was made and decanted or transferred from the vessel in which it was liquefied to another by means of a valve, and thereby rendered capable of use as a cooling agent. In support of this assertion, I call as witness Prof. Charles Olszewski himself, who states in the *Philosophical Magazine*, February 1895, p. 189: "In 1883, and for several years following, I liquefied the gases in a strong glass tube." There is no suggestion made that a steel cylinder and valve was used by Olszewski till the year 1890. Whereas four years in advance I had used a much safer and better form of apparatus, practically identical in principle with that used in Cracow in the year 1890. Have I ever suggested that Prof. Olszewski was anticipated, or attempted to raise any question of priority? Perhaps the critic will have the audacity to say, in reply, this is no publication, the *Proceedings* of the Royal Institution, English and American science periodicals, not being amongst the class of recognised scientific journals. Well, if I am pleased to throw my bread upon the waters, adopting the view that every truthfully recorded experiment which appears in any journal associated with my name is publication, surely I should simply be conducting myself in the "too modest" way my critic commends.

As a specimen of the distortion of facts to prove another case of priority that is claimed, I find that MM. Charles Olszewski and Auguste Witkowski, Membres Correspondants, presenting their memoir "Propriétés optique de l'oxygene liquide," on October 3, 1892, and, on referring to the paper, it is dated July 15, 1892, and the following footnote is added:

"Avant la publication de notre communication, MM. Liveing et Dewar ont fait connaitre (*Phil. Mag.* Aout 1892), les resultats de leurs recherches sur la refraction des gaz liquéfiés."

Yet the critic says our experiments were "mainly repetitions of the work of Olszewski and Witkowski." The garbled extracts selected to make it appear that I have been guilty of misrepresentation are all of the same kind. . . . Thus I am taken to task for using the expression in the lecture on liquid air, of 1893: "Having no recorded experience to guide us in conducting such investigations, the best instruments and methods of working have to be discovered." The next sentence runs as follows: "The necessity of devising some new kind of vessel for storing and manipulating exceedingly volatile fluids like liquid oxygen and liquid air, became apparent when the optical properties of the bodies came under examination. Apart altogether from the rapid ebullition interfering with the experimental work, the fact that it did take place involved a great additional cost in the conduct of experiments on the properties of matter under such exceptional conditions of temperature." What can be said in defence of such glaring misrepresentation of the meaning of my words? Mr. M. M. Pattison Muir's demand for "*instant and serious consideration*" of his client's "*case*" has been quickly met. I trust the result will . . . . fit in with his brief.

JAMES DEWAR.

Royal Institution, February 12.

[A few personal remarks in Prof. Dewar's letter have been omitted, as they do not affect the points at issue.—ED. NATURE.]

Vertebrate Segmentation.

MR. H. G. WELLS, in a recent number of NATURE, honours my little book by making it an example of a contravention of what he regards as a principle of education. With that I have no quarrel. But I must object to the instance he has chosen. The sentences from which he quotes refer to the phenomena of segmentation common to cœlomate tissues, and not to the derivation of vertebrates from any invertebrate group. So far from giving "the impression almost in so many words—'cut and dried,' and ready to be cast into the oven—that the vertebrate type is merely a concentrated derivative (concertina fashion) of the chætopod type," I devote the chapter (xv.) from which he has taken his quotations, to showing that the earthworm and the vertebrates merely belong to two out of the many isolated groups; and at the end of the chapter (though not in spaced type, as I did not consider the question of vertebrate descent congruous with the aims of an elementary textbook) I state that "the type common to the lowest members of the groups of which the earthworm on the one hand, and the vertebrates on the other, form the highest examples, is a simple unsegmented cœlomate animal."

P. CHALMERS MITCHELL.

The Black-veined White Butterfly.

