TRANSACTIONS

OF THE

GEOLOGICAL SOCIETY OF GLASGOW.

VIII.—*Some Points in* GEOLOGICAL TERMINOLOGY. *By* JOHN YOUNG, M.D., F.G.S., *Professor of Natural History, University of Glasgow.*

(Closing Address as President.—Read 8th February, 1872.)

THE science of Geology is so popular that it is almost counted a discredit if any one errs in the use of its technical terms. Yet it is doubtful if the terminology of any other science is in the same state of uncertainty; and it is probable that in no other science should we find a leader prepared to advocate the propriety of terms being used in a somewhat loose sense. It may be a little troublesome, but it is always possible to follow the changes which take place in zoological notions, for the terms are very precise. New words have been, to a large extent, invented to represent particular views, or familiar terms are used with a careful restriction which protects them from abuse. But geological language, as distinguished from that of mineralogy, is that of ordinary life transferred without alteration. That there should be no definition of Coal is not surprising, even though the legal mind was greatly exercised thereby. But when we find no exact meaning attaching to Formation, Period, System, Contemporaneity, and when we find that something very like resentment is entertained towards palæontologist who shall be rash enough to advance views founded on the facts of his science, it is clear that some confusion exists as to the vaunted mutual aid of palæontology and geology.

But the confusion has not yet reached its maximum. The very definition of Geology itself is undergoing practical revision. It is long since it was established by Hutton as a science dealing with

phenomena similar to or identical with those observable at the present day. At that time Geography was either a physical description of the earth's surface, or a series of details grouped from a political, ethnological, or antiquarian point of view. It was understood also to include the study of the earth's figure and motions, and of other cognate astronomical questions. Now Geology is divided between Geognosy, in so far as it deals with mineral character; Zoology and Botany, in so far as it records the varieties of animals and plants preserved in mineral masses; and Geography, of which it forms an integral part as a description of past earth-surfaces. Palæontology is in fact no longer a distinct science any more than Human Anatomy, Ichthyology, or, in Botany, Filicology and Lichenography. The palæontologist is a naturalist who makes a more or less special study of fossil forms. But, as the distribution of animals and plants illustrates, and is illustrated by, modifications of the earth's surface, the work of the palæontologist is (when not devoted to the systematic classification of the forms with which he deals) a contribution to geography; and the geologist, or he who maps out the characters, positions, and proportions of mineral masses at various places, is likewise a contributor to a more extensive science. Professor Ramsay has stated the relation in the title of his volume, "Physical Geology and Geography," and the subordination of geology to geography is already familiar in school teaching. The field covered by geography has been extended in another direction; it has come to include as an essential element those astronomical facts and theories which throw light on variations of temperature, whether these variations are due to the position of the earth relatively to the sun, or to modifications of its own form. The change, therefore, is enormous, since geology stood isolated from every other science concerned with the mineral layers of the earth's crust, cataloguing them by their chemical composition, or, if fossils were found, using them as mere compendious labels. The labels became more dignified as their true relations to existing forms were appreciated; as labels, they must to some extent continue to be used, and too many are satisfied when they have mastered this their lowest function. But while geological enquiries are all biological in their ultimate aim, the language is still that of the earliest investigators. A *system* was a convenient designation of an assemblage of rocks presenting a tolerably definite aspect; a

formation expressed pretty accurately agreement in physical or chemical characters, and presumably also, therefore, in mode of origin. Age and Period were the terms adopted by those to whom palæontology first revealed the existence of organisms like, yet different from, those now living, whose true affinities have not in all cases been established even yet. Theological and scientific preconceptions dominated, and successive creations and destructions—indicated by ages, periods, epochs, reigns—were the reflex of cataclystic doctrines. At the present day we are violently anti-cataclystic, though the wise caution of a few already suggests that the pendulum has swung too far in the direction of uniform quiescence, and that in our science as in our politics, compromises should be the rule. But every one, Catastrophist or Uniformitarian, uses the terms period and formation, without any attempt to fix the precise meaning of the terms he uses. We are, in truth, to be compared to a party of explorers who, after spending long time on our work, discover that our observations are not comparable, because our instruments were not corrected before starting by reference to any uniform standard. As Evolutionists (to use the term adopted by Professer Huxley in his "Address to the Geological Society of London, 1870"), we use the language of Catastrophists; as men desirous of recording facts, we speak after the fashion of those who squared their facts to their theories.

