These inferences can be only put forth as provisional, until a thorough examination of the deposits described by Mr. Kaye in their stratigraphical relations be made, and the fossils of those localities which he did not visit have been still further examined on the spot. To the palæontologist his collections are invaluable, as the specimens are in so fine a state of preservation, as to permit of an examination of their minute structure.

The descriptions of fifteen of the Trinconopoly species in the catalogues were furnished to Mr. Kaye by Mr. George Sowerby.

[*Note.* With regard to this report, it was also intended that it should have been accompanied by a descriptive catalogue of the fossils, and by figures of new species, and it is in so far, therefore, incomplete. It is published in this place as an indication of the important results actually arrived at by the study of these interesting fossils.—ED.]

4. *On the PERMIAN SYSTEM as developed in Russia and other Parts of Europe.* By RODERICK IMPEY MURCHISON, Esq., F.G.S., V.P.R.S., and M. E. DE VERNEUIL, Hon. Mem. Geo. Soc. of London.

ON the part of his associates, M. de Verneuil and Count Keyserling, and himself, Mr. Murchison has previously explained in the Proceedings of the Geol. Soc. the nature of the various deposits which constitute the subsoil of European Russia. As in all other parts of the world which have been adequately examined, the Silurian rocks are those which contain the earliest forms of animal life, and in Russia they are overlaid by Devonian and carboniferous deposits, each of which is there singularly well defined by its organic remains and regular superposition.

In common with many other geologists, Mr. Murchison was formerly of opinion* that the above-mentioned three systems constituted the whole Palæozoic series, but the examination of Russia and Germany has led him to include also therein the next group in ascending order, or that to which he had assigned† the name of Permian.

When two or more conterminous formations are shown to have a community of fossils, it has recently been deemed essential to group them under one name; and following the practice of assigning to any such newly classed group a geographical name

* See "Silurian System," p. 46. *et seq.* In England Professor Phillips has, however, some time maintained that the fossils of the magnesian limestone ought to be grouped with the inferior strata.

† See "Letter to M. Fischer Von Waldheim, Sept. 1841"; Leonhard's "Jahr Buch," part i. p. 91 1842; "Phil. Magazine," vol. xix. p. 418.

derived from the region where the strata are best developed, the term "Permian" was employed. This system was first proposed to embrace the deposits known in Germany as the *Rothe-todte-liegende*, *Zechstein*, *Kupferschiefer*, &c., and in England as Lower New Red Sandstone, Magnesian limestone, &c.

In communicating some of the results of a journey in Poland and Germany during last summer, Mr. Murchison, one of the authors of the present memoir, states that his object is to show that his first view concerning the inferior limit of this system is correct—to extend its upper limits, and from the distribution and character of its organic remains to demonstrate that it is of palæozoic age.

Near Zwickau in Saxony, and Waldenburg in Upper Silesia, productive coal-fields (in the latter country recumbent on carboniferous limestone) are unconformably surmounted by red conglomerate, sandstone and shale (the *rothe-todte-liegende*), which in those countries, as in Thuringia and Hesse Cassel, pass conformably upwards into the *Zechstein* or its equivalents. The same relations of a lower sandstone to the Magnesian limestone are, indeed, well known in England, and have been pointed out in detail by Professor Sedgwick. Seeing that these two deposits are so intimately associated, few, if any, geologists would wish to disunite them; but the question arises, what is the uppermost limit of this group. In Russia, beds of limestone identified with the *Zechstein* and Magnesian limestone by their organic remains are overlaid by a great thickness of marls, sands, and conglomerates, containing some of the same types of life as the lower members, particularly the plants which are very closely allied to and are in some instances identical with the vegetables of the carboniferous era. It became therefore desirable to ascertain whether similar palæozoic features were to be found in other parts of Europe. Now in Thuringia and Hesse Cassel, the *Zechstein* is, in numerous localities, conformably surmounted by red and spotted sandstones, in which no traces of fossils distinct from those of the Permian era are observable, the only land plant found in them (the *Calamites arenarius*) being inseparable from well-known carboniferous forms. This overlying sandstone being perfectly conformable to the *Zechstein*, may, it is conceived (like the overlying sandstones of Russia), be classed with that rock. In making this suggestion, the authors disavow the intention of derogating in any respect from the Trias of German geologists, also a tripartite system, and of which the *muschelkalk* is the centre, with certain red and mottled marls and sands beneath, and the *keuper* sandstone above. The Triassic system does not contain a single Palæozoic form, whether animal or vegetable, whilst the fauna and flora of the Permian are both so connected with the carboniferous and inferior systems, that they evidently constitute the last remnant of the same era. In the whole geological series, therefore, no two systems are more completely separated than the Permian and the

