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## Geological Society

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tric, vaginal, vesical and uterine ganglia are delineated in the fourth month of pregnancy, and also the plexuses of nerves on the anterior surface of the uterus.

From an examination with the microscope of portions of the plexuses under the peritoneum of a gravid uterus in the ninth month, which had long been immersed in rectified spirit, Professor Owen and Mr. Kiernan inferred that they were not nervous plexuses, but bands of elastic tissue, gelatinous tissue, or cellular membrane.

The author concludes his paper with a letter from John Dalrymple, Esq., containing the results of the observations he had made with the microscope on the uterine nerves in the recent state. Filaments of the nerves which surrounded the ureter, and which were situated upon the body of the uterus, were submitted to the microscope. The instrument employed was a very powerful object-glass, whose focus was the eighth of an inch, made by Ross. Mr. Dalrymple found that it was impossible, even with the most careful dissection, to detach any filament of nerve without including a quantity of cellular and elastic tissue; so that although the tubular portion indicating the nerve was distinct, yet it was surrounded by innumerable extremely minute threads coiled and contorted, such as those which constitute the component of elastic tissue, and the ultimate element of cellular membrane. Under slight pressure, however, the tube was plainly discernible, and was found to contain granular matter, not uniformly distributed, but collected in minute masses at intervals. Small blood-vessels were also here and there seen, with blood-discs within them, which served to indicate the difference between the nervous and vascular tubes, and thus to avoid the possibility of error. Being, however, aware that some of the most distinguished foreign microscopical anatomists had differed as to what was the real characteristic of the nerves of the sympathetic system, and feeling, from this discordance of opinion, that there was no absolute test, or at least none which was not open to cavil, Mr. Dalrymple thought of making a comparison of the uterine nerves with those that undeniably belonged to the ganglionic system. He therefore traced some nerves on the surface of the stomach up to the great ganglion that gave them origin; and he selected some also from the small intestine. These he submitted to the same microscopical power, and under the same circumstances of light, and pressure, and medium. In all of these he observed the tubular part filled with granular matter, and similarly collected in minute masses. He also observed that each tube was surrounded by the minute serpentine threads before described. In fact, so closely did they agree in every particular with the appearances presented by the uterine nerves, that it would have been impossible to distinguish the one from the other.

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GEOLOGICAL SOCIETY.

[Continued from p. 402.]

March 24, 1841.—The reading of the paper on Russia, by Mr. Murchison and M. E. de Verneuil, was resumed and concluded.

The Memoir, of which the following is an abstract, is the result of a journey through the Northern and Central Governments of Russia in Europe, made during the summer of 1840, a verbal account of some of the chief points of which, accompanied by a new geological map of those regions, was offered to the public at the meeting of the British Association for the Advancement of Science, in September 1840.

*Introduction.*—The authors preface their memoir with a sketch of the condition of geological knowledge concerning the flat and central countries of Russia in Europe anterior to their visit, and show that the early efforts of Strangways\* had not been followed up by any connected attempt to establish the classification and succession of the older sedimentary deposits on the true principles of the order of their superposition, and their distinctions by organic remains. They point out, however, that certain elements of the subject had been prepared; first, by the map and descriptions of Strangways; secondly, by the publication of the palæontological works of Fischer de Waldheim, Pander, and Eichwald; thirdly, by the recent researches of Colonel Helmersen in the Waldai Hills; and fourthly, by the important zoological distinctions indicated by M. Leopold de Buch, who, on hearing of the plan of the voyage of the authors, expressed his belief (from the examination of certain fossils alone) that the triple subdivision of the *palæozoic* rocks into the Carboniferous, Old Red, and Silurian systems, as indicated by Mr. Murchison†, would be found to prevail in Esthonia, Livonia and Courland.