I need not weary you with a detailed repetition of the geological principles which it is necessary for my argument that you should bear in mind. Let me put them in brief summary.

(1.) Deposits vary at different localities, both in the quantity and quality of their ingredients. The differences testify to change from time to time in the source and direction of the materials, and in the majority of cases a change of materials involves a change in the amount and character of the organisms which the locality supports.

(2.) These variations often depend on the movements of the earth's crust, and such movements vary from time to time in the same locality, both as regards their direction and intensity; stationary intervals of greater or less duration alternating with periods of disturbance.

(3.) The length of these intervals and their recurrence are irregular; nor is there any evidence on which to base calculations, even approximative, of their comparative values.

(4.) Animals and plants are influenced as regards their numbers and strength by the external conditions under which they are placed. Altered conditions result in their improvement or deterioration, commonly in their migration, and tend to produce permanent structural modifications.

(5.) But their powers of endurance and adaptation are unequal and variable. Changes in the fauna and flora of a region do not therefore furnish any absolute guide to geographical changes. Nor does identity of organisms necessarily tell of identical conditions.

(6.) Each group of plants and animals has its greatest development in space and time not necessarily coincident with that of any other.

(7.) The geographical distribution of plants and animals at the present time had its counterpart in the past. And we have neither geographical nor biological data for estimating the duration and direction of the migrations of which the present is one phase.

Bearing these—which may be fairly claimed as articles in the accepted faith of modern geology—in mind, let us apply them to the definition of a formation.

Mr. Judd, in a note to his paper on the Punfield formation (Quar. Jour. Geo. Soc., Vol. xxviii., p. 225), regrets that *formation* is used by English writers, either for a great group of strata, as the Silurian, or for a division thereof, as the Ludlow, in which latter sense he uses the word in his paper, *system* being applied to the larger groups. The difficulty which he thus indicates is akin to that which would arise were we to attempt the correct employment of the word *vicus*, or village, at the present day. The combination to which the term village is strictly applicable no longer exists in this country, save in a dim, distant, ghost-like shadow. We have transferred the word to any group of inhabited houses, however their association may have been determined. And we do so rightly without scruple, because the birth of the village no longer happens on the old plan. The commune is no longer possible; at least its functions are no longer discharged in the primitive fashion. But in geology the case is different. We are not dealing merely with past events. The same processes are going on, and we must make our terms in accordance with our theories. If the accidental combination of houses rising round a railway junction, a mineral spring, or a convenient bathing locality, took place at the same time as the acquisition by the commune of

lands to be divided according to the old fashion, it would be manifestly a source of confusion were we to speak of both as villages in the same sense. But as the accidental growth is now the rule, the term is of little consequence. On the other hand, the formation is still going on. What is the best term to describe it?

In a paper of considerable ingenuity Mr. Hull* laid down a Ternary classification of strata, and Principal Dawson has elaborated a Quaternary system.† Now, to give scientific value to either of these speculations, it would be necessary that the three events—dry land, deep sea, dry land—should occupy equal times wherever they recurred; that they should be equal in intensity, and that their foci should coincide. Mr. Hull practically admits that none of these conditions are fulfilled in all cases, since his table omits certain strata, whose absence destroys the integrity of the whole. Mr. Hull, in truth, advocates a catastrophic doctrine as accounting for the separation of each pair of his groups. The elevation which makes the close of a triplet is the disturbance which permits the incoming of a new set of conditions. Obviously Formation means to Mr. Hull the same as period of time, and is determined on fossil evidence. It is a palæontologist's notion, not geographical. The "natural groups" which should contain the three divisions are not defined. If they mean the groups of strata found in *one* locality, and associated in a single continuous series by physical and palæontological concord, then he has not laid down a law of development, but invented a convenient mnemonic for certain localities. If, on the other hand, he means to include in his natural group strata from different localities, but united by common fossils, there is no limit he can rationally assign to his triple colligations. He may either, disregarding the known irregularity in point of time, with which movements of the earth's crust occur, sort out his triplets at discretion; or, bearing in mind, that land and deep sea always exist, abandon the artificial method, and fall back on the natural method indicated by Professor Huxley—that is to say, confess the impossibility of trustworthy classification by putting the land surface in a parallel column to the marine; the two columns containing each an unknown quantity; on the one hand the length of time spent in the working out of physical phenomena;

