. This is a hard, brittle rock, with a splintery fracture; it gives no action with acid. It contains the mould of a large Brachiopod. The surface in places is covered with the impressions of slender elongated spicules, but in the interior of the specimen only the axial portions of the spicules remain. This specimen is precisely similar in appearance and character to the cherty rocks of the Yoredale Series in Yorkshire, and could not be distinguished from them.

3. Specimen from the *Productus*-chert at Green Harbour, Icefjord. This is a dark, siliceous rock, with *Producti*, Polyzoa, and probably small Corals. The cells of these organisms have been infilled with siliceous material, and their walls have been weathered away on the surface; the *Productus* shells are, in part, replaced by silica. No spicules can be determined on the outer surface of the rock, but they can be seen in a thin section. Amongst the monactinellid spicules there is a cruciform spicule belonging to a hexactinellid sponge (Pl. VIII. Fig. 15).

4. Specimen from the *Productus*-chert from South Axel's Island. This is a hard, dark, siliceous schist, containing fragments of the problematical fossils known as *Taonurus* or *Spirophyton*. It appears mainly to consist of very minute subangular quartz grains in a dark cement. There are scattered in the rock numerous minute cylindrical spicules, similar to those of *Reniera bacillum*, Hinde, from the Yoredale Series of Yorkshire and North Wales (Pl. VIII. Fig. 10). Frequently the spicules occur as hollow casts or partially replaced by iron rust.

5. Specimens of dark siliceous schists from the *Productus*-chert division of South Axel's Island and Middle Hook in Bell Sound. These rocks, like the preceding, are mostly made up of minute subangular grains of quartz and a varying amount of calcite. Thin sections show a few spicules in places, but they are insufficient to affect the character of the rock.

6. Nodular masses of chert intermingled with crystalline calcite from Cape Wijh. The chert in these specimens is nearly translucent, and shows but little structure. It contains traces of spicules and Foraminifera.

7. Dr. Nathorst has also forwarded to me a smooth rounded pebble of chert, from the gravels of Nordenskiöld's Berg, which are of Tertiary age, with the view of ascertaining if its minute structure corresponded with that of flints from the Chalk, which, in outward appearance, it much resembles. A microscopic section of the pebble showed that it was composed of chalcedony and crystalline silica, and that it is filled with the remains of spicules which are now for the most part only represented by the infilled casts of their axial canals; in some instances, however, the spicules consist of an opaque material. They are chiefly fragments of rod-shaped forms, but amongst them are fusiform, acerate, and also lithistid spicules, closely

resembling those of *Doryderma Dalryense*,[1] H. (Pl. VIII. Fig. 13), from the Carboniferous of Ayrshire, and minute hexactinellid spicules (Pl. VIII. Fig. 12). Both the forms of the spicules and the mineral structure of the rock point to the conclusion that the pebble has been derived from some of the cherty sponge-beds of the Permo-Carboniferous series.

The character of these chance fragments from the *Productus*-chert division of the Permo-Carboniferous series distinctly shows that the chert beds in this division are largely composed of the detached spicules of disintegrated siliceous sponges, and thus of organic origin in the same manner as the chert-beds in the Yoredale Series of Yorkshire, North Wales, and Ireland. Not only is the general character of the rock extremely similar, but in some instances the same forms of spicules are present in the Spitzbergen, as in the British rocks. The dark siliceous schists, on the other hand, intercalated between the cherts, are chiefly composed of minute grains of quartz, and thus merely of sedimentary origin, but in some of these sponge spicules are also numerously represented. It is true that the number of specimens of chert available for examination is very few, and they might be regarded as insufficient of themselves to warrant the conclusion that this great thickness of rock, which at one locality on Axel's Island reaches 870 feet, is due to the accumulation of the skeletal débris of siliceous sponges; but taking into consideration the fact that beds of similar cherty rock, which in Yorkshire[2] have an estimated thickness of 90 feet, and in North Wales of 350 feet, can be proved to be due to sponge remains, there is nothing extravagant in the supposition that this much greater thickness of rock has had a similar origin. It is reasonable to suppose, moreover, that if specimens collected indiscriminately thus show their derivation from sponge remains, still stronger evidence would be obtainable if search were specially made for it.

