# ON THE GEOLOGICAL STRUCTURE OF THE CENTRAL AND SOUTHERN REGIONS OF RUSSIA IN EUROPE, AND THE URAL MOUNTAINS

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# CENTRAL AND SOUTHERN REGIONS OF RUSSIA IN EUROPE, AND OF THE URAL MOUNTAINS.

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BEING A GENERAL SUMMARY OF A SECOND GEOLOGICAL SURVEY DURING 1841.

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## PART I.

### ON CENTRAL AND SOUTHERN RUSSIA.

WITH the exception of a sketch of the Ural Mountains, to be given in a subsequent memoir, and of two short notices previously read, on the Freezing Cave of Iletzkaya Zatchita, and on the "Tchornoi Zem," or Black Earth*, the following abstract contains the chief results of a second examination of Russia in Europe. Following the same method as in the account of their first examination, the authors describe the depositary strata in ascending order, successively adding to or correcting their previous knowledge of each mass of deposits.

*Silurian Rocks.*—The boundaries of these the most ancient fossiliferous strata are more correctly defined than last year, and new localities are cited. The lowest subdivisions of blue shale and ungulite grit, which were previously spoken of in certain inland spots only, are now described in the sea-cliffs of the Baltic between Reval and Narva, as well as on the banks of the rivers Narva and Luga, in which situations, as in the tracts S. and S.E. of St. Peters-

* See Proceedings Geol. Soc. London, pp. 712–714.

burgh, they constitute the inferior masses or representatives of the Lower Silurian Rocks.

The Upper Silurian Rocks, chiefly composed of thin-bedded limestone, occupy the summits of the coast-cliffs in question, and the platform on which the river Narva flows from the lake Peicpus to a chasm worn by its own action, where it constitutes the picturesque falls above the Castle of Narva. It is believed by the authors that this water-fall has receded (like those of Niagara, in America, and other places,) in consequence of a solid tabular rock overlying less coherent strata, which have been undermined and have occasioned the subsidence of the superior layers. In addition, however, to these conditions, the wearing away of the vertical cliffs of the Baltic and the retrocession of the falls of the Narva, are supposed, by the authors, to have been accelerated by another cause, viz. the direction of the symmetrical joints in the overlying limestone. These joints present a number of salient and re-entering angles which are exposed on the surface of the impending cliffs, and when the softer supporting strata have been partially excavated, the dividing lines of these natural joints facilitate the fall of the calcareous beds into the abyss below

Besides the chief masses of limestone which extend over a considerable tract in the province of Esthonia, (including the Isles of Oesel and Dago,) the authors advert to a separate tract near the small town of Schavli, in the government of Wilna, occupied by upper Silurian rocks, which they discovered in their journey to St. Petersburgh, and which they place as the highest member of the system, or above the principal masses of the Orthoceratite and Trilobite limestone and beneath the overlying old red or Devonian formation. In this limestone fifteen species of fossils were observed, including *Pentameri*, *Terebratulæ*, and *Orthidæ*; and it is considered to be the representative of a calcareous rock which ranges to the north of Dörpat and Weissenstein, and is known at Oberpahlen, &c. Notwithstanding their almost perfectly horizontal position, the strata in the Baltic provinces of Russia indicate most clearly a passage from a lower horizon on the north to a higher on the south, where they are surmounted by the Devonian system.

In announcing a large accession of Silurian fossils to their former lists, the authors advert to the labours of Professor Eichwald,

who after a personal examination of the coast-cliffs and of the Isle of Dago, has been sedulously occupied in describing many new species. They also dwell upon the important addition to their knowledge of new forms contributed by Dr. Wörth, the secretary of the Imperial Academy of Mineralogy,—forms which they purpose to figure and describe in the course of the ensuing winter; and they acknowledge their obligations to Colonel Helmersen and the officers of the School of Mines, for aiding them in their acquisition of fresh knowledge concerning the contents of these the most ancient deposits of the Russian empire. In their tabular list of fossils the authors give the following as characteristic of, and in part peculiar to, the Silurian rocks of Russia :—