* Quarterly Journal of Science. † Acadian Geology.

on the other the length of time required for the completion of biological changes.

The Quaternary classification of Principal Dawson is more complicated than Mr. Hull's.

Palæozoic Cycles.	E. America.			
Shallow subsiding marine areas filling up with sediment, ..	Hudson R. Group.	L. Helderberg.	Chemung.	U. Coal Formation.
Elevation followed by slow subsidence, land surfaces, &c., ..	Utica Shales.	Salina.	Hamilton.	Coal Measures.
Marine conditions, Limestone,	Trenton. Black R. Chazy.	Niagara. Clinton.	Corniferous.	L. Carb. Limestone.
Subsidence, disturbance, deposition of coarse sediments,	Potsdam. Calciferous Sandstone.	Oneida. Medina.	Oriskany.	L. Coal Measures, and Conglom.

Admitting for the moment that this table represents equal values for America, let us apply it to Europe. Take the Carboniferous. The Carboniferous Limestone series and the Coal Measures fix two points in the table. The first stage of "subsidence, disturbances, deposition of coarse sediments," is represented by the Upper Old Red Sandstone, with its volcanic rocks and conglomerates, and the Calciferous series or Limestone, shales, coals, ironstones;. an enormous thickness of strata representing two diverse physical conditions—that of the Old Red and the oscillating marine condition of the early Carboniferous. But in England this lower group is of different proportions and contents, the two countries presenting little agreement at this stage. The continuous mass of the English Limestone again testifies to a very different set of things from the coal-bearing strata of Scotland. The Coal Measures of England are purely terrestrial; those of Wales, partly marine. The comparison of the Carboniferous Limestone of Limerick with that of England and Scotland is interesting in this point of view. The absence of *Productus giganteus, Lingula, Crania, Anomia,* is remarkable. Of 138 species, 58, or 42 per cent., are not met with in Scottish limestones, the latter possessing a much larger ratio of shallow-water forms. In the north of Ireland, Mr. Hull has pointed out that from Fermanagh towards the north-east the Scottish type of Carboniferous rocks is gradually assumed. The specific agreement is greater here; of 33 species, 15, or 46 per cent., are common. In both areas the Cephalopoda are fewer than in the south, the estuarine, or even fresh-water Ganoids, being more abundant. Finally, the upper Red Sandstone, with the

thin Limestone, cannot be regarded as the equivalent in any sense of the groups of strata below the coal. The case is all the more complicated if we find that the Russian Devonian rocks include fossils which belong to the British Devonian seas on the one hand, and the British Old Red Sandstone rivers and estuaries on the other. This latter fact brings into prominence the difficulty of cyclical arrangement, for there is no proved superposition in Britain of Devonian to Old Red Sandstone; and it is equally prejudicial to the views of Hull and Dawson whether these groups of strata are regarded as of the same or of different age. In either case we have a sea to interpose between two land periods; and unless we go to Germany for the upper and lower subsidence seas, there are only probabilities to fall back on as regards the Old Red Sandstone. Nor is the complication yet at an end. Professor Ramsay has shown that some of the groups of strata slumped under the designation Silurian are not in reality physically continuous, but both stratigraphically and palæontologically are separated from each other. If, therefore, the Llandeilo and Caradoc beds are separated by a break in the succession of life, and by an unconformity from the Lower Llandovery; and if the Lower Llandovery is similarly cut off from the Upper Llandovery, we have an unclassifiable group in the Caradocs which is either equivalent to all the rest of the Silurians, containing sedimentary and calcareous strata; or, if it is regarded as one of the four stages, the Bala and Hirnant limestones must have an importance attached to them altogether out of proportion to their actual dimensions.

