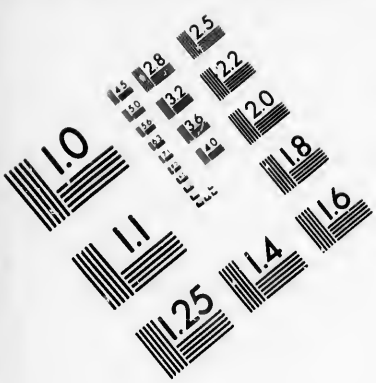

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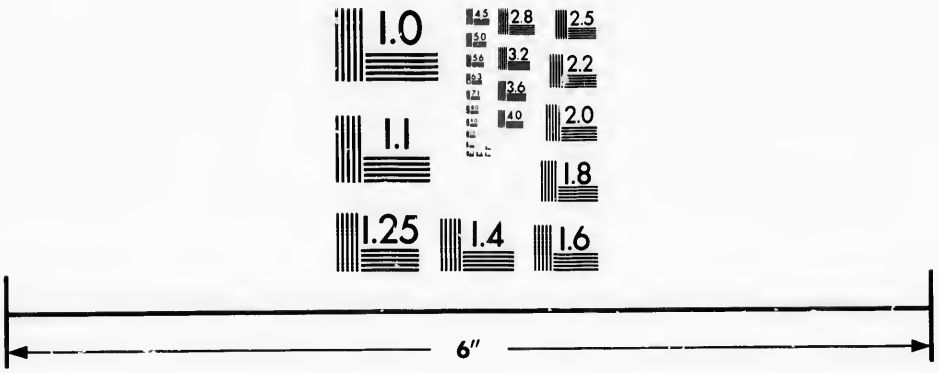

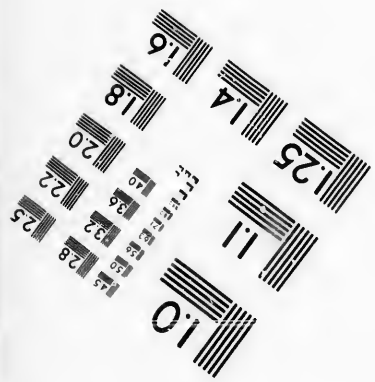

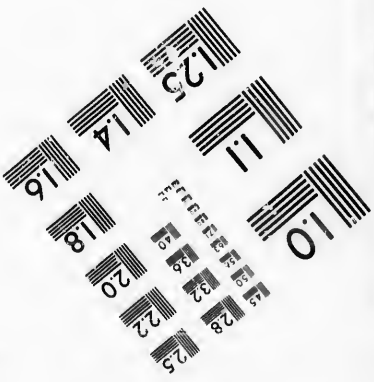

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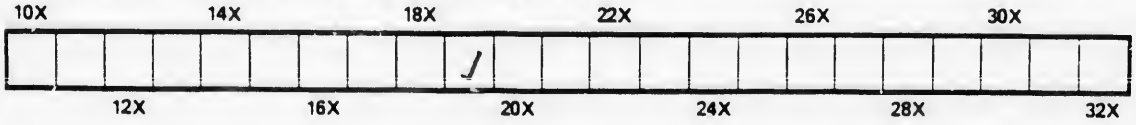

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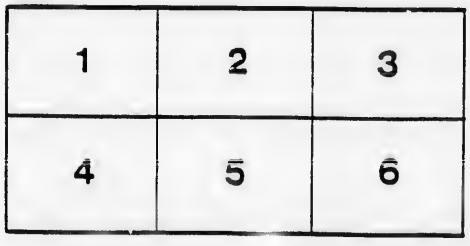

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[*From the* REPORT OF THI [redacted] N FOR THE ADVANCEMENT

ON

SOME ADDITIONS TO THE GEOLOGY

OF

THE ARCTIC REGIONS.

By J. W. SALTER, F.G.S., A.L.S.

[In an accompanying map were exhibited the discoveries lately made in Arctic geology, and an attempt made to show at one view all that is now known on the subject.]

In a communication to the Geological Society, in 1853, I had the honour to demonstrate the existence of a wide-spread Upper Silurian formation in the lands which border the Polar basin in North America.