Trias, the one forming the uppermost Palæozoic stage, the other the base of the secondary deposits.

After showing that the "Grès de Vosges," as described by M. Elie de Beaumont, is one of the arenaceous equivalents of the Permian system, and after alluding to its development in the neighbourhood of Strasburg and in other parts of Europe, where it is well separated from the Trias, attention is directed to the fact, that as far as researches had yet gone, the Trias is always conformable to the Permian, whilst the "rothe-todte-liegende," or base of the latter, is frequently unconformable to the carboniferous rocks, on which it rests, and out of whose detritus it has often been formed. These phenomena, say the authors, prove that the most marked distinctions between the fossils of succeeding formations cannot be referred to physical revolutions of the surface; for in the examples cited there is a sequence of congeneric remains, where the succession of the strata has been powerfully interrupted (Carboniferous to Permian), and a total change of fossils where the contiguous formations are conformable (Permian to Trias).

These relations are expressed in this diagram :—

The Permian fauna is then considered, and is said to exhibit the last of the successive alterations which the Palæozoic animals underwent before their final disappearance. The total number of Permian species known to the authors in different parts of Europe (without reckoning certain ichthyolites not yet named, and a few doubtful forms of shells) is 166, of which 148 are characteristic of the system, 18 only being found in the subjacent Palæozoic rocks. The Brachiopods being viewed as the shells of most value in determining the durations of the ancient rocks, it is stated, that 10 out of the 30 Permian species are common to this system and the carboniferous. After some observations on the species of *Productus*, *Spirifer*, *Orthis*, *Terebratula*, *Leptæna* (*Chonetes*), which have lived on from earlier periods, it is remarked that no form of the *Pentamerus*, a genus peculiarly characteristic of the Silurian strata, has yet been found in the Permian strata, whilst the Brachiopod most frequent in the latter is the *Productus*, a genus very abundant in the carboniferous or conterminous deposits, but unknown in the Silurian. Among the Conchifers

(26 in number) the *Modiola* is very characteristic of the Permian system, both in Russia and England; and though the large species of *Axius* so well known in England has not yet been found in Russia, its place is there taken by two other species of the same genus. The *Avicula* is also a good Permian shell, the *A. Kazanensis* being the best type in Russia, whilst the *A. antiqua* is there common to this deposit and the carboniferous.

The Gasteropods, so abundant in the carboniferous era, have undergone great diminution before the formation of the Permian strata, and have had great difficulty in accommodating themselves to new conditions; still more so the Cephalopods, for the forms of *Goniatites*, *Nautili*, and *Orthoceratites*, so very common in the preceding epoch, are almost unknown in this system, a fragment or two of one genus (*Nautilus*?) alone having been found in all parts of Europe. This scarcity of Cephalopods at the close of the Palæozoic series has a remarkable parallel in a subsequent geological period; for as these animals were reproduced in vast abundance and under many new forms in the Triassic, Jurassic, and Cretaceous systems, so towards the termination of the last of these we perceive a second and similar disappearance of the greater number of the shelly Cephalopods. The extreme reduction of the Gasteropods at the close of the cretaceous period, as indicated by M. Alcide D'Orbigny, is also pointed out as an additional feature of analogy to the Permian changes. Trilobites, so eminently characteristic of the Silurian system, and which dwindle away to a few small species in the carboniferous system, are unknown in the Permian of Western Europe and in Russia, and are only represented by a species of *Limulus*. Fishes, on the other hand, are numerous in proportion to the other Permian classes, 43 or 44 species being named, and several from Russia being yet undescribed; these are all, with one exception, absolutely peculiar to the stratum in which they occur, thus confirming the truth of the generalisation of Agassiz, that these vertebrata mark with great precision the age of the stratum in which they are found. Lastly, the Permian beds of Russia, like the Dolomitic conglomerate of England and the Kupferschiefer of Germany, contain bones of thecodont Saurians, indicating the earliest appearance of animals of that high organisation, and their direct association with Palæozoic shells and plants, some of which are undistinguishable from true carboniferous species.