So far as I am aware, the Spitzbergen chert beds have never been specially studied; the principal notice of them which I have seen is by Baron A. E. Nordenskiöld,[3] who writes of them in 1876 :—"In Ice and Bell Sounds, as well as in Hinloopen, the *Spirifer* Limestone and gypsum are covered by a statum of impure limestone rich in silica, or by a black flint extraordinarily rich in fossils, especially in *Producti* of large size and with large shells. Within this division the flint strata of silica are scarcely ever of the nature of sandstone, but form beds, several hundred feet thick, consisting of a nearly pure flint, and I think it highly probable that the formation of these immense flint beds stands in connexion with the eruptions whence originated the massive layers of plutonic rocks which meet us everywhere on Spitzbergen, and which in many places form the very boundary between the Mountain Limestone and the overlying strata belonging to later formations." From this it would appear that an

[1] British Fossil Sponges, pt. i. pl. v. fig. 7*b*, Pal. Soc. vol. for 1886.
[2] British Palæozoic Sponges, pt. ii. Pal. Soc. vol. for 1887, p. 100.
[3] Sketch of the Geology of Ice Sound and Bell Sound, Spitzbergen, Geol. Mag. Dec. II. Vol. III. 1876, p. 66.

organic origin of the chert, or flint as it is termed, is not even suspected, but it is supposed to have an undefined relation to igneous[1] rocks. But in the section measured by Geer on Axel's Island the chert and siliceous schists form an uninterrupted series of strata, 376 mètres in thickness, without volcanic materials, nor do such occur in the Permian strata overlying them.

The fact is not without significance that the geological horizon on which this enormous series of cherty rocks in Spitzbergen occurs corresponds approximately with that in which rocks of a similar character are so largely developed in the British Isles. The Carboniferous chert beds in Britain mainly appear in the upper portion of the *marine* Carboniferous series, between the true Mountain Limestone and the Millstone Grit. In Spitzbergen, also, they form the upper portion of a series of rocks regarded stratigraphically as the equivalents of the Carboniferous Limestone, even though they contain a certain admixture of Permian fossils. In Spitzbergen, however, the grits, sandstones, and coal-bearing beds, which succeed the Yoredale rocks in this country, are not represented, and the Permo-Carboniferous cherts are directly followed by shales, marls, and sandstones, containing an exclusively Permian Fauna.

II. On the Fossil Sponges from Spitzbergen described by Dr. E. von Dunikowski.

The cherty rocks of Spitzbergen, unlike those of Yorkshire and North Wales, have yielded entire forms of sponges, in addition to the detached spicules thickly scattered through the rock itself. These sponges were discovered by the last Swedish Expedition under Nathorst and de Geer, most of them in the dark siliceous schists of the *Productus*-chert series of Axel's Island; some were also obtained from the *Cyathophyllum* limestone of Templeberg and Gypshook, and from the *marine* beds of the Ursa sandstone at Middlehook in Bell Sound. The specimens were entrusted to Dr. E. von Dunikowski for description, who prepared microscopic sections from them, and described them as a new genus of monactinellid sponges under the name of *Pemmatites*, including within it the following species: *P. verrucosus*, *P. arcticus*, and its two varieties, *macropora* and *latituba*.

The characters assigned to the genus appeared to me so peculiar, that at my request Prof. Lindström kindly forwarded to me most of the type-specimens, and the microscopic sections from them, for examination, as well as an additional specimen of *P. arcticus*, var. *macropora*, which had not been submitted to Dr. Dunikowski, from which, and from another specimen, I have had further microscopical sections prepared. As the results of my study of these type-specimens I have arrived at conclusions as to their characters so widely

[1] A somewhat similar origin was attributed to a band of flinty or horny rock in the Carboniferous Limestone of Glencart, Dalry, Ayrshire, by my friend Mr. John Young, F.G.S., who regarded the silica as deposited chemically by heated waters from springs connected with volcanic vents in the neighbourhood (Proc. Nat. Hist. Soc. Glasgow, April 25. 1882, p. 237). Since hearing my paper on the organic origin of the Irish Carboniferous chert, Mr. Young examined sections of this flinty band under the microscope, and he has informed me that it is crowded with minute sponge-spicules, so that no doubt of its origin from these organisms can be entertained.

different from those of Dr. Dunikowski, that it will be necessary for me to state in some detail the structural features on which they are founded.

Little requires to be said of the outer form of the Sponges. They are in some cases flattened or discoid bodies, with circular, oval, or irregular outlines, in others nearly round, and, as is so frequently the case with the Palæozoic sponges, they show no stem or surface of attachment. Their exterior surfaces are usually uneven, with blunted warty eminences irregularly dispersed over them. Under favourable circumstances the surface also exhibits between the elevations a reticulation or network of siliceous translucent fibres, bounding circular or subpolygonal interspaces of a dark appearance.