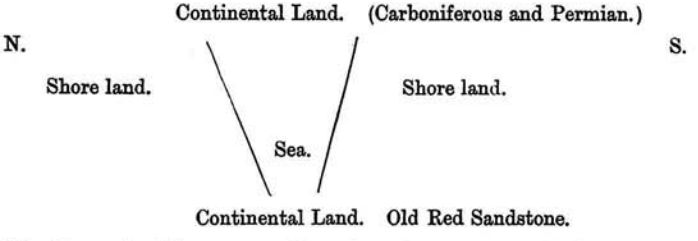
If we take the Cretaceous series, we find that the land surfaces of the Wealden and Purbecks are placed in the vertical table as of equal value with the marine beds; and as a record of British strata there is no exception to be taken to it. The Geological Survey has departed from the rule that all strata not found in Britain are to be stuck into the British series—into those gaps which palæontological refinement is sorely taxed sometimes to demonstrate statistically. The index map contains parallel columns for the Devonian and Old Red Sandstone, the Carboniferous, Permian, and Cretaceous series, the difference of local development forbidding their generalisation. In France the Cretaceous series loses in thickness towards the south, and the highest beds are, in truth, a Wealden deposit. Coquand objects to the development

of one region being taken as the standard for another, and the remarkable absence in the south of France of the cephalopods which figure so largely in the deep-sea deposits to the north, illustrates very well the differences of distribution of animals, which render strict comparisons difficult. Now, since there must have been dry land somewhere, we seem to have the shore of the Cretaceous sea during depression along the line of the English Greensand; and the shore during the later part of the Cretaceous sea, if not during re-elevation, in the south of France. But it may be said that all this is petty criticism—that we must take broad views: we must look over large areas, and not confine ourselves to limited localities. In other words, we are asked to generalise great areas, and to average geographical changes. There would be no possible objection to this if the changes were parallel all over these great areas, and if strict contemporaneity were demonstrable. But this habit of taking large views is premature; we do not know the details sufficiently, and it is difficult, when one hears of these broad views, to realise the fact that those who advocate them strongly disavow the old catastrophic doctrines. Yet generalisations of the kind I object to are practically an attempt to establish the same phenomena as occupying the same time—to establish what Herbert Spencer denominated the onion-coat theory of geology. Take the broad view, and what do we arrive at? Only this, that elevation and depression are successive to each other, a doctrine which needed no elaborate scheme to establish. A greater service would be rendered by any one who, starting with the axiom that great depths and great heights co-exist with each other, and upward with downward movement, should try to show what were the corresponding heights and depths.

The Scottish Coal Measures were probably the equivalents in point of time of large part of the English Coal measure series, including a considerable portion of the Carboniferous Limestone. The Scottish Carboniferous Limestone was, in fact, partly a shore accumulation to the deep-sea limestone, while the barrier running east and west across England gave another land surface. While, therefore, in Scotland, or at any locality in England, the series is represented by a vertical column—

Land,
Sea,
Land,

the history of the Carboniferous development in Britain would be represented thus:—



The Devonian history would perhaps be represented thus:—

British Carboniferous Continent. Russian Carboniferous Continent.

Devonian Sea.

Dr. Dawson makes out a stronger case against his own arrangement when he dwells on the greater affinity of the Devonian to the Mesozoic than to the Carboniferous flora; for he thus demonstrates the broad view of a continuity of continental land during all that great interval, and correspondingly localises the vertical succession he tabulates.