After alluding to the vast importance to the Russian empire of a correct knowledge of the subsoil of these flat regions, the authors explained the scheme which they had devised, before they left their own countries, for ascertaining the data required. Aware of the two great difficulties which are opposed to the examination of this region,—the slight altitude of the masses above the sea, and the vast quantity of drift or the slight superficial detritus which obscures the fundamental rocks,—they overcame these obstacles by examining, in succession, the banks of the rivers between the longitude of St. Petersburg and of Archangel, which, flowing from N.N.W. to S.S.E., or transverse to the only apparent lines of elevation, might be expected to offer the evidences required. They also ascended the great Dwina, from the White Sea to Ousting Veliki; and afterwards extended their researches to the south of Nijnii Novogorod, in order to determine the relations of the secondary rocks to those older deposits with which they had become familiar.

In terminating these introductory explanations, the authors dwelt with pleasure on the valuable assistance they had received, particularly in the early part of their tour, from the Baron A. de Meyendorff‡, now executing, by order of his Imperial Majesty, a statistical survey of Russia, who endeavoured to combine geology and natural history with the chief object of his expedition by attaching to it two excellent naturalists, Count Keyserling and Professor Blasius. They

\* Geol. Trans., First Series, vol. v.; Second Series, vol. i.

† Silurian System and map.

‡ Assisted by M. Zenofief.

further testified their warm thanks to the Russian minister, the Count de Cancrine, who specially aided this geological inquiry, and they also acknowledged their obligations to Count Nesselrode, Count Alexander Strogonoff, Baron Humboldt, Baron Brunnow, and General Tcheffkine. They further expressed their sense of the value of the services of a zealous young geologist, Lieutenant Koksherof, without whose aid the authors could not have accomplished their task. A geological map and sections illustrated the description, and the characteristic fossils of each group were laid upon the table.

*Crystalline Rocks, Metamorphic Rocks, Trap Rocks, Physical Geography, &c.*—Before they proceed to describe the sedimentary deposits in their order from S. to N., or from the older to the younger strata, the authors mention some peculiar varieties of gneiss which occupy the little islands of the White Sea near Onega, one of which is charged with garnets. They then give a brief sketch of the altered condition of the sedimentary strata on the western shore of the lake Onega, where they are pierced by masses of greenstone and trappean conglomerate.

A few words explain how the Waldai Hills, the great watershed of Central Russia, afford the best means of reading off the succession of the older strata. The rivers Msta, Wolkoff, Siass, &c., which flow from the south to the north, having short courses, necessarily occupy deeper rents, and therefore expose on their banks better sections than those streams, which, descending on the other side of the crest, glide along on a very slightly inclined plane to the south. By examining the banks of the north-flowing rivers, the older formations were found to succeed each other in the following ascending order :—

1. *Silurian Rocks.*—The oldest sedimentary deposits of Russia (those on which St. Petersburg is situated) are clays, sandstone, limestone and flagstone, which from their position and organic remains are considered the equivalents of the Silurian system of the British Isles. The detailed order of these beds was long ago given by Strangways; but at the early day when he wrote, the study of organic remains was not sufficiently advanced to enable him to determine the exact place of these beds in the geological series, nor to point out their true relations to the adjacent masses. Many of the fossils have since been described by the native authors, Pander and Eichwald, and recently some very characteristic forms by M. de Buch.

The Silurian deposits consist in ascending order of *blue clay, intermediate grit, and overlying limestone, &c.* In the first of these no organic remains have yet been found; and the intermediate sandstone or grit is alone distinguished by a remarkable form unknown in western Europe (*the Ungulite*), which the authors consider to be nearly allied to *Orthis*. They likewise discovered in this grit one small shell resembling a *Pecten*. In the limestones, and certain overlying flagstones first described on this occasion, organic remains abound; and they agree well in the leading characters on which the Silurian system was established, viz. that the forms of *Trilobite*,

*Orthoceratite*, and *Orthis* are distinct from the types of the overlying members of the palæozoic series.