The fact, mentioned both by Conybeare and Jameson, of the chain coral being found in the limestones of Barrow's Strait, would be, in the present state of our knowledge, a sufficient proof of the existence of Silurian strata there. But it required the extensive collections made by the expedition under Capt. Austen along that strait, and those made by Penny and his comrades up Wellington Channel, to enable us to decipher the meaning of the old lists of fossils, and to show that an uniform horizon of *Upper Silurian* limestone stretched from near the entrance of Barrow's Straits to Melville Island northwards as far as those expeditions reached, and evidently very far to the south along Prince Regent's Inlet. These collections, brought home by the officers and medical gentlemen from various points, showed so many fossils referable to the same types as our own Dudley limestone, and so entire an absence of characteristic Lower Silurian ones, that there need be no hesitation in referring the whole of the limestones, in a general way, to the Wenlock group.

The common fossils are *Rhynchonella Phoca, Orthoceras* and *Murchisonia*; and there are several species identical with European ones; *e. g. Pentamerus conchidium*; a trilobite (*Encrinurus lævis*); the chain-coral; *Favosites, polymorpha*, &c. The type of the numerous corals is, however, rather American than European, *Favistella* and *Columnaria* being present,—the former abundant.

The limitation of these strata to the Upper Silurian period is an independent confirmation of the inference drawn by our able friend Mr. Logan as to the age of the lowest rocks he was able to find north of the great Lawrentine chain. These strata, which were certainly shore accumulations, contained in plenty the fossils of the Clinton group (*Pentamerus oblongus, Atrypa hemisphærica*, &c., with large species of *Orthoceras*, known in North America as Upper Silurian forms). Similar species of *Orthoceras* were found far to the west in lat. 62° by Sir John Richardson,

and Upper Silurian fossils h[illegible]y Mr. Isbister from localities nearer to Hudson's Bay. So t[illegible] evidence, as far as yet collected, all points the same way, viz. that a wide extent of Polar or circumpolar land existed, during Lower Silurian times, north of this great ridge, which land, at the commencement of the Upper Silurian period, was depressed, covered by sea, and peopled by Mollusca and Radiata like those of our own latitudes, many species being identical.

That this depression continued during the Devonian æra, we have less proof, though it may be inferred from the character of some of the shells collected on the Slave Lake by Richardson, and, as will be presently mentioned, from some of those brought from the furthest point examined by Sir E. Belcher.

One of the great points, however, established for us by the researches of the last-named officer and his associates, is the existence of a considerable marine Carboniferous formation in the highest latitudes explored.

The age of the coal plants of Melville Island was not doubtful after the statements of Drs. Lindley and Buckland; but it is satisfactory that Capt. M'Clintock should have found in that island, a degree further north than the coal, shells distinctly comparable with those of our own mountain limestone. The Rev. Prof. Haughton has recognized two British species among them; they are from lat. 76°. Winter Harbour is 75°.

In skirting the newly discovered coast-line of Albert Land, in lat. 78°, Capt. Belcher found the shore, especially at a place called Depôt Point, strewn with blocks of a whitish-gray limestone, mixed with some redder fragments, all full of beautifully preserved fossils. These he has placed in the Museum of Practical Geology. They prove to be all truly carboniferous types: corals of the genera *Clisiophyllum*, *Zaphrentis*, *Lithostrotion*, *Stylastræa* and *Michelinia*; Brachiopod shells, *Producti* and *Spirifers*, with *Fenestella*, and a new foraminiferous shell of a peculiarly carboniferous character, viz. a large species of *Fusulina*.

This *Fusulina*, *F. hyperborea*, is five times as large as the common Russian species, and is constricted in the middle. It is a most interesting example of the concurrence of similar organic forms with like geological periods. The little *Fusulina* of Moscow is no bigger than a grain of wheat, but occurs in myriads. A still smaller, rounder species is characteristic of the mountain limestone in Asia Minor; and here, in the Polar circle, another species, gigantic in comparison, occupies the same place, and keeps up the facies of the carboniferous fauna.

The corals, with one or two exceptions, are not known European species,—a fact in harmony with the previous investigations of Edwards and Haime. *Stylastræa inconferta* of Lonsdale is not, however, rare, and was first described from Russia.