The sponges are now compact throughout; in sections or fractured surfaces they exhibit a mesh of the translucent siliceous fibres, some of which have a generally radial direction from the central portion to the surface of the sponge, whilst others run transversely, and unite with the radial fibres, and thus form a connected meshwork, the spaces between which, as at the surface, are of a dark mineral (Pl. VIII. Figs. 1, 2). The sponges are now mostly of silica, but in all the specimens examined there is a slight reaction with acid.

In microscopic sections the *dark* portion of the sponge is seen to consist chiefly of minute particles and rods of an opaque material, probably of carbonaceous, though some may be of ferruginous origin, imbedded in a lighter granular (?) matrix; in this, also, are rod-shaped or acerate siliceous spicules, disposed quite irregularly both with respect to each other and to the direction of the interspaces in which they occur. Further, the spicules are by no means uniform in shape or in size in the same specimen, or in the same portion of it. There is every probability that, as suggested by Dunikowski, the dark rods mentioned above are merely replacements of siliceous spicules.

The translucent siliceous fibres of these sponges, when seen in microscopic sections, are either colourless or of a yellowish tint, their margins are uneven, they consist of fibrous radiating chalcedonic and crystalline silica, which gives brilliant tints between crossed Nicols. In this ground-mass there are frequently microscopic crystals of calcite, and here and there elongate rod-like spicules with stumpy lateral projections (Pl. VIII. Fig. 2). These spicules are frequently isolated in the fibres, their length corresponding with the direction of the fibre; occasionally several occur together closely united, evidently in their natural positions, by the apposition of their blunt projections to the surfaces of adjoining spicules (Pl. VIII. Fig. 4). They have the same general characters, and the same mode of union with each other as the spicules of lithistid sponges. Though, as a rule, only a few of these spicules now remain in the translucent fibres, their outlines are, for the most part, peculiarly distinct, and, strangely enough, though there can be no doubt that they are the spicules of siliceous sponges, and they are at present imbedded in a siliceous ground-mass, yet they are now chiefly composed of clear calcite. The fact is of importance also, that though there are plenty of acerate and smooth

rod-shaped spicules in the dark portion of the sponge, none of these forms can be seen in the translucent fibres, and, similarly, the lithistid spicules of the fibres do not occur in the dark interspaces. There is further a general uniformity in the character of these lithistid spicules, not only in the same specimen, but in those of distinct species.

Dr. v. Dunikowski attaches, in his paper, but little significance to these lithistid spicules.[1] He does indeed mention the occurrence of a few nodose irregular lithistid spicules with some of tetractinellid origin, but he thinks they have probably nothing to do with the proper skeleton of the sponges, but should be considered as merely accidentally introduced forms. I find, however, that they are very generally present in the translucent fibres of the sections[2] prepared and studied by this author.

Dr. v. Dunikowski considers that the dark portions of these sponges, which form, as already mentioned, the irregular interspaces between the translucent anastomosing fibres, are the true skeletal fibres, and the acerate spicules imbedded in them irregularly, as the monactinellid spicules proper to the skeleton. The translucent connected portions, on the other hand, which in this paper I have denominated fibres, are described by this author as the original canals of the sponge, which, after the death of the animal, have been infilled with crystalline quartz free from any admixture of those foreign substances which have given such a dark appearance to the rest of the sponge. These so-termed canals are described as main canals, and concentric or connecting canals.

My interpretation of the characters of these sponges totally differs from that of Dr. Dunikowski, for, in my opinion, the translucent anastomosing fibres—the "canals" of Dunikowski—are in reality the fibres of the sponge which were originally composed of lithistid spicules. Most of these have been dissolved, and their spaces filled with chaceldony and quartz; some remain, either singly or united in their natural positions in the fibres. The dark portions of the sponge—the "skeletal fibres" of Dunikowski—I regard as merely the irregular interspaces between the true skeletal fibres, in which the water circulation was carried on during the lifetime of the animal, and which after its death became infilled with the materials of the sea-bottom, consisting of a fine siliceous mud, with numerous spicules, chiefly of disintegrated monactinellid sponges, dispersed through it.

In support of my view, I may state that fossil lithistid sponges, in which the fibres have been replaced in a similar manner to these Spitzbergen forms, are of not unfrequent occurrence. I have before me microscopic sections of *Aulocopium* and *Astylospongia* from the Silurian strata of Gotland, in which the process has taken place; and, in one instance, the lithistid spicules are now of calcite, imbedded in a chalcedonic matrix, under the same circumstances as those of *Pemmatites*.

