the blood of the various animals. He (Dr. Playfair) had shown, by some analyses published in 'Liebig's Physiology,' that the ultimate composition of blood and flesh was nearly identical. Hence the Professor's results might be considered as tables of the economic value of the flesh of animals, and the results agreed closely with actual facts. Thus, according to the author of the paper, the blood of man contained 74.194 of albumen; the blood of the ox, which formed, after being transformed into flesh, the most nutritious food for man, contained 74.45 of the same body; the pig, the flesh of which was equally nutritious, contained also exactly the same as that of man —viz. 74.80. Then in those animals, the flesh of which is less nutritious, we find the proportion of albumen considerably less than in man; thus in the blood of the goat it is only 62.905; in the goose 48.695; in the fowl 48.52.

FRIDAY.

SECTION C.—GEOLOGY AND PHYSICAL GEOGRAPHY.

Dr. DALE OWEN 'On the Western States of North America.' The Memoir was illustrated by Maps, Sections, and Diagrams of Fossils.

The grand feature of the country is the Illinois Coalfield, equal in extent to all England, separated from another coalfield, that of the Ohio, by an axis of much older rocks; the object of the memoir was to identify those lower rocks with the systems which supported our own carboniferous series. But we need not give an abstract of this paper at present, as it will be read at the next meeting of the Geological Society.

Mr. PHILLIPS compared the extreme simplicity in the succession of strata and distribution of organic remains observable in these districts of N. America under consideration, with the great breadth occupied in Ireland by calcareous beds of the carboniferous era, where a similar deficiency existed in the middle and superior members of the series. This particular American series was deficient in tertiary rocks; its cretaceous system was deficient in white chalk, the Neokomian beds and the oolites were all absent, the lias and new red sandstone were also deficient; and then came the coal, succeeded by limestones, sandstones, and shales, and these by altered strata and granite. The analogy between the American cretaceous deposits and those of Europe was very striking; though specific differences did exist between the fossils of the two countries, yet these differences were very slight, merely marking the effect of local influence; regarded as a group, the two deposits were identical, and there could be no question of their contemporaneous deposition. Passing from the cretaceous deposits, we did not meet with the series which in Europe succeed to them, but we passed suddenly to the coal formation, without a trace of the fossils of the intervening beds; whilst the plants of the American coal measures, although they might differ specifically from those of Europe, belonged to the same leading groups—Stigmaria, Pecopteris, Neuropteris, Sigillaria, &c. In the limestone (E.) under the coal was shown the state of the sea of that period. There were the Productas, (of the P. antiquata group), the Lithostrations, and the Syphonophyllia, resembling those of the English and Irish carboniferous limestone, and the Pentremites sufficiently characteristic to afford a good temporary designation for the deposit. One fossil would seem to have strayed from its proper place, the Calceola, but as no single shell could be regarded as marking the boundary of a formation, this was not an *exception* to the law; the evidence given by a large number of forms proved these beds to be the equivalents of our carboniferous limestone. Beneath this limestone occurred a fine sandstone (D.); the identity of its fossils was doubtful; it were unsafe to call them Silurian; the Spirifer represented was evidently one of that peculiar Producta-like group, with transverse bars, belonging to the carboniferous limestone, and the other fossils seemed to indicate an intermediate term of life. In the lower limestone, (B.) a Pleurorhynchus was found—a genus which occurred in Devonian, but not in the Silurian rocks; Pentremites were also figured as belonging to this deposit. The lowest deposits (A.) forming the basis of the series contained the usual Silurian forms, Orthidæ and Spirifera. These rocks appeared as one series of calcareous deposits, formed under circumstances less subject to fluctuation than their equivalents in Europe; and the continuity of specific forms and types of organization seemed to have been much greater than in countries where physical changes produced well defined lines of separation in the deposits. The successive periods of deposition of strata were much better determined by organic forms than by the mineral constitution of the rocks, but in applying this principle, it is impossible to be too cautious, the evidence being not of *time*, but of *circumstance;* the character of the organic remains being determined by the physical conditions of the period. The order of physical changes, and the series of organic life, must be inquired into separately, and their results combined, before we could be safe; he had no intention of interfering with or undervaluing investigations based on other grounds, but he believed he had presented a view which did not clash in its result with that given by investigations of another kind.