The most prevalent fossils are the *Orthoceratites vaginatus*, *Asaphus expansus*, *Illænus crassicauda*, the peculiar Crinoidean *Spheronites* (allied to the *Ischadites* of the Upper Silurian rocks), and a vast profusion of many species of *Orthis*. Although, upon the whole, the Silurian fossils of Russia differ more than those of Sweden from British species of the same age (as might indeed be expected from their more remote distance), certain shells are identical with those published from England; among which are enumerated, *Leptæna depressa* (*L. rugosa*, Dalm.), *Leptæna sericea*, *Lingula Lewisii*, *Orthis canalis* (*O. elegantula*, Dalm.), &c.; and according to M. Eichwald, two or three species of *Trilobites*\*.

With the exception of some very trivial dislocations in the low hills south of St. Petersburg, the Silurian rocks are so uniformly horizontal, that in the fine quarries on the banks of the Wolkoff, the authors were able to prove a difference of 2° or 3° to the S.S.E. only by pouring water on the surface of the rocks.

These Silurian deposits occupy the islands of Öland, Gothland, &c. in the Baltic, and trend along the shores of Esthland in a broad band from W.S.W. to E.N.E., till they are lost under vast heaps of granitic detritus between the lakes Ladoga and Onega. Near the latter, these deposits are deflected to the north, and there meet with great ridges of trappean rocks, which run from N.N.W. to S.S.E. In that region all the deposits are in a metamorphic condition; the limestones present no distinct traces of fossils; and the authors having satisfied themselves that there was no chance of observing any further evidence of a descending order between such rocks and the great primarized granitic chain of Scandinavia and Russian Lapland, the boundary of which they coasted, confined their attention to the *ascending* order of the strata, which is clearly exhibited on the banks of the Wolkoff and at other places.

2. *Old Red, or Devonian System*.—That the inferior strata are the true equivalents of the Silurian system, was determined not only by their aspect and fossil contents, but by their being overlaid by other rocks which are completely identical with the “Old Red System” of the British Isles, as defined by Mr. Murchison†. This system is of great extent in Russia. It passes from Livonia by the lakes of Ilmen and the Waldai Hills, and is extended over a vast region to the N.E., where it constitutes a large portion of the shores of the White Sea. This system consists of flagstone, clays, marls, concretionary sandstones, the whole bearing a considerable resemblance to some red deposits of the same age in our isles, but differing by containing copious *salt springs* and much *gypsum*. It was the occurrence of so much salt and gypsum that led previous writers to consider these deposits an equivalent of our new red system, which,

\* See Professor Eichwald's work, published since the authors' visit to Russia, entitled 'Silurische-Schichten-system in Esthland.'

† See *Silurian Researches*, p. 165, and Table with the Map.

being found to contain the same minerals in the western parts of Europe, had been even termed by some, the saliferous system. That the red deposits (red and green) are, however, the true equivalents of our old red sandstone, is demonstrated, not only by order of superposition, but also by the many organic remains which they offer. Fishes are the most distinguishing fossils of this great Russian system, and among these are species (notably the *Holoptychius Nobilissimus*, Murchison, with the *Cocosteus*, *Diplopterus* and *Ctenoptychius* of Agassiz), forms which occur in deposits of the same age in Scotland. The fishes are in abundance, and a work, illustrative of them, is now preparing by Professor Asmus, of Dörpat, near which University they abound. The authors have traced these fish-beds for a great distance, occupying several stages in the system, and each stage characterized by peculiar species of ichthyolites.

The zoological contents of this system are also of great value in illustrating and confirming the palæozoic classification proposed by Messrs. Sedgwick, Murchison and Lonsdale; or in other words, the evidences found in Russia leave no doubt that the old red and Devonian systems of rocks are identical. The *Orthis subfusiformis*, *O. striata*, *Spirifer calcarata*, *S. trapezoidalis*, *Productus caperatus*, *Terebratula prisca* (large var.), and *Serpula omphaloides*, shells distinct from those of the carboniferous system, but similar to those which occur in Devonshire, Westphalia, Belgium, and other places (in deposits which have been shown by these authors to be of the age of the old red sandstone), are found in Russia *in the same beds with the fossil fishes of the old red sandstone* of the British Isles.