*Asaphus expansus* (Dalm.*), *A. cornutus*, *Illænus crassicauda* (Dalm.*), *Amphyx nasutus* (Dalm.*), *Orthoceratites vaginatus* (Schloth.†), *Lituites convolvens* (Schloth.†), *Clymenia Odini* (Eichw.‡), *Terebratula Wilsoni*[1] (Sow. in Sil. Syst.), *T. sphæra* (Von Buch§), *T. camelina* (Von Buch§), *Orthis anomala* (Terebrat. Schloth.†), *O. Uralensis*[1], n.s., *O. Panderi*, n.s., *O. cincta* (Eichw.‡), *Leptæna imbrex* (Pand.,), *Leptæna rugosa* (Dalm.‖), *Spirifer biforatus* (Terebrat. id. Schloth.), *S. lynx* (Eichw.‡), *S. æquirostris* (Terebr. Schloth.), *S. porambonites* (Von Buch§), *Pentamerus Vogulicus*[1], n.s., very near to *P. Knightii* (Sil. Syst.), *Crania antiquissima*, nob. (*Orbicula antiquissima*, Eichw.‡), *Lingula quadrata* (Eichw.‡), (*L. Lewisii*, Sil. Syst.), *Ungulites* (Pand.¶), *Obolus* (Eichw.), *Sphæronites aurantium* (*S. citrus*, His.**), *Hemicosmites pyriformis* (Von Buch), *Catenipora labyrinthica* (Gold.††), *Favosites Gothlandica*[1],‡‡ *Favosites Petropolitana*, *Graptolites*, &c.

*Devonian Rocks* (Northern Zone).—By visiting Livonia and Courland some essential points of interest were added to the knowledge

* Om Palæaderna eller de sa Kallade Trilobiterna. Stockholm, 1828.
† Die Petrefactenkunde der Vorwelt. 8vo. Götha, 1820.
‡ Sur le Système Silurien de l'Esthonie. 8vo. St. Petersbourg, 1840.
§ Beiträge zur Bestimmung der Gebirgsformationen in Russland. 8vo. Berlin, 1840.
‖ K. Vet. Acad. Handl. 1827.
¶ Beiträge zur Geognosie des Russischen Reiches. 4to. St. Petersburg, 1830.
** Lethæa Suecica. 4to. Holmiæ, 1837.
†† Petrefacta Germaniæ. 1ter Thiel. fol. Dusseldorf, 1826—1833.
‡‡ Lamarck, Animaux sans Vertèbres, tome 2. 8vo. Paris.

1 The fossils marked (1) occur in the Ural mountains only.

which the authors had previously obtained of the relation and contents of the old red or Devonian series. The central districts of Courland have been, for the first time, proved to contain rocks of this age charged with typical fossils, both fishes and shells. A section of the Düna river above Riga which exhibits some undulations of the strata, exposes siliceous limestones, subordinate to red and greenish shale; whilst the country between Riga and Dörpat is occupied by sands and marls. M. Pander, who now resides in this district, has collected a large and instructive series of its organic remains, chiefly from the banks of the river Aa; and among the Ichthyolites which they obtained from him, the authors recognised remains of *Coccosteus* and *Holoptychius* similar to those previously collected by them in the Waldaï Hills, and which Professor Agassiz has identified specifically with forms described by him from the old red sandstone of Scotland. Professor Owen has also identified among teeth from the collection of M. Pander, two or more varieties of the genus *Dendrodus* (Owen), equally characteristic of the old red sandstone of Scotland, one of them being indeed undistinguishable from the *Dendrodus* of that author, described from specimens found at Scat's Craig near Elgin.

In the marls and sands of Dörpat, Professor Asmus of the University at that place has collected and is describing certain gigantic bones, which were formerly supposed to belong to Saurians, but which, by their analogy to existing skeletons, he has shown to belong to fishes*. A single bone of one of these remains is nearly three feet long, and according to the estimate of Professor Asmus, the Ichthyolite of which it is a part must have had, when entire, a length of not less than thirty-six feet. The union of these fishes, some of the species of which, as above stated, are typical of the old red sandstone of the British isles, with numerous fossil shells which have been found to characterize the beds of the Devonian age in England, Belgium, and the Boulonnais (an union was pointed out last year as resulting from an examination of the provinces of St. Petersburgh, Novogorod, Olonetz, &c.), is now more amply con-

* At the request of Mr. Murchison, Professor Asmus has prepared and sent to England duplicate casts of these the most remarkable and most gigantic fossil fishes ever yet discovered. One set of these has been given by Mr. Murchison to the British Museum, another to the Geological Society of London, and a third to Professor Agassiz.

firmed by reference to the structure of the north-western governments of Russia, through which the same system is spread.