Mr. SEDGWICK contended, that the expression *law* was not used in a correct sense, if, by using it, we excluded the idea of laws of a higher order: it merely implied that, having grouped together a set of phenomena, we used the term to represent the state of our knowledge at any moment of time. Such were the laws of the distribution of organic remains; it was impossible to ascertain all the conditions which involved the appearance of any particular form of life; and we never have risen, nor can rise, to such laws. With respect to the identification of strata in distant countries by organic remains, in the absence of direct evidence, he considered this evidence was as strong as we could expect to obtain; having proved its correctness in this country, we applied it to more distant tracts. Assuming, in the first instance, a coincidence between the conditions and organic types of our own country and that which we examine, if in this investigation we meet with nothing contradictory, we extend the value of our inductive process. Amongst the lower rocks of that part of America described, there was a carboniferous and pentremite limestone, an intermediate group, and a Silurian group, all bearing a remarkable analogy to those of our own country. The series, as a whole, was more calcareous, and, therefore, we might not expect the same tranchant differences which the alternation of masses of shale and sandstone had produced with us. An illustration of these local differences occurred in the interpolation of the calcareous beds, of which the *crumbling* colleges of Oxford were built, between the Oxford and Kimmeridge clays of the south of England. At Cambridge, these clays formed one uninterrupted deposit of mud, 2,000 feet thick. In England, all the work was done; the long tiresome narrative, like an old chronicle full of enormous detail—like a book, too, some of the leaves were torn out, and others so defaced that no mortal man could read them. To supply this, we looked to other countries; and, believing that nature has no starts, or blanks, seek to supply the deficiencies in our own series, by an examination of those of other countries. In reference to the economical importance of the district which formed the subject of the memoir, Mr. Sedgwick remarked, that this country possessed inexhaustible mineral treasures, and the finest inland navigation in the world, and pictured the influence it might be expected to exert, in the coming period of time, its effect on the fortunes of the civilized world, when all the intellect of the most active and energetic men on that part of the earth should be brought to bear on these treasures; and he rejoiced that men, with English feeling and English blood, should be bringing them into operation.

Sir H. T. DE LA BECHE remarked, that the principal groups of strata were separable all over the globe, and the physical conditions which produced those deposits and governed the changes of organic life must have been the same over large portions of the globe also; he assumed a similarity of condition, not perfect identity: those deposits were formed of the detritus of pre-existing rocks, and as there were not equal conditions for producing and carrying that detritus, there would be more striking deviations from the general rule in one place than another: the deposits might have no representations at all in *time;* therefore, to say that one deposit was perfectly represented by another, would be drawing conclusions without the necessary evidence. Both sections and fossils were necessary; but, after all, we could only give names to represent the state of our knowledge; facts much more numerous and much stronger than those on which our divisions were founded, might compel us to alter all our names. The division of the older rocks into Carboniferous, Devonian, and Silurian, should be retained as long as possible; but the moment we attained a sufficient body of evidence, we must modify our views. The different value of names in different parts of the world, rendered it useless to attempt to make American deposits square exactly with our own; our definition of carboniferous limestone would not apply to Ireland; *à fortiori*, we could not expect it to coincide strictly with America; and lastly, we should endeavour to make our nomenclature as effective as possible, for distinguishing grouping formations in all parts of the world, so as to make the terms comparable.