MR. KIRBY, on p. 340 of your last issue, says (in criticism of Mr. Furneaux) that this insect "would not frequent open ground at a distance from trees." I suppose there are not now many Englishmen who have taken it in this country; and it may be worth while to record that the common on which my brother and I used to find it tolerably abundant in the years 1857–1859, was quite an open place, with no adjacent wood, and very little hedge timber. This common is about a mile and a half to the west of Cardiff; I passed it in the train a few weeks ago, and noted that it is being encroached on by suburbs. We had many a hot chase there over gorse and briar, and always considered this butterfly the most difficult of all to catch. I have never seen it in England since 1859 or 1860.

Oxford, February 11.

W. WARDE FOWLER.

Parrots in the Philippine Islands,

PRAY allow me space to acknowledge a bad mistake which I first made in the ninth edition of the "Encyclopædia Britannica" (xviii. p. 322), and have lately repeated in the "Dictionary of Birds" (p. 687), by asserting that parrots are "wanting in the Philippine Islands." Seeing that the article was written more than ten years ago, it is quite out of my power to account for the misstatement: my only wonder is that it has not been before challenged, since there is, and has been for some centuries, abundance of evidence to show that there are plenty of parrots in that group of islands, which, indeed, is as well furnished with them (as remarked by my friend Mr. L. W. Wiglesworth, who has kindly drawn my attention to my error) as is the island of Celebes, and I had already (p. 93) noticed the Philippine species of Cockatoo.

Cambridge, February 9.

ALFRED NEWTON.

TWENTY FIVE YEARS OF GEOLOGICAL PROGRESS IN BRITAIN.

LOOKING back across the fourth part of a century in the progress of any branch of science, we naturally turn first to the list of names of those to whose labours that progress has been due, and though many of these names may happily still be counted among the living, we note many a blank where the hand of death has thinned the ranks. Perhaps in this country no department of natural knowledge can boast a more illustrious bead-roll than that of Geology. The story of the earth had hardly begun to be scientifically studied until the first decades of the present century, and some of the early fathers of geology lived on until well within the life-time of the present generation. A curious transition has thus been going on during the last five-and-twenty years. On the one hand, there have been moving amongst us geological magnates who achieved their fame in the old days when it was still possible for a man to possess a tolerably full personal knowledge of almost every department of the science. On the other hand, around these few living memorials of the heroic age, grew up hosts of younger men, who, finding the main lines already traced for them, have become in large measure specialists, devoting themselves with enthusiasm, but with more restricted vision, to one formation, or one group of rocks, or one tribe of fossils. The days of broad outlines and rapid generalisation have gone. No new systems remain to be added to the geological record of these islands. No new assemblages of extinct types of life now reward the sedulous collector. We have entered upon the era of minute detail and patient elaboration. The field-glass has given way to the microscope. The advance of the science must now be based on laborious research, less brilliant no doubt in its immediate effect, but probably not less lasting in its influence and its results.

Among the great leaders who have passed away within the last twenty-five years are some who have largely helped to mould the whole fabric of geological science. In the philosophy of geology, when will men cease to venerate the names of Lyell and Darwin? In laying down the broad lines of stratigraphy, Sedgwick and Murchison, Phillips, Griffith, Logan, Ramsay and Jukes have left behind them imperishable monuments of their genius. In the palæontological domain, among many other illustrious men, Owen, Lonsdale, Salter, Davidson, Morris, Wright and Egerton have left us. In other departments of the science, our losses have been likewise heavy—the gentle Scrope, pioneer of volcanic geology; Robert Chambers, who, after Agassiz, led the way here in the study of ancient glaciers; David Forbes, who did so much to revive the study of rocks in Britain; as well as men like Page and Ansted, who by their popular writings helped to spread abroad an interest in geology.