*Southern Zone of Devonian Rocks, or Geological Axis of Russia in Europe.*—Previous to their visit to the central and southern regions of Russia, the authors believed, in common with their precursors, that the ascending order of the strata was continuous from the Baltic provinces on the north to the Black Sea and Sea of Azof on the south, with the exception only of the granitic rocks and carboniferous tracts of the southern steppes. They were undeceived, however, by discovering in the heart of Russia (Orel, Voroneje, &c.) a great domelike elevation, which is composed of rocks loaded with Ichthyolites and Mollusks, all eminently characteristic of the Devonian system*. This mass sinks to the north under a great band of carboniferous rocks (Tula, Kaluga, &c.), the northern part of which was last year described as occupying the territory around Moscow and extending thence north-eastwards to the neighbourhood of Archangel: to the south it is lost under younger accumulations of secondary age. The dome of palæozoic rocks rising to an altitude of about 800 feet above the sea, was thus found to divide Russia into two distinct geological basins, viz. that of the carboniferous limestone of Moscow on the north, and that of the Jurassic, cretaceous and tertiary deposits on the south. One of the most remarkable features of this central mass consists in the lithological character of its rocks, as contrasted with that of formations of the same age, and containing the same fossils, in the northern governments; for whilst the latter in their range from the western borders of Lithuania to Olonetz and Archangel, including part of the Waldaï Hills (see last year's memoir, *ante*, p. 401), are invariably made of sands, sandstones, marls, and impure limestones, of prevailing *red* and *green* colours; their equivalents in Orel and Voroneje are *yellow* and *white* marlstones and limestones, the latter often

* A part of the tract between Orel and Lichwin was examined by Colonel Helmersen during the same summer, and before the visit of the authors, and he also recognised the existence of Devonian rocks. The authors, however, were quite unaware of this circumstance when they first published their views on this point at the end of September 1841, in a letter addressed to Dr. Fischer de Waldheim, and it was on their arrival at St. Petersburgh only, that they found that Colonel Helmersen had come to the same conclusions as themselves, in respect to a portion of the country in question.—See *Bulletin de la Société Impériale des Naturalistes de Moscou*, Oct. 1841.

in the state of magnesian limestone, and resembling in external aspect the Zechstein of Germany or the rocks of Sunderland in the British Isles. In addition to the characteristic fossils, enumerated last year from the great northern Devonian region, the central masses, particularly at Voroneje, have afforded many shells which have been published as typical of strata of the same age in Western Europe, such as *Spirifer Archiaci, S. Verneuillii, Leptæna Dutertrii, Productus productoides,* of the Boulonnais*, together with *Orthis crenistria, Productus spinulosus,* and *Aulopora, Favosites,* and other polypifers. It is indeed very remarkable, that in countries so distant from each other as the central region of Russia and the Boulonnais, twelve species at least of the fossils found at Voroneje should prove to be common to the rocks of the same age in both localities, and that in both instances the order of superposition should be so clear. The superior value, however, of the Russian sections of this division of the Palæozoic rocks over those in every other part of Europe, consists in the conjunction before adverted to and so generally observed in Russia, of Holoptychius and other fishes of the old red sandstone of Scotland and England, with the fossil shells characteristic of South Devon, the Boulonnais, and the Eifel†.

*Carboniferous Limestone and Coal.*—The lowest beds of the carboniferous system in Russia are, as stated in our first abstract, p. 8, sands and shale with thin seams of coal, *Stigmaria ficoides,* &c. The authors examined a considerable tract occupied by these beds to the south of Tula and Kaluga, where many additional natural outcrops have been discovered by Colonel Olivieri, the mineral having the lignite or impure character of the beds of coal described last year in a similar position in the Waldaï Hills. These strata are, the authors conceive, of the same geological age as those of the great productive coal-field of Berwickshire, which equally underlies the mountain limestone.

By their recent labours the authors have divided the carboniferous limestone of Russia into three members. The lowest of these,

* See Mr. Murchison on the Boulonnais.—*Bulletin de la Société Géol. de France,* tome xi.

† The large scales of *Holoptychius Nobilissimus* were found by the authors at a locality called Kipet between Lichwia and Bielef.