'Report on British Belemnites,' by Mr. Phillips.—Mr. Phillips stated that he had been called upon by the Committee for a report on this subject; he had prepared drawings of some of the most characteristic forms, to which he now desired to call attention, as this class of organic remains had been greatly neglected, and he had experienced considerable difficulty in procuring information on the subject. M. Blainville had pointed out the analogy of structure they presented to certain bodies found in cuttle-fish, and other analogies with the nautilus. M. Voltz and Dr. Buckland had also investigated the subject, and published many important results. Mr. Phillips stated that he had himself published several forms of belemnites in his 'Geology of Yorkshire,' but that until he had examined the splendid collection at Strasburg, formed by Prof. Voltz, he was not aware of any principles by which they could be separated into groups, and the differences of specific form be accurately determined. Mr. Phillips proceeded to describe the general structure of Belemnites as consisting of a cylindrical hollow sheath, with a radiating fibrous structure, the hollow, or alveolus, conical and slightly curved. He mentioned that the bilaterality of Belemnites was generally overlooked; the sides, front and back, being figured indiscriminately in different works on the subject. So little had been done to determine the value of specific characters in this group, that at present we were quite unable to apply them as evidence in determining the conditions of ancient waters; and it was desirable to arrange the facts in such a manner as to give them a general value. He had endeavoured to form such a system of measurement, to be applied in the description of the different portions of which belemnites were composed, as should enable him to form conclusions, not merely as to specific differences, but applicable to the mode of life of groups. The form of the belemnitic sheath would be most frequently found to preserve a certain characteristic form, not specific only, but distributed in groups in various strata. Thus in the cretaceous group of England, Norway, and America, certain forms of belemnite were found with a groove on the anterior side of the *base* of the sheath, extending as far as the alveolus, and this character was associated with a mucronate point. In many liassic belemnites, there was no groove on the point, but two lateral grooves at the *apex*. In many oolitic belemnites, there was no groove at the base or on the sides, but a single one commencing at the apex and running down the front. In grouping together these and other facts, and representing them by the term *law*, he wished to be understood as using that expression only in the sense of a *law of phenomena*, and by no means interfered with the idea of a *law of causation*. Used in this sense, the term was extremely convenient, as expressing the explanation attached to a set of phenomena.

'Report on the Fossil Fishes of the Devonian System, or Old Red Sandstone,' by Prof. Agassiz.—The author commenced by describing the favourable circumstances under which he had examined these remains. The rapid progress which had been made in developing the riches of these deposits since 1834, when Dr. Fleming and Messrs. Sedgwick and Murchison first pointed out the existence of a few scales at Cleishbinnie, and afterwards discovered two new genera of fish at Caithness; four species only were then known, and of these but one was figured. The researches of Dr. Traill and Messrs. Murchison and Lyell, had enabled him in a former report to raise the number of genera to ten, and the species to seven-