Passing from the workers to the work accomplished, we may note a few of the more prominent features in the progress of geology in Britain during the last quarter of a century. Space will not permit the survey to be extended to the history of the science on the continent of Europe and in North America. And first as to the general recognition of the science as an important department of a liberal education. No previous generation has seen so many proofs of this recognition. Many new chairs of Geology have been founded in our universities and colleges. Text-books, class-books, hand-books, manuals and primers of the science have been issued in edition after edition, and new publications are constantly appearing. Field-clubs, and other local associations, have started abundantly into existence, and field-geology is one of their most attractive features. At no time of its comparatively short history has geology been more popular, in the best sense of the word, than it is at the present time.

If one were asked to specify the feature which above all others has marked the progress of geology in Britain during the last five-and-twenty years, one would reply with little hesitation—the enlarged attention given to the study of rocks, or what is termed the petrographical department of the science. For many years in this country that study was almost entirely neglected. The attractions of fossils and of stratigraphy drove minerals and rocks out of the field. As David Forbes used sarcastically to complain, geologists had forgotten that their father was a mineralogist. They allowed the petrography of the British Isles to lapse into a condition of dire confusion, without system, without accurate determinations, and without reference to what had been done in the subject abroad. The first important step in the way of reform was taken by one who is happily still among us, Mr. H. C. Sorby. Reviving the method of making thin slices for microscopical examination, devised by William Nicol, of Edinburgh, he applied it to the study of rocks, and showed how fruitful it might be made in investigating their history. Though his first paper appeared in 1856, it was long in awakening geologists in this country to the value of the new implement of research thus placed in their hands. It attracted notice sooner in Germany, and its applicability as demonstrated there, led ultimately to its adoption in the land of its birth. But only within the last twenty years has it been acknowledged to be absolutely indispensable in the investigation of the origin and history of rocks.

The introduction of the microscope as an adjunct in research has entirely revolutionised the study of petrography. And nowhere has the change been so marked as in Britain. The former chaos has been in large measure reduced to order. The rocks of this country, instead of being neglected, are a foremost object of study, and this branch of British geology has been brought abreast of the petrography of the continent.

It is perhaps inevitable that in such a complete transformation of methods, the new should be apt to be regarded as completely replacing the old way. The microscope has done so much, that its potency may not unnaturally be exaggerated, and a tendency so to magnify it may sometimes be observed. But, after all, the great field-relations of the rocks must in the first place claim our attention and guide our reasoning. The minute structures revealed by the microscope may be made admirably serviceable in controlling that reasoning, and in supplementing the field-evidence by a new body of data otherwise unattainable. Yet the microscope must remain the servant, not the master, in the applications of petrography to the larger questions of geological theory.

If now we turn to the stratigraphical domain of geology, perhaps the first remark that will occur to a reflective observer is that a much closer attention than ever before has been given in Britain to the investigation of the most ancient accessible parts of the earth's crust. The fundamental platform on which the oldest fossiliferous rocks repose, has been searched for with enthusiasm, and though this enthusiasm has led to mistakes, it has undoubtedly been successful in detecting that platform in several places where it was not before supposed to exist. The rocks of the platform have been laboriously investigated, and have been found to include both aqueous and igneous materials. Not only so, but a succession has been observed among them, vast sedimentary masses lying ununiformably on still more ancient gneisses. In these sedimentary accumulations no certain trace of organic forms has yet been detected. Nevertheless the search has not been abandoned. If it should eventually be successful, it would reveal evidence of a fauna or flora older than the oldest relic of life yet discovered in Britain.

In the region where the most ancient gneisses are typically developed, foliated representatives of almost all the well-known plutonic rocks have been recognised, and perhaps also, though dimly, traces of a group of primæval sediments, into which igneous masses have made their way. We have thus been able to take several distinct steps backward into the abyss of time. We know more clearly than before the general outlines of two or more great geological periods anterior to the earliest relics of animal life. And as a band of zealous investigators is busy in the exploration of these dim records, it is perhaps not too much to anticipate a rich harvest of discovery from their labours.