[1] *Loc. cit.* p. 7.

[2] They are present in seven out of ten slides of *P. arcticus*, in both of the slides of *P. verrucosus*, in two out of three slides of the var. *macropora*, and in two out of three slides of the var. *latituba*, which were sent to me by Prof. Lindström.

The dark portion of the sponge, which I regard as infilled material from the sea-bottom, is clearly of the same nature as many portions of the rock-matrix, which show in microscopic sections dark granules, rod-like bodies, and spicules of various forms interspersed in a siliceous matrix. It is quite in accordance with our experience of fossil sponges—and of recent forms as well—to find their canals and interspaces between their skeletal fibres filled with a varied assortment of spicules, often of a character quite different from those proper to the sponge itself. Further, in one of the Spitzbergen specimens the supposed canals are distinct cylindrical siliceous fibres, whilst the dark portion—the supposed skeleton—hardly shows traces of spicules, and passes uninterruptedly into the surrounding rock-matrix, and cannot be distinguished from it.

On Dunikowski's view that the siliceous fibres were originally canals, it is difficult to account for the presence in them of lithistid spicules exclusively, and it is equally as difficult to imagine that whilst foreign spicules and other materials were accidentally introduced into what are stated to be the skeletal tissues, none should have found their way into what are stated to have been the empty canals of the sponge.

But the most convincing evidence that the translucent portions in these sponges are, in reality, the skeletal fibres, and not the canals, is afforded by sections, prepared by v. Dunikowski, of a specimen from the *Cyathophyllum* limestone of Gypshook. The translucent portions in these sections are in places filled with the original spicules, running parallel with each other, and evidently in their natural position in the fibre. Unfortunately the outlines of these spicules have been rendered very indistinct by the fossilization, so that their complete forms cannot be made out definitely, and they appear to differ from the typical forms of *Pemmatites* in being furcate at one or both ends (Pl. VIII. Fig. 7). Unlike the specimens from Axel's Island, the spicules in these sections are not replaced by calcite, but consist of chalcedonic silica. The dark portions in these sections do not contain many spicules, and no doubt can be felt that they are simply the rock-matrix. The sections are named by Dunikowski, *P. arcticus*, var. *latituba*, but it is probable, judging from the form of the spicules, that the sponge is generically distinct from *Pemmatites*.

The grounds above stated appear to me to justify the view that these Spitzbergen sponges are really lithistid and not monactinellid forms. On this interpretation the diagnosis of the genus given by Dunikowski requires to be fundamentally altered; but as the term *Pemmatites* has reference to the outer form of the sponges merely, and no bearing on their inner structures, there is no reason why it should not be retained with the amended description as below:—

Order: Silicispongiæ.
Suborder: Lithistidæ.
Family: Rhizomorina.
Genus: *Pemmatites*, v. Dunikowski, emend. Hinde.

1884, Kongl. Svenska Vet.-Akad. Handl. Bd. 21, No. 1, p. 13.

Discoid, compressed or globular, sponges, apparently without stem or surface of attachment. The skeleton consists of a meshwork of subcylindrical anastomosing fibres, which are composed of rod-shaped lithistid spicules with blunted and facetted lateral processes. The open spaces between the fibres form an indefinite canal-system, with circular or polygonal apertures at the surface of the sponge.

I do not propose here to enter upon the detailed descriptions of the species and varieties given by Dunikowski, which appear to me to be substantially correct as regards the measurements and other particulars relating to the form and direction of the fibres, etc., but I may remark that in referring to them we must bear in mind that the structures described as canals are the skeletal fibres, whilst the so-termed fibres are only the interspaces between the real fibres, now infilled with matrix. Examined from the new point of view, the sponges described as varieties *macropora* and *latituba* (*loc. cit.* pp. 15, 16) appear to be sufficiently distinct from *P. arcticus* to be considered as separate species.

The lithistid spicules in these sponges, as shown by the accompanying figures (Pl. VIII. Figs. 3–6), vary somewhat in size and form; for the most part they consist of a straight or slightly curved rod-like axis, truncated or obtusely pointed at the ends, with short lateral projections terminating in minute facets.[1] They vary from ·4 to ·6 mm. in length, and about ·06 mm. in thickness.

I have not been able to detect a dermal layer (Deckschicht) as distinct from the fibres, in any of the sponges; the structure so named and figured by Dunikowski appears to me to be merely a thin layer of matrix incrusting the surface of the sponge.