If, then, there is not much to be made of cyclical arrangements, will continous vertical tabulation help us? Perhaps these generalised tables of strata have done more to perpetuate erroneous notions than any more explicit statements. The British strata, all put in a column, do not represent the truth for any locality in Britain any more than they form a standard for the world. The simultaneous distinction and re-creation of animals and plants would, as a creed, require the vertical tabulation. But the more the geographical conception of a formation is adopted, the more numerous will become the parallel columns of our stratigraphical tables. The following sections in Britain will illustrate the facts lost sight of in the ordinary method of statement:—

Ross-shire.	Dumbarton.	Dumfries.	Warwick.	Anglesea.	S. Wales.	I. of Wight.
Oolite.	C. Meas.		Trias.	Permian.	C. Meas.	Eocene.
Old R. S.	M. Grit.		L. Permian.	C. Meas.	M. Grit.	Cretaceous.
L. Silur.	C. Lime.	C. Lime.	C. Meas.	M. Grit.	C. Lime.	Wealden.
Cambrian.	L. Carb.	Permian.	C. Lime.	M. Grit.	Old. R. S.	
Laurentian.	U. Old R. S.	L. Silurian.		Old R. S.	L. Silurian.	
	L. Silurian.			Cambrian.		

It may be perfectly true that if we bored down from the Isle of Wight we would find some, or all, the members of the

Palæozoic series. There is no evidence one way or the other, as we do not yet know the depth at which metamorphism destroys the characters of sedimentary rock. But it is absolutely certain that such a bore would not pass through all the strata enumerated in the tables. The Harwich bore passed through

Drift,	25 feet.
Tertiary strata,	51·5 ,,
Chalk,	888 ,,
Greensand and Gault,	61 ,,
Black slaty rock (Palæozoic),	44.5 ,,
	1070 feet.

What may have been the thickness of this Palæozoic rock mass, it is idle to speculate on; but if the total thickness of above thirteen miles be attained by the sedimentary strata, their proportions must be different from those quoted by Darwin from Professor Ramsay. As the table given in the "Origin of Species" has been made somewhat unfairly to misrepresent its author's meaning, it is here subjoined.

"Professor Ramsay," says Mr. Darwin, "has given me the maximum thickness—in most cases from actual measurement, in a few cases from estimate—of each formation in different parts of Great Britain, and this is the result:—

Palæozoic strata (not including igneous rocks),	57,154 feet.
Secondary strata,	13,190 ,,
Tertiary strata,	2,240 ,,

making altogether 72,584 feet; that is very nearly thirteen and three-quarters British miles. Some of the formations which are represented in England by their beds, are thousands of feet in thickness on the Continent. Moreover, between each successive formation we have, in the opinion of most geologists, enormously long blank periods. So that the lofty pile of sedimentary rocks in Britain gives but an inadequate idea of the time which has elapsed during their accumulation; yet what time this must have consumed!"

No one will dispute the measurements, but Professor Ramsay is not answerable for the conclusion that the British sedimentary strata represent thirteen and three-quarters miles in thickness. Such a notion is, in fact, at variance with his own teaching. The generalisation is one which loses sight of the geographical accidents

on which the deposit, the denudation, and the preservation of strata depend. My reason for drawing attention to this point is that Mr Darwin's remarks, which I cannot but think are based on a misunderstanding of the case, have been transferred in quotation to Professor Ramsay, who, in spite of his very clear statements in his memoir in the "Pretriassic Red Rocks of England" (Quar. Jour. Geol. Soc., vol. xxvii., p. 241), is represented as ignoring the geographical variations of sedimentary deposits.

What, then, is the definition of a Formation? What is the view which will enable us to escape the vagueness, if not the errors, which, as seems to me, are perpetuated in current language? It would be safer for me to describe a formation than to attempt at present the precise definition. A formation, then, is an accumulation of sedimentary deposits (with or without contemporaneous igneous rocks), in which are entombed the remains of plants or animals, whether marine or washed down from adjacent land; but in either case giving account of the life of a particular district. In other words, a formation represents a larger or smaller biological province. The Reptilian and Amphibian fossil remains indicate that the Arctogæal province was marked out in Pretriassic times; in other words, that so far as the land population went, the north of Europe, Asia, America, and the South of Africa belonged to one great province. But it would be unwarrantable to conclude that therefore the adjacent marine areas were of corresponding dimensions. This want of parallelism between the terrestrial and the marine organisms has led to much confusion as to the geographical relations of Africa, among other questions.