Among the applications of palæontology to the stratigraphical side of geology, unquestionably the most important in recent times has been the recognition of life-zones among the stratified formations, and the adoption of these as a clue to the interpretation of the sequence of strata, and even of tectonic structure. It is long since the ammonite zones of the Lias, first worked out in Germany, were traced in this country. Subsequently the palæontological platforms in the Chalk, so well developed in France, were found to hold good also in England. Still more recently the vertical distribution of graptolites has been shown by Prof. Lapworth to be so restricted that these organisms may be used to mark definite zones in the Silurian system. Nor is it in the animal kingdom only that such restriction has been asserted. The members of an extinct flora have been found to show a more or less marked sequence of genera and species, so that, alike in France and in England, the Carboniferous system has been subdivided into more or less distinct plant-zones.

The value of this palæontological aid in the investigation of stratigraphical succession can hardly be overestimated. Among the undisturbed Secondary rocks of England, indeed, it is not indispensable, for the sequence of their formations and their subdivisions can be accurately determined there from other evidence. Nevertheless stratigraphical arrangement gains much in precision, as well as in scientific interest, when changes in lithological characters are found to be accompanied by changes in organic forms; or, on the other hand, when the succession of animal or vegetable types is found to be repeated in distant localities irrespective of local variations in lithology. But where the rocks have been so folded and broken that from mere mineral characters their true order cannot be made out, the presence in them of determinable life-zones, elsewhere well established, may enable their complicated structure to be unravelled. How this task can be successfully accomplished, has been well shown by Messrs. Lapworth, Peach, and Horne, in regard to the excessively convoluted structure of the Silurian uplands of the South of Scotland.

There is, however, some risk of error in the application of this valuable aid in tectonic investigation. Obviously the existence of a life-zone, which will be of general utility, must be determined upon a basis of evidence sufficiently wide to eliminate mere local peculiarities. It should rest not on the presence of a single species, but on a group of species or genera, for the narrower its palæontological range the greater will be the risk of elevating accidental into general characters. We cannot suppose that a given species began and ended everywhere at the same time or on the same platform. In some areas the conditions would be favourable for its earlier appearance or longer continuance, so that we may expect the zones not to be very sharply defined, but to blend into each other, and in such a way that if we were to define them by single species we should find them to present exceedingly variable limits. In a restricted region, where the sequence of life-zones has been accurately ascertained, these platforms are of great value in working out questions of geological structure. But as we recede from that region the necessity of caution increases. The broad features of biological sequence will no doubt remain, and we shall be able to say where the upper or the lower members of a sedimentary series lie, but we may be led into mistakes by trying too rigidly to make the palæontological zones of one country agree with those of another.

In the department of geotectonics, one of the most interesting features has been the increased attention bestowed upon the nature and results of the great movements that have affected the crust of the earth. The early experiments of Hall, showing that the stratified rocks have undergone enormous lateral compression, have been repeated and extended, and many of the remarkable structures of mountain-ranges have been successfully imitated. More detailed investigation has been bestowed upon plicated and disrupted rocks, especially in Switzerland, Saxony and Scotland. The effects of mechanical deformation in producing foliated structures, even in what were originally massive rocks, have been copiously illustrated. The study of these questions has led to a better appreciation of the enormous plications, inversions, and dislocations which mountain-chains, modern as well as ancient, have undergone. In the Alps and in the Scottish Highlands, the subject has been pursued with great ardour, and these regions will henceforth be classical examples of some of the great features of geotectonic geology.

Another distinguishing characteristic of the last quarter of a century of geological progress has been the increased interest taken in the history of the earth's surface. It is strange that while, generation after generation, men laboured zealously to investigate the history of the planet as recorded in the rocks of the terrestrial crust, they neglected to take account of the superficial topography. They did not realise that every land-surface is a kind of palimpsest, on which the chronicles of a long series of ages may be more or less distinctly traced, and thus that every landscape has, as it were, two histories: first, that of the rocks which form its framework, and, secondly, that of the configuration into which these rocks have been carved. It was in Britain that this fascinating branch of geological inquiry first took definite form in the early days of Hutton and Playfair, and it is here that, after long neglect, it has within the last twenty or thirty years been renewed and pursued with most success. The varied geological structure of these islands, their changeable climate, their mountainous groups, and long lines of sea-beaten coast, make them exceptionally suitable for the prosecution of this inquiry. But this branch of geology is now receiving even more attention in the United States than among ourselves, and in many respects the geological structure of North America offers peculiar advantages for its cultivation.