Whilst thus differing from Dr. Dunikowski as to the interpretation of the structure of these sponges, I wish to bear testimony to the very careful manner in which he has investigated and described their characters. The specimens are in a very unfavourable state of preservation, and owing to the very complicated changes which take place in the fossilization, it is, without special experience, easy to make a mistake in determining the original characters of these organisms from the older rocks.

Summary.

Specimens of chert-rock from the *Productus*-chert division of the Permo-Carboniferous series of Spitzbergen are shown to consist largely of detached siliceous sponge spicules, thus indicating the probable derivation of this rock from the skeletal remains of these organisms. The chert is of the same character as that of the Yoredale beds of the British Isles, and it occurs on the same relative geological horizon. The *Productus*-chert division has a thickness on Axel's Island of 376 m., of which 265 m. are chert, and 111 m. dark siliceous schists, likewise containing sponge remains, but less abundantly than the chert. The chert had previously been regarded as connected in some way with the igneous rocks of the island.

[1] As already mentioned, the spicules in *Pemmatites latituba* differ in form, and they are more slender than in the other species described.

The Sponges obtained from these rocks, which had been described as Monactinellid forms by v. Dunikowski, are shown to be really Lithistid sponges, this author having mistaken the original fibres for canals, and the infilling matrix, in which detached spicules occur, for the fibrous skeleton of the sponge.

EXPLANATION OF PLATE VIII.

FIG. 1. Part of a vertical section of *Pemmatites macropora*, Dunik., showing the disposition of the translucent skeletal fibres and the dark matrix. Enlarged four diameters. From the *Productus*-chert beds of the Permo-Carboniferous series, Bell Sound, Spitzbergen.

„ 2. Part of a section from the same specimen, enlarged twenty diameters, showing lithistid spicules in the translucent fibres, as well as crystals of calcite.

„ 3. Detached spicules from the same section, enlarged sixty diameters.

„ 4. Spicules from the same, showing their mode of union with each other. Enlarged sixty diameters.

„ 5. Two detached spicules occurring in the translucent fibres of *Pemmatites arcticus*. Enlarged sixty diameters. Drawn from a section prepared by v. Dunikowski.

„ 6. Two spicules from the translucent fibres of *P. verrucosus*, Dunik., similarly enlarged. Also from one of Dunikowski's sections.

„ 7. Part of a section of *P. latituba*, Dunik., from the *Cyathophyllum*-limestone at Gypshook, Bell Sound, showing spicules (now partially obliterated) in the translucent fibres. Enlarged sixty diameters. Drawn from a section prepared by v. Dunikowski.

„ 8. A section of the White Chert from Templeberg, Spitzbergen, showing its structure of sponge-spicules irregularly intermingled together. Enlarged forty diameters.

„ 9. Two detached cylindrical spicules of *Reniera clavata*, Hinde, from the White Chert of Templeberg. Enlarged sixty diameters.

„ 10. Detached cylindrical spicules of *Reniera bacillum*, Hinde, from a section of the *Productus*-chert at South Axel's Island. Enlarged sixty diameters.

„ 11. A fusiform acerate spicule from a section of a chert pebble (probably from the Permo-Carboniferous), from the Tertiary gravels of Nordenskiöld's Berg. Enlarged sixty diameters.

„ 12. Flesh spicule of hexactinellid sponge from the same pebble. Enlarged 175 diameters.

„ 13. Lithistid spicule of *Doryderma Dalryense* (?), Hinde, from the same pebble.

„ 14. 15. Modified hexactinellid spicules. Enlarged sixty diameters. From Axel's Island and Green Harbour, *Productus*-chert series.

II.—New Palæoniscidæ from the English Coal-Measures. No. II.

By Dr. R. H. Traquair, F.R.S., F.G.S.

(For No. I. see Geol. Mag. Dec. III. Vol. III. 1886, p. 440.)

Elonichthys Binneyi, sp. nov., Traquair.

OF this I have seen only two specimens. One of them, slightly longer than the other, measures $3\frac{1}{2}$ inches in length up to the commencement of the caudal fin, which is deficient in both; the greatest depth of the body $\frac{1}{12}$ inch, the length of the head nearly the same. The dorsal fin is opposite the interval between the ventral and the anal; both dorsal and anal are triangular acuminate in shape, with delicate rays which at first are somewhat distantly articulated, the joints being ornamented with one or two longitudinal sulci. The pectorals are not seen in either specimen, but the smaller of the two shows a well-preserved ventral, which is pretty large, and acuminate in shape.