Still more striking, observe the authors, are these cumulative proofs, when it is stated, that although in France and Germany there are scarcely any lithological equivalents for the British old red system, yet, that in extending researches far to the east, this member of the series is found to resume very many of the same mineral characters which distinguish it in the central and northern parts of the British Isles; and then under *similar conditions* it contains the ichthyolites of the British deposits.

3. *Carboniferous System*.—In the northern regions of Russia, the lower or calcareous part only of the carboniferous system exists, which in the Waldai Hills, near Wytegra, on the Onega, and in many other places, is seen to overlie the old red sandstone. The inferior beds consist of incoherent sandstones and bituminous shale, which sometimes contain thin beds of *impure pyritous coal*, and impressions of several plants well known in the carboniferous system of our own islands. These are surmounted by various bands of limestone, the lowest of which only have occasionally some mineralogical resemblance to the mountain limestone of Western Europe; other beds being lithologically undistinguishable from the magnesian limestone of England; some from a pisolite; a third and very prevalent band of considerable thickness is milk-white, and not more compact than the calcaire grossier of Paris. This white *Productus* limestone was traced by the authors from the neighbourhood of Moscow to beyond Archangel (and they ascertained that it ranged

far into the country of the Samoiedes), a distance of not less than 1000 miles. This formation has also a mineral resemblance to chalk, in being loaded with thin bands of flints, sometimes concretionary, in which shells and corals occur. Associated with this formation, on the banks of the Dwina, about 200 wersts above Archangel, and south of Süsskaia, are splendid bedded masses of white gypsum, which, for many miles, present at a little distance all the appearance of white limestone\*. With these grand gypseous deposits, in which are occasionally large concretions, two or three thin bands of limestone alternate, in one of which the authors detected fossil shells (*Avicula*) which are new to them. Other peculiar bands near Ust-Vaga, which are rather higher in the series, contain a *Productus* approaching to *P. scabriculus*, with *Pectens* and *Corals*.

The carboniferous limestone of Russia is highly fossiliferous, and from the normal and unaltered condition of most of the beds, the fossils are generally in an excellent state of preservation. Among them are many well-known British species, the lower beds being distinguished by the large *Productus hemisphericus* so well known in the same lower beds of England and Scotland; and the white beds being loaded with many of the species published by Fischer, Phillips and Sowerby, such as *Productus Martini*, *P. punctatus*, *Sanguinolaria sulcata*, *Spirifer Mosquensis*, *Cardium aleforme*, *Cidaris vetustus*, together with the abundant and characteristic Russian coral, *Chatites radians* (found, according to Mr. Lonsdale, in the carboniferous limestone of Bristol, &c.), and the *Lithostrotion floriformis*, one of the most characteristic fossils of the English carboniferous limestone, &c.

Owing to its mineral aspect, the age of this rock had, till within the last year, been misunderstood; but Colonel Helmersen having observed its position in the Waldai Hills and its association with certain beds of coal, and having ascertained the nature of the fossils through the examination of M. von Buch, he first gave out in Russia, that it must be considered the true mountain limestone. The authors have completely confirmed this view, by ascending and descending sections, and have largely extended it.

*Newer Red Formations.*—The manner by which the authors were led to believe in the existence of newer red deposits, forming a vast basin in the governments of Vologda, Nijnii, Kostroma, is explained at some length, by describing the ascending section of the Dwina, and by details relating to the structure of the banks of the rivers Volga, Okka, &c. They show that, although this great red series of the central government agrees with that of the north, in containing salt and gypsum, yet that it differs from the "old red" group in the lithological and zoological character of its marls, limestones, and fine conglomerates, none of the fishes or organic remains before alluded to being anywhere discoverable. In expressing their suspicion that this newer red system may be found eventually to contain the *equivalents* of the upper coal measures, lower new red sandstone

\* See M. Roberts's account of these white cliffs, which he supposed to be limestone.—*Bulletin de la Soc. Géol. de France*, 1840.