After thus following it back *in time*, the Permian fauna is next considered in horizontal extension or *distance*, the fossils of Russia being compared with those of similar age in western Europe. The number of species collected by the authors in Russia is 53 or about one third of the total number of the whole European fauna of the period, and of these 32 are peculiar to Russia, a large number when the recency and rapidity of the survey of the authors is adverted to; and when it is considered that 33 species only were found by Professor Sedgwick in deposits of this age in England, and 41

according to the recent tabular view of Geinitz is the total number known in Saxony where the Zechstein is very fully elaborated. Like other formations of synchronous age when at great distances from each other, the Russian succession of Permian strata cannot be brought into a detailed analogy with that of western Europe. Instead of occupying a fixed place like the calcareous beds which represent the Zechstein, they inosculate with great thicknesses of fossiliferous grit, whilst Saurians and fishes with certain *Producti* and *Modiolæ*, as well as most of the plants, unquestionably occur in conglomerates, tufaceous limestones, and marls, which overlie the beds which contain Zechstein or Magnesian limestone fossils. In Germany, the Protosaurus belongs to the Kupfer-schiefer which is below the Zechstein, whereas in Russia all the cupriferous and sauroid beds are above that rock.

In analysing the species common to the Permian system of Russia and the rest of Europe (by stating the number which have lived on from the carboniferous to the Permian, and the diminished proportion of the latter), Russia alone is appealed to, and three only of the Permian *species* of that country are found to descend into the Palæozoic rocks. The authors, therefore, infer that these results necessarily prove the existence of a relation between the greater or less duration of species and their propagation or extension to distant parts, thus confirming a law previously announced by one of them.

Some detailed observations then follow on the species in each class found in Russia, and Mr. Lonsdale is cited as having assured them that although the Permian corals are evidently Palæozoic in their generic characters, there is not a single species which is identical with a carboniferous form; and it is also remarked that of 20 species of Brachiopods found in Russia 8 are peculiar to that country.

Lastly, deriving their knowledge of the specific character of the plants from the examination of M. Adolphe Brongniart, aided by Mr. Morris, who had previously examined them, it appears certain, that whilst all the forms indicate a continuation of vegetable life of the same nature as that which prevailed during the carboniferous era, there are a few species (*Neuropteris tenuifolia*, *Lepidodendron elongatum*, and *Calamites Suckovii*) which are identical with carboniferous plants, and not one which can be compared with a triassic plant.*

The results of the inquiries of the botanist, the authors conclude by remarking, are therefore completely in accordance with those

* The species of plants, ten or twelve in number, which have been found in the Kupfer-schiefer or the sandy beds associated with the Zechstein in Germany, are chiefly marine fucoids, and have been termed *Caulerpites*. According to M. Adolphe Brongniart, the only terrestrial plants of these German strata are the *Teniopteris Echaridi* (Germar), and a *Neuropteris* mentioned by Naumann, which not being determined must be considered doubtful.