There is a general belief that in former times there was a greater uniformity of life on the surface of the globe than there now is. Mr. Salter says (Quar. Jour. Geo. Soc., 1865), that zoological provinces recognisable in Silurian areas diminish in distinctness, thereafter disappearing in Carboniferous areas. Contrary assertions have been made to the effect that the amount of representative forms, not identical, was greater in the past than in the present. These conflicting opinions are explicable by reference to the fossil groups on which the generalisation is based. Those who advocate a greater amount of representation in the past rest their case on Mesozoic fossils. The great antiquity of the Southern Continents here comes into play. The molluscs (for they were chiefly regarded) have long been domiciled in the Southern Seas,

and their modification has been effected through long lapse of ages. The early Mesozoic molluscs of Europe have a greater resemblance to the South African molluscs, because they are nearer in time to their common origin (for the writers to whom I refer accept the common ancestry). The terrestrial condition of South Africa dates from about the Carboniferous, the Triassic strata of that region yielding a well-marked amphibian fauna. But the changes in that region thereafter were few. There was probably a greater dispersion of fossils at the close of the European Carboniferous than there was in Africa, and the changes in the former have since been vastly greater than in the latter area.

The singular circumstance connected with the advocates of these antagonistic views is, that the one set assert and the other deny that identity of fossils is proof of contemporaneity. To the former it is natural to regard the wide range of Silurian forms as proof of former greater uniformity; though, of course, the criticism is obvious, that more stress is laid on individual resemblances than on the character of groups. It is illogical for the latter to urge representation as a marked feature in Mesozoic times, because, in the particular case I have chosen, migration must have taken place to a considerable extent before the representation could have occurred. There is here, as in many other cases, a residuum of unconscious belief in the old notion that formations in former times covered large tracts of the earth's surface.

It must be remarked, in justice to Mr. Salter, that in his memoir on the Himalayan fossils he does not attempt to intercalate the species he recognises in the British standard. Had he done so, as has been done in obedience to the statistical method in the case of the Tertiaries, the bulk of the Silurian strata would have attained enormous dimensions.

One phrase of frequent recurrence is evidently residual of Catastrophic doctrines. I mean the "base of a formation," which is sometimes said to be wanting. The conception underlying such a phrase is that the only "complete" formation is one which begins and ends in conformity with the inferior and superior strata. To the same category belongs the phrase "incomplete;" it is usually—in this country, of course—applied to departures from our insular standard of stratigraphy, and, in so far, is on a par with the zoological phrase "imperfectly developed." Both

suggest disregard of conditions. The zoologist loses sight of physiological fitness—the geologist of movements of the earth, with or without climatal changes. If formations were complete according to the standard I have mentioned, the onion-coat theory is the only one which would justify the phrase. The absence of the base means only unconformity. We have the lowest beds for that locality—not, perhaps, all that were ever laid down, but the first of those the conditions of whose deposits were comparatively permanent.

The anxiety with which the strict co-ordination of strata is attempted testifies to an implied belief in the possibility of strict parallelism. But the cases of admixture of forms belonging to various horizons yield (when extreme ones are selected) insuperable difficulties. Thus Dale Owen describes in the Cedar Valley a group of rocks intermediate between Silurian and Carboniferous strata. There are 18 species in the shell beds and the coral layers which lie above and below them. Of these 18 there are nine common to this country, ranging—one from Bala to Middle Devonian, one Caradoc to Wenlock, one Upper Silurian to Middle Devonian, one Bala, one Upper Silurian, two Middle Devonian, one Lower Carboniferous. The equivalence here is between a section of 70 feet in the Cedar Valley and nearly 10,000 feet in this country—a mass of rock which, moreover, represents, as tested by unconformities, several very distinct sets of physical conditions. Other cases might be cited. The Devonian of France and of Spain contain Silurian, Devonian, and Carboniferous species found in Europe and America, and some even in Asia. Dr. Duncan finds evidence of mixture of stages in the Corals of Scinde; and Hall notes in America the gradual passage of the Devonian into the Carboniferous series, a passage which unites characters distinct in Britain. It is needless to multiply instances: these are those which come first to memory. We admit, though we sometimes require to be reminded of the fact, that no two sets of strata, at a moderate distance apart, agree as to their fossils, whether the difference is due to mixture of remains from strata elsewhere distinct, or the presence of species peculiar to one in addition to those common to both localities.