teen. Since that time such an impulse had been given to these researches by Mr. Murchison's work on 'The Silurian System,' that on again visiting Scotland in 1840, he had the opportunity of examining double the number of genera, and triple the number of species, which had been lately discovered and not yet described. On this occasion, one of the most remarkable forms of organic life, and one entirely new, the Pterichthys (so named by him from its possessing appendages resembling wings), was discovered by Mr. Miller of Cromartie. Another form, also new, and equally curious, the Coccosteus, was discovered at Caithness, by Mr. Sedgwick and Mr. Murchison, opening to the comparative palæontologist a field of research as fruitful as the discovery of the Plesiosauri and Ichthyosauri a quarter of a century before. These two genera presented characters so different from any known fish, as to have been referred, in the first instance, by able naturalists to the Cheloniæ, Fish, Crustaceans, and even Coleoptera. M. Agassiz proceeded to notice the researches of Dr. Malcolmson, Mr. Alexander Robertson, and especially the late Lady Gordon Cumming, who had collected these remains and distributed them amongst geologists with the greatest liberality. Lady Cumming had studied the remains with great care, and prepared a series of drawings of all the most perfect specimens with a precision of detail and artistic talent, which few naturalists could hope to attain. The collections of Lord Enniskillen and Sir Philip Egerton had also furnished him with many beautiful specimens, and Dr. Traill and Mr. H. E. Strickland had considerably increased the number of species by their examination of the Orkney schists. In the southern part of Scotland, Prof. Jamieson and Mr. Anderson had collected the species belonging to the upper part of this formation, several of which were figured by Mr. Anderson in his 'Memoir on Fifeshire.' The distant excursions of Mr. Murchison enabled the author to extend his Report to fossil fish of the same age found in Russia, but perfectly identical with those of Scotland. The continental researches of M. Omalius d'Haloy and M. Haeninghausen had also brought to light scales of fish belonging to this formation. M. Agassiz then presented some general considerations on the characters and geological distribution of the fossil fishes found in these strata, first observing, that in examining these remains he had employed the method established by Cuvier—of comparing them with each other and with living species. Wherever this principle had been adhered to, it had given results which had suffered scarcely any modification by time. He first remarked, that all species and nearly all the genera of fish found in the Devonian strata were entirely confined to them, neither extending downwards to the Silurian, nor upwards to the carboniferous series. The genera which had no representatives in other strata, were those which contained the greatest number of species—Pterichthys, Coccosteus, Cephalaspis, Ostrolepis, Dipterus, Glyptolepis, Platygnathus, Dendrodus, Diplacanthus, Cheiracanthus, and Cheirolepis. Those genera which occurred also in the Silurian system and coal measures, such as Onchus, Ctenacanthus, Ctenoptychius, Ptychacanthus, Acanthodes, Diplopterus, and Holoptychius, did not contain a single *species* identical in the separate formations. This result agreed precisely with that which M. Agassiz stated he had obtained in the upper formations, in which the fish, echinodermata, and mollusks of separate formations never extended from one system, or even subdivision of the strata, to another. In this view, which differed from that entertained by most palæontologists, he was supported by M. d'Orbigny, and he attributed the similarity of the results, obtained by them from the examination of remains of fish and molluscous animals, to the employment of the same principles in both cases.—M. Agassiz remarked, that the fish found in those formations, and, indeed, in all the older rocks, as compared to those of modern times, were small and even insignificant in size; and he wished particularly to insist on this circumstance, because the idea of colossal dimensions, which we were accustomed to attach to the fossils of all geological epochs, was untrue both as regarded the fish and all other classes of animals, with the exception of a few particular types. The principal exception, was the number of gigantic saurians in the secondary rocks, but their existence was the less remarkable, as at that period mammifers scarcely existed, and the cretaceans and gigantic pachyderms were absent. In speaking of the fish of the old red sandstone, small or middling sized, he meant that generally they did not exceed one or two feet in length. A few genera contained species as much as three or four feet long, but none which could be compared with the dimensions of the sword-fish, shark, &c. of our own seas. M. Agassiz then remarked that there was a singular uniformity of size in the species of almost all genera and families, not only amongst fish, but other classes, which he illustrated by reference to the different orders of mammals, reptiles, insects, &c. In examining the fish of these deposits, considerable diversity of type will be seen, and the species must necessarily be referred to a variety of orders and families. 1. Thus there are four genera, Ctenacanthus, Onchus, Ctenoptychius, and Ptychacanthus, belonging to the order Placoides, which are furnished with spiny rays in the dorsal fins, similar to the great Ichthyodorulites of the coal and oolitic formations. In the order of Ganoides, the genera Acanthodes, Diplacanthus, Cheiracanthus, and Cheirolepis, presented a separate group; for although they were covered with enamelled scales, these scales were so small as to give the skin the appearance of shagreen. The manner in which the fins were sustained by spiny rays, or, in the absence of those rays, the positions of the fins themselves, served as characters for determining the genera. 2. The genera Pterichthys, Coccosteus, and Cephalaspis, formed a second group, in which the size of the head and the large plates which cover it, and also invest a large portion of the body, and the moveable winglike appendages placed at the sides of the head, give them a most extraordinary appearance. The large bony and granulated plates of the Coccosteus caused it to be referred to the Trionyx. The crescent-shaped head of the Cephalaspis, and peculiar scales resembling transverse articulations of the body, made it easily mistaken for a genus of Trilobites. Another curious point in the structure of these genera, was the association of exterior bony plates, with a soft and cartilaginous vertebral column resembling that of the sturgeon, a character common to the greater part of the species found in those ancient rocks. He remarked the great difficulty of comparing these forms to any recent types, the resemblances being only partial, and confined to particular parts of their structure. Thus the helmed heads of the sturgeons, and the granulations which protect the heads of Trigla, Dactylopterus, &c., resemble a little the Cephalaspis and Coccosteus. The appendages of Pterychthys might, perhaps, be compared to the moveable suborbitaries of the Acanthopsis, or with the elongation of the preoperculum of certain species of Trigla and Cephalacanthus. He pointed out the analogy between the imperfect developement of the vertebral column, and the interior position of the mouth in these genera, with the form of the dorsal cord and position of the mouth in the embryo of fishes. 3. A third group of the fish of this formation, were characterized by the structure of the ventral fins, which in the genera Dipterus, Osteolepis, Diplopterus, and Glyptolepis, were double, resembling the caudal fin in appearance; these genera differ from one another in the structure of their teeth. 4. A fourth group were distinguished by their large conical teeth placed in the side of the jaws alternately with smaller teeth. This structure obtains in the genera Holoptychius, Platygnathus, and Mr. Owen's genus Dendrodus. This original diversity of types in the fish of so ancient a formation, M. Agassiz regarded as a great argument against the theory of the successive transformation of species, and the descent of all living organized beings from a small number of primitive forms. The result of all his observations concurred in proving the appearance of new species with each formation.