(*roh-te-tod-te liegende*), magnesian conglomerate, zechstein, and the Trias of German geologists, the authors reserve their opinions on such details until they have accomplished a tour to the Ural Mountains, on the western flanks of which they hope to detect the evidences required; it being very difficult to trace the exact sequence in the flat and obscure regions over which they followed these deposits to so wide an extent.

*Oolitic or Jurassic Series.*—Certain rocks of the oolitic series have been long known to exist in the centre of Russia, and some of the fossils of this series were sent to England by Mr. Strangways.

The beds of black shale which rest at once on the great red formation along the banks of the Volga, between Kostroma and Nijnii Novogorod, belong unquestionably to the middle oolite, as they contain *Ammonites* and *Belemnites*, closely approaching, if not identical in species with those of the Oxford clay and "Kelloway Rock" of Smith. Other fossils found near Jelatna, Kacimof and Moscow exhibit close relations to the fauna of the Lias as well as to that of the middle and lower oolite. Having examined a suite of specimens from Moscow, Professor Phillips confirms the views of the authors, who are disposed to think that the middle and lower oolite, as well as the Lias, are all represented in Central Russia simply by beds of black shale with subsidiary courses of oolitic marlstone, concretions, &c. Near Moscow these shales repose directly and conformably upon the carboniferous limestone. Among the fossils of the group on the Volga and the Okka are *Ammonites flexistria*, *A. Gulielmi*, *A. Königii*, *A. sublevis*, with *Gryphea Maccullochii*?, &c. Among the fossils from Moscow are *Ammonites* of many species, some of which are figured by Fischer, others are described by Professor Phillips, for this memoir. *Belemnites absolutus* (*B. sulcatus*, Miller); *Serpula tetragona*, Sow.; *Amphidesma*? *donaciforme*, Phill.; *Lima proboscidea*?, Sow.; *Pecten Fisherii*, N.S., *Inoceramus dubius*, Sow.; (*P. rugosus*, Fischer) *Terebratula serrata*, Sow.; *T. acuta*, Phill. These forms characterize the lower oolite and lias of the British Isles.

*Ferruginous Sand.*—The shales of the oolitic series are covered by ferruginous sands, occasionally green, which contain large flattened concretions of grit (the Moscow millstones); but never having observed fossils in this rock, the authors are unwilling as yet to hazard an opinion regarding its age. With the exception of certain very recent deposits, these grits are the youngest solid strata in the northern half of Russia in Europe.

*Chalk.*—The cretaceous system is largely developed in the south, near Simbirsk, and in the Crimea; but on this occasion the authors did not extend their tour to the chalk districts.

*Tertiary Deposits.*—The white shelly limestone of Crimea, and its relations to the underlying chalk, have already been described by one of the authors\*. Such deposits have not yet been discovered in any of the northern or central regions of Russia.

*Post Pleiocene (Pleistocene).*—It was formerly the general belief,

\* M. E. de Verneuil.



that the great masses of superficial detritus, whether clays, sands or blocks, which cover so very large an area of the northern region, were all referable to one epoch (diluvian) in which the bones of great extinct quadrupeds were also imbedded. The duration of their journey was not sufficient to enable the authors to make many distinctions of age between these different masses; but they have commenced this division by the discovery of beds of clay and sand on the banks of the Dwina and Vaga, upwards of 200 miles south of the White Sea, which contain *twenty-two species* of shells, many of which still preserve their colours, and which, having been referred to Dr. Beck, of Copenhagen, have been pronounced by him to be all of modern *northern* species. Mr. Lyell states that they are identical with the Uddevalla group described by him in Sweden. Mr. Smith adds, that these shells are nearly all the same as those which he has found in various ancient elevated sea bottoms around the coasts of Scotland. In referring twenty of these to modern arctic species, Mr. G. Sowerby doubts if a certain *Mya* has ever been found recent, and states that a *Cardium*, approaching to *C. ciliatum*, is different from any northern form he is acquainted with, and near to certain Australian types. This discovery, in which they were assisted by Count Keyserling, who accompanied the authors in their tour to Archangel, is conceived to be of high geological interest, as it demonstrates that, during the *quasi* modern period, the whole of the vast flat country of north-eastern Russia was beneath the sea for a considerable time, the eastern boundary of that sea being probably the slopes of the Ural Mountains.