The Brachiopods, as usual, are the cosmopolite forms. We cannot distinguish the two species of *Producti*, *P. semireticulatus* and *P. Cora*, from English fossils. And when it is remembered that these are found, wherever the Carboniferous rocks have been examined, from India to th[illegible]cy Sea, in South America, and one of them in Australia, they would appear the [illegible]ost likely of all to have reached these high latitudes.

With them is a fossil which as yet has only a polar or subpolar range. Von Buch described in 1846 the few relics obtained by Keilhau in exploring a small island (Bear Island, lat. 74° 30') between Spitzbergen and the North Cape. The cliffs were limestone, capping coal shales (with ferns), and contained the above-named *Productus Cora*, with other European species. The principal fossil was a *Spirifer* of peculiar form, which he named after its discoverer, *S. Keilhavii*, and figured in the Berlin Transactions. Curiously enough, this species, which appears to range to the Icy Sea in Russia, is the most abundant of the Arctic fossils brought home by Capt. Belcher. He found it both at Depôt Point and on the island he has called Exmouth Island, between the coast and North Cornwall. The *Productus Cora* was found *in situ* on the summit of the island, which consists of a red ferruginous sand with balls of pyrites, and capped by *reddish limestone*, which is thus proved to be carboniferous.

The age of the red sandstone is equivocal. On the main land it is interstratified with a fissile greywacke grit, which forms considerable cliffs stretching away to the eastward, to North Yorkshire and Cardigan Straits, on the shores of which a blackish earthy limestone occurs, quite different to that of Albert Land, and with different fossils. There are species of *Rhynchonella*, *Orthis*, and *Spirifer*, which all

have a Devonian aspect, and small *Producti* are associated in it with *Atrypa reticularis*, which species is never found in carboniferous rocks.

If this indication be accepted (and I think it a good one), that the Devonian system is here interposed between the Silurian plateau and the Carboniferous rocks, it would be satisfactory; and it is worth while to remember here, that in the easterly trend of these rocks Dr. Sutherland discovered a considerable formation of stratified sandstones along the north-eastern end of Baffin's Bay. I have provisionally given them the same colour. But nothing is known of the intervening ground.

The terminal member of the Palæozoic series, the Permian, is not yet traced in Polar America. But in Spitzbergen it has long been known, and we are indebted to Prof. De Koninck for a valuable list, chiefly European species, from thence. The *Productus horridus* and *P. cancrini*, *Spirifer alatus* and *S. cristatus*, are too well known to need any comment. They were collected at Bell Sound by M. Robert, in a latitude as high as that of Albert Land.

And now we come to the most interesting part of the Geology of the Arctic Basin, for I must be permitted, with the evidences before cited of an ascending section northwards, to call it so.

The reddish limestone forming the cap of Exmouth Island before referred to, is clearly, from its fossils, of carboniferous date. But in building the cairn on the summit, the fragments of limestone were carefully examined, and some of them at least contained bones of Vertebrata, which, under Prof. Owen's examination, have turned out to be *Ichthyosaurus*! Sir Edward Belcher assures me there was no perceptible difference between the fragments with bones and those with the Carboniferous shells above quoted. Yet this similarity of composition need not prevent our inferring that on this summit we have an outlying patch of Oolitic or Liassic rocks brought into close contact with the old limestone.

And as confirming the idea of the fossils being here *in situ*, and not drifted masses, Capt. M'Clintock had the good fortune to discover oolitic or lias fossils, *Ammonites*, *Spirifers*, *Pecten*, &c. in Prince Patrick's Land, lat. 76° 30′, long. 117°. These are quoted in the Royal Dublin Society's Journal for Nov. 1854. By referring to the map, it will be seen that the trend from this point to Exmouth Island follows nearly the direction E. by N. which the Carboniferous formation takes in its range from Melville Island to Albert Land. Science is greatly indebted to both these gallant officers for their exertions.

In the Dublin Journal above quoted are some excellent observations by Dr. Scouler on the Tertiary (miocene probably) flora of W. Greenland; but these do not come within the object of this communication. It is worth while, in conclusion, to observe, that elevation of the land has taken place since the period of the (drift ?), for Arctic shells imbedded in it were found by the former expedition as far as 500 feet above the sea-level, and Capt. Belcher has found bones of large Vertebrata (whales ?) at even greater elevations.