Mr. MURCHISON exhibited the drawings of fish belonging to the genera Pterychthys, Coccosteus, &c., and referred to in M. Agassiz's memoir; he also mentioned the remains of gigantic fishes allied to the Pterichthys, which had been discovered in Russia; he believed that M. Agassiz would be obliged to modify his statement of the comparative insignificant dimensions of the fish found in the older rocks. He remarked, that it would scarcely be safe, in the present state of our knowledge, to draw divisions in strata upon zoological evidence only. In that case, the occurrence of fish in the upper Silurian strata would make it necessary to include those deposits in the old red sandstone. The evidence of Mr. Owen, in his Report on Fossil Saurians, and that of M. Agassiz in the present Report, agreed in disproving the transmutation of species, in passing from one stratum to another.—Mr. SEDGWICK referred to a recent statement by Prof. Owen, that the remains of an Ichthyosaurus found in the lower chalk, greensand and gault, were identical with those of a species common in the lias, showing a greater range than had ever been suspected in an animal so highly organized.—Sir H. DE LA BECHE stated, that from all our knowledge of the distribution of species, and their continued existence from one deposit to another, he was disposed to doubt the statement of M. Agassiz, as to the limited range of species. He could not regard the fish of the tertiary as entirely distinct from those of the present time; yet he believed that M. Agassiz regarded not merely the fish, but the *shell* of the tertiary, as altogether distinct from the existing Fauna.—Mr. PHILLIPS observed, that the amount of reliance to be placed upon M. Agassiz's views of the distribution of fish in the older rocks, must depend upon the degree of completeness of that evidence. A few years ago, comparatively little was known; now we are acquainted with more than eight hundred forms. The state of our knowledge of fossil fish was still imperfect, and in order to make the evidence given by it of equal value with that of other departments of zoology, ten times the amount of research would be needed. And not merely were the data insufficient as regarded the old rocks which had been the especial objects of examination, but the strata of Russia and many other countries where fish remains were found, must be examined and brought into comparison with the results previously obtained, before we should be justified in adopting such views as some of those entertained by M. Agassiz. Mr. Phillips proceeded to describe some remains of a small fish resembling the Cheiracanthus of the old red sandstone, scales and spines of which he had found in a quarry at Hale's End, on the western side of the Malverns. The section presented beds of the old red sandstone, inclined to the W.; beneath these were arenaceous beds of a lighter colour, forming the junction with Silurian shales; these again passing on to calcareous beds in the lower part of the quarry, containing the corals and shells of the Aymestry limestone, of their agreement with which stronger evidence might be obtained elsewhere. He had found none of these scales in the junction beds, or in the Upper Ludlow shales; but about sixty or one hundred feet lower, just above the Aymestry limestone, his attention had been attracted to discoloured spots on the *surface* of the beds, which, upon microscopic examination, proved to be the minute scales and spines before mentioned. These remains were only apparent on the surface, whilst the "fish bed" of the Upper Ludlow rock, as it usually occurred, was an inch thick, consisting of innumerable small teeth, spines, &c. Future observations would probably show, that many forms supposed by M. Agassiz peculiar to certain deposits, would, at other localities, be found occupying a higher or lower level in the series. That fish remains might be met with in many localities not hitherto suspected, was shown by researches in the Ardwick limestone near Manchester, by Mr. Binney and his friends, which had been hitherto considered a part of the magnesian beds, until the discovery of numerous fish and shells proved it to belong to the carboniferous period. By renewed search, we might expect to obtain evidence of this nature, by which many discordances in our system would be adjusted, and the correspondence in distant parts of the same series rendered much closer than it was seen now.

SECTION D.—ZOOLOGY AND BOTANY.

Mr. GASKELL exhibited the gigantic horns of the Wapiti deer, which inhabits the western regions of North America. In the specimen produced, the skull exceeded two feet in length, and the antlers measured six feet from the skull to the tips. These horns were brought over with a pair of the young deer, now in the possession of Her Majesty, in Windsor Park.

'On the Nidus and Growth of the *Purpureus lapillus*, and also on the *Patella pellucida* and *P. levis*,' by C. W. Peach.—From a series of observations, Mr.