*Drift and Erratic Blocks.*—Overspreading all the formations, and greatly obscuring them, is a vast mass of detritus, the large granitic and other crystalline blocks of which have excited much attention, from the days of Pallas to the present time. This detritus, the blocks of which have all been derived from the north, is shown to have been deposited *under the sea*, or in other words, upon a sea bottom, since it covers the above-mentioned shells.

Notwithstanding the obscuration occasioned by this wide-spreading drift, it is stated that the nature of the subsoil, or fundamental deposits, can often be surmised from the colour of the superficial clay and sand, and the materials of small detritus, the surface of the Silurian zone being grey, that of the old red, red; whilst the cover of the carboniferous limestone is often charged with many broken flints derived from the underlying beds of that formation, some of the siliceous fragments of which have been transported further southwards, and spread over the regions occupied by the newer red and oolitic deposits. Thus, as all the larger and harder blocks can be shown to have been carried from the mountains on the N.N.W., so in passing to the S.S.E. the finer ingredients, or matrix of the detritus, is found to change by the successive additions of materials derived from the denudation of the different members of the palæozoic series. There is no instance of any substance having been transported from S. to N., except by the modern action of streams, and by local causes dependent on the present configuration of the

land. Near Nijnii Novogorod large blocks of a very peculiar trap-pean conglomerate were detected, which had been derived from a rock *in situ* N. of Petrazowodsk, a distance of nearly 600 miles. In endeavouring to account for the immense distances to which these blocks had been transported, the authors expressed their belief that they had been floated in former icebergs, which breaking loose from ancient glaciers, which they suppose may have existed in Lapland and the adjacent tracts, were dislodged upon an elevation of the northern chain, and impelled southwards into the sea of that period, in which the post pleiocene shells, to which allusion has been made, were accumulated. In the relation of the blocks to the sea shells, they conceive that Central Russia presents an exact parallel (though on a much grander scale) to the phænomena described by one of the authors in the central counties of England, where a similar collocation was accounted for, by supposing that the northern blocks were borne thither in vessels of ice, which in melting dropped them upon what was then a sea bottom\*.

*Glacial Action.*—After alluding to the works of Sefström† and Bötlingk upon the supposed “diluvial” currents of Scandinavia and Lapland, as evidenced by the parallel striæ and polishing of the surface of the hard rocks of these regions, the authors describe the most southerly of the scratches, which came under their notice near Petrazowodsk, on the lake Onega, no such markings having anywhere been observed in Central Russia. They then examine the applicability of the glacial theory, as proposed by M. Agassiz, to the tracts of Russia under review. Starting from what they conceive to be an axiom, that the advance of every modern glacier depends upon the superior altitude of the ground behind it, they show, that if certain parallel striæ, observed by M. Bötlingk, and others noted by themselves, are to be taken as proofs of the *overland* march of glaciers, such bodies must often have been propelled from lower to higher levels. For the proofs of this they refer to the eastern sides of the Bothnian Gulf, where M. Bötlingk found the striæ (“*diluvial schrammen*”) directed in common with the boulders from N.W. to S.E.; and yet any glaciers which bore these blocks must have advanced from Scandinavia, across the Baltic Sea, and then have ascended the rocky tract in question. Again, near Petrazowodsk, in the isles of the lake Onega, the authors observed such striæ exactly parallel to the major axis of the lake, N.N.W. and S.S.E., even from a good many feet under the clear fresh water, and thence rising to the height of twenty feet above the summer level of the lake on the sloping surfaces of the rock. They then argue, that in this tract there are no hills of sufficient altitude on the N.N.W. to account for the determined forward direction to the S.S.E.; and as a still further reason for rejecting the application of the “Alpine glacial theory” to this country, they add, that as the striæ in one region have all a given and parallel direction, so must the supposed glacier not only

\* Silurian System, p. 535 *et seq.*

[† A translation of M. Sefström’s paper on this subject will be found in Part ix. of Taylor’s Scientific Memoirs.—EDIT.]