I might give many and interesting details regarding the manner in which, along any coast line, the faunas gradually become distinct—the statistical method yielding results as regards

horizontal replacement of faunas more striking than the successive faunas of the Tertiaries. But you are already familiar with these facts, and I would rather consider the difficulties which lie in the way of applying practically the geographical definition of a formation. Dawson, in his Acadian Geology, speaks of a passage in the earth's history, the Permian, as unrepresented in America, and, contesting the Homotaxial doctrines of Huxley, urges the uniformity of Carboniferous type over great areas, notably in America. This reasoning in a circle is the more curious, that in speaking of the Lower Carboniferous strata he recognises a Permian character in the limestone fossils, albeit there are present at the same time fossils which do not elsewhere ascend higher than the Lower Carboniferous strata. It is obvious, that so long as there exists a fundamental difference of opinion as to the origin of species—so long as some ascribe to migration and long time results which others deny to be possible save by creative effort—there is no common ground on which to construct generalisations applicable to more than limited portions of the earth's surface. There is not, moreover, at present, sufficiently detailed knowledge of many localities to permit of close comparison: but the need is all the greater of so restricting our terminology that in the future there will be the least possible need of altering or replacing terms sanctioned by long use. If, therefore, it were understood that by *formation* was meant merely a deposit found in one locality, and presenting a certain sum of animal and vegetable life, and that it was not necessarily the equivalent, either in chronology or in duration, of any other deposit, however closely similar might be its fossil contents, the advocates of antagonistic doctrines as to the origin of species might meet on common ground. Such consent is not likely to be secured, for the doctrines to which I have referred are commonly held with a tenacity unfavourable to compromise. But it would be an enormous advantage if writers would define at starting the sense in which they employ "formation" and other similar terms.

I had intended to investigate the terms *unconformity* and *overlap*, *grit*, and one or two others, but what I have said as to the word "formation" may be perhaps the means of suggesting to yourselves the necessity of carefully enquiring what meaning you attach to your words, and of watching, lest you confuse yourselves

by varying, however slightly, the notions you connect with particular terms. This, not the reform of geological nomenclature, was my purpose. I hoped to suggest an instructive lesson for yourselves, not to propound rules for general acceptance. And in handing over, as I now do, my office to my colleague, Sir W. Thomson, I know that in place of the hints which alone I can offer you, you will receive from him positive practical guidance in the investigation of problems which it is foreign to my province even to touch upon.

IX.—*Notes on a* Section of Strata *containing Beds of* Impure Coal *and* Plant-remains, *showing* Structure, *at* Glenarbuck, *near Bowling.* By John Young, V.P.

(Read 14th Dec., 1871.)

Since the period when the late Mr. Currie, of Bowling, communicated to this Society a short notice on the occurrence of one or two beds of impure coal, interstratified amongst the traps of the Kilpatrick hills, in Auchentorlie Glen, near Bowling, other evidence of interbedded strata, containing remains of plants and fishes of carboniferous age, has been obtained from the same district.* Another instance still of the occurrence of coal-beds and shales with plant-remains, in these hills, has recently come under my notice, and is to be seen in the gap of the hill above Glenarbuck House, a mile or so to the eastward of the former locality. As the beds are thus shown to have a considerable extension amongst the traps of the Kilpatrick hills, and as they clearly establish the carboniferous age of the various outflows of igneous rock-matter of which these hills are principally built up, I have thought it right that this other discovery should be recorded in the Transactions of the Society.

Before noticing, however, the coal-beds and plant-remains referred to, and the conditions under which they occur, I will point out briefly the relations of the various strata that underlie the traps of the Kilpatrick hills to the north-west, in order that their age may be more clearly placed before you. The lowest traps of this range

* See Trans. of this Society, Vol. II., p. 149; also Vol. IV., p. 77.