of the palæontologist. They clearly prove that the Permian system is the uppermost stage of that long Palæozoic series, which, commencing with the lowest Silurian rocks, presents a connected succession of animal and vegetable life, the last traces of which passed away with the termination of the strata under review. Until Russia was explored, the upper member of these ancient rocks had scarcely afforded a trace of terrestrial plants. Neither in the British Isles nor in Germany had there been found more than one or two species of land plants in deposits of this age, not one of which has yet been fully identified or described. Now in reference to the Russian species, such of them as had been previously alluded to by other writers were placed by some in the carboniferous rocks, by others in the New Red Sandstone.* Our sections, however, have shown that neither of these views is correct; and as the Russian plants to which we have called attention, occur for the most part in strata distinctly *overlying* beds containing the fossils of the Zechstein, it is clear that certain red sandstones, marls and conglomerates, above that rock, belong to our Permian group, are wholly distinct from the Trias, and are truly Palæozoic.

We repeat, therefore, that we have now adduced ample botanical as well as zoological and stratigraphical evidence to vindicate the application of the collective word *Permian* to a succession of strata which had not been previously united through their geological relations and organic contents.

These proofs will, we trust, be considered as still more strongly borne out by the grandeur of the phenomena to which we have appealed; for the Permian deposits of Russia repose upon carboniferous strata throughout more than two thirds of a basin which has a circumference of not less than 4000 English miles.

A detailed tabular list of the animal remains of the Permian system in Europe was also given, mentioning the names of the authors who have described each species, the localities at which it has been found, and its vertical range in the Palæozoic series. This table will appear "in extenso" in the forthcoming work upon Russia, and in the meantime the following recapitulation is subjoined; but the authors express their regret that their table was drawn up without the benefit of the long-promised assistance of Professor Agassiz. His observations on a few of the Permian ichthyolites which were submitted to him will increase the number of that class of fossils.

* See a very recent memoir by M. Ysikoff, "Bull. de Moscou," 1843, part ii. p. 237., in which he refers an interesting portion of the Permian rocks described by us upon the Kama, and between that river and the Sok, either to the *New Red Sandstone* or the *Carboniferous Limestone*.

Recapitulation of the Fauna of the Permian System in Europe.

Classes.	Genera.	Total Number of Species in Europe.	Species exclusively peculiar to the Permian system in Europe.	Species found in older formations.	Species found in Russia.			
					a. Peculiar to that country.	b. Previously found elsewhere.		
						In the Permian and older formations.	In the Permian beds exclusively.	In older formations exclusively.
Polyparia - - - -	7	15	13	2	3	1 ?	2	
Echinodermata - - -	2	2	1	1				
Conchifera, Ord. Brachiopoda	7	30	20	10	8	3	4	5
Ord. Dimyaria -	10	26	26		8		3	
Ord. Monomyaria	5	16	15	1	4		3	
Mollusca, Ord. Gasteropoda	11	22	19	3	3			
Ord. Cephalopoda	1	3	3		1			
Annelida - - - -	1	2	2					
Crustacea - - - -	2	2	2		2			
Pisces - - - -	16	43	42	1	2			
Reptilia - - - -	4	5	5		1			
Total - - - -	66	166	148	18	32	3 or 4	12	5

FEBRUARY 21. 1844.

The following communications were read :—

1. *Some Remarks on the WHITE LIMESTONE of CORFU and VIDO.*
By Captain PORTLOCK, R.E., F.G.S.

As I have reason to expect that I shall hereafter be able to prepare a detailed account of the Geology of the Ionian Islands, and have at present but few data for a description of even the limited portion of the country as yet examined, I now only offer a few remarks on that portion of the white limestone which is adjacent to the city of Corfu, and occupies the whole of the Island of Vido, and on the more recent strata connected with it.

On approaching Corfu the physical aspect of the country is very striking. Monte Decca on the south, and San Salvador on the north, the former with its sharp, broken, rugged outline, the latter with its conical peak rising from a long ridge, and both exhibiting steep faces marked by numerous deep furrows, by no means recall the ordinary forms of limestones in our more northern countries ;