*Phil. Mag.* S. 3. Vol. 19. No. 126. Dec. 1841.

have moved on as it were without a cause, but also have maintained an incredibly enormous advancing front of many hundred miles in length!

Without pretending to offer a complete solution of so difficult a problem, and after stating that many additional and even experimental researches are required in relation to the power of water, drift, and ice, they cannot avoid suggesting as a probable explanation of the chief phenomena in the North of Russia, that currents strongly determined in given directions by the elevation of the northern continental masses, might dislodge and set in movement icefloes and detritus, which, *grating upon the bottom of a sea, may have produced the parallel striae*. They are the more confirmed in this hypothesis, by the fact, that the longer axes of the lakes and stony ridges of Northern Russia have generally the *same direction*; so that the supposed icebergs and *land detritus* would necessarily be borne in that direction. By adopting this view, the existence of the post pleiocene shells of the Vaga and the Dwina, and their relations to the overlying drift from the North, are in harmony; and whilst admitting so much of the glacial theory as to allow, that in former days glaciers probably advanced further to the South and occupied many insulated tracts, and to a much greater extent than at the present day, the geologist, they conceive, is alone called upon to define and limit the area of *land* in Scandinavia and Lapland, once covered with solid ice, in doing which he must of course exclude from such agency the vast countries now covered by erratic blocks, which he can demonstrate were deposited upon the *bottom of the sea*.

*Angular block-ridges on lake and river Banks.*—On the western shore of the great lake of Onega, the attention of the authors was directed, by Colonel Armstrong\*, to three parallel ridges of large angular blocks of hard grit (old red sandstone?), which occur at heights, varying from 20 or 30 to 150 feet or more above the level of the water. As these blocks were identical in composition with the solid subjacent rock, and also quite angular, it was at once evident that they had not been drifted, but simply rent from the solid rock which forms that side of the lake. On a first inspection, the authors were disposed to think that these appearances might have been caused by upheaving or vertical shocks of earthquakes, which they presumed might be among the last signs of the great igneous action which had once been so dominant in these northern tracts; and they were unable to account for them satisfactorily, until they detected the results of modern action of river ice, which completely explained the lacustrine case.

About 80 miles above Archangel they met with a ridge of large angular blocks of white limestone piled up between the road on which they travelled and the river edge, and about 20 or 30 feet above the stream. Having ascertained that this great river was periodically subject to occasional extraordinary rises in the spring, and that on those occasions it bursts and throws up upon its banks blocks

\* Director of the Imperial Iron Foundries of Petrazowodsk.

of ice to heights of 20 or 30 feet above its ordinary level, they had at once a solution of the phænomenon; for the blocks of white limestone had evidently formed parts of the subjacent strata, which, projecting into the mud and water on the edge of the Dwina, had been first entangled in ice, and rent off at their natural joints upon the expansion of the ice by which they were upheaved into their present position, taking their present irregular talus shape when the ice melted away from them. Believing, therefore, that the angular ledges on the lake of Onega were similarly formed, the authors see in them the proofs of the lakes of Northern Russia having formerly stood at much higher levels, from which the waters, they suppose, have been let off by successive elevations of the land; and they further think, that the diminution of shallow lakes, and the conversion of marshes into land within the historic period in Northern Russia, strongly corroborate the rise of this portion of the earth.

*Conclusion.*—In recapitulating the chief point of the first and practical part of their Memoir, wherein they establish, they trust, on a sound basis, the general classification of the Palæozoic Rocks of Russia in Europe, the authors remark, that the fact of some of the deposits of such high antiquity being found to stretch in horizontal and almost unbroken sheets over spaces of a thousand miles in length, in a very slightly solidified or lapidified state, is the more interesting when coupled with the absence, throughout the same regions, of all plutonic or igneous rocks. This phænomenon must, it is conceived, exercise considerable influence upon geological theory, it being now apparent, that the lithological nature of the most ancient subsoil of Russia in Europe is such as to compel geologists to reject the conclusion, that in proportion to their antiquity the strata have been hardened or crystallized by any general radiation of central heat; for in these wide tracts such crystalline and hardened state is clearly seen to be purely metamorphic, and dependent exclusively on the vicinity of rocks of igneous protrusion, in receding from which to the South all the strata described are at once found in their normal soft condition.

In taking leave of the Society, the authors explained some of the chief objects of their journey to the Ural Mountains, Orenburg, &c., on which they were about to proceed.

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*Note.*—After these sheets were sent to press, Mr. Murchison received letters from his friends and fellow-travellers, the Baron A. de Meyendorf and Count A. Keyserling, in which the researches of these gentlemen in the South of Russia are explained. These letters communicate important additions to the results already offered to the Geological Society, particularly in regard to the extension and development of the carboniferous system. The geological map which has been prepared by their labours, and from those of other Russian authorities, agrees with that of Mr. Murchison and M. de Verneuil, exhibited to the Society, in the fundamental classification of the rocks which occupy the northern and central governments of Russia, and in the lines of demarcation between the *Silurian*, *Devo-*

nian or Old Red, Carboniferous, Newer Red, and Oolitic Systems; but it is copiously enlarged, by showing the extension of the carboniferous system over a very wide area, ranging from near Witepsk, by the south of Tula and Kaluga, to the S.E. of Cazan. A vast spread of chalk and tertiary deposits directly overlies these carboniferous limestones, which rise again from beneath these younger formations in the great carbonaceous tract of the Donetz, the southern edge of which consists of the granitic steppe. A section made by Count Keyserling and Professor Blasius to the south of Kaluga, indicates a succession from what these naturalists believe to be the lower beds of the carboniferous limestone, containing *Spirifer Mosquensis*, into superior strata of sand and shale with coal, subordinate to bands of limestone containing the *Productus hemisphericus*, the coal being associated with much red earth, and overlaid by the upper carboniferous limestone. They also express their belief that the millstone grits which have been alluded to near Moscow must be considered of tertiary age, as similar beds overlie true chalk.

Mr. Murchison takes this opportunity, in the name of his friend M. de Verneuil and himself, of recording his sense of the value of the additional data which are due to the labours of Baron de Meyendorff and his associates, and trusts that after an exploration of the flanks of the Ural, and other tracts near Orenburg and in the South, all the chief facts will have been obtained for the construction of a general geological map of Russia in Europe.

Count Keyserling, who has traced the shales with *Ammonites* near Ust-Sisolsk (N. Lat. 61°, E. Long. 51°\*), has indeed contributed most powerfully to these results, both by his patient observation, sound knowledge of natural history, and by his barometrical admeasurement of heights,—a point of great geological importance in those central parts of the country where the strata are not deranged. By one of his observations, it appears, that the younger pleiocene deposits on the Dwina, which he detected in company with M. de Verneuil and Mr. Murchison, are about 150 feet above the White Sea. Count Keyserling, now at St. Peterburgh, will accompany the authors in their journey to the Ural Mountains this summer.—*March 26.*

#### LXXIV. *Intelligence and Miscellaneous Articles.*

##### MR. BRAYLEY'S LECTURES ON IGNEOUS METEORS AND METEORITES.

THE following is the Syllabus of a Course of Lectures on Igneous Meteors and Meteorites which I am about to deliver at the London Institution, as announced in our last Number, p. 414, as it has been

\* Similar Jurassic beds had been previously observed by M. Strajesko in the N. Ural, Lat. 64° north, and their fossils are described by M. Leopold de Buch in his recent work, 'Beitrage zur bestimmung der Gebirgsformationen in Russ-land.'