It is impossible within the limits of this article to do more than present in brief outline a retrospect of a few of the departments of so wide a science as geology. Let me, in conclusion, make reference to but one more subject which has greatly exercised the minds of geologists during the last quarter of a century. It is more than thirty years since Lord Kelvin pointed out that there must be an ascertainable limit to the antiquity of the earth, and that from the data at that time available the limit could not be fixed at less than twenty, or more than 400, millions of years ago. He based this calculation on the thermal conductivity of the globe. Afterwards returning to the subject, he placed the limit within 100 millions of years; and still more recently, reviewing the question in the light of the arguments from tidal retardation and the age of the sun's heat, he has brought down the period of the earth's antiquity to about twenty millions of years.

Geologists have not been slow to admit that they were in error in assuming that they had an eternity of past time for the evolution of the earth's history. They have frankly acknowledged the validity of the physical arguments which go to place more or less definite limits to the antiquity of the earth. They were, on the whole, disposed to acquiesce in the allowance of 100 millions of years granted to them by Lord Kelvin, for the transaction of the whole of the long cycles of geological history. But the physicists have been insatiable and inexorable. As remorseless as Lear's daughters, they have cut down their grant of years by successive slices, until some of them have brought the number to something less than ten millions.

In vain have the geologists protested that there must somewhere be a flaw in a line of argument which tends to results so entirely at variance with the strong evidence for a higher antiquity, furnished not only by the geological record, but by the existing races of plants and animals. They have insisted that this evidence is not mere theory or imagination, but is drawn from a multitude of facts which become hopelessly unintelligible unless sufficient time is admitted for the evolution of geological history. They have not been able to disprove the arguments of the physicists, but they have contended that the physicists have simply ignored the geological arguments as of no account in the discussion.

So here the matter has rested for some years, neither side giving way, and with no prospect of agreement. Within the last few weeks, however, as readers of NATURE will have observed, the question has been taken up anew from the physical side.[1] Prof. Perry, feeling that, after all, the united testimony of geologists and biologists was so decidedly against the latest reductions of time, that it was desirable to reconsider the physical arguments, has gone over them once more. He now finds that on the assumption that the earth is not homogeneous, as postulated by Lord Kelvin, but possesses a much

[1] NATURE, January 3 and February 7, 1895, pp. 224–341.

higher conductivity and thermal capacity in its interior than in its crust, its age may be enormously greater than previous calculations have allowed.

The question being *sub judice*, we must wait until it is settled. But there seems at present every prospect that the physicists will concede not merely the 100 millions of years with which the geologists would be quite content, but a very much greater extent of time.

ARCH GEIKIE.

NOTES.

THE second of the special meetings of the Royal Society is announced for the 28th inst., when Prof. Weldon will bring forward as a subject for discussion, "Variation in Animals and Plants."

A SUM of 12,000 francs (£480) was voted to the Mont Blanc Observatory by the French Chamber on Tuesday.

PROF. HENRY A. ROWLAND has recently been elected a Foreign Member of the Reale Accademia dei Lincei of Rome, in the section of Physics.

THE death is announced of the Marquis de Saporta, the eminent botanist, at Aix. He was a Correspondent of the Section of Botany of the Paris Academy of Sciences.

MR. REGINALD STUART POOLE, late Keeper of Coins at the British Museum, died on Friday last, in his sixty-third year. Few men have done so much as he to extend the study of Egyptology and antiquities, or have added more to these branches of knowledge. Before he was seventeen years of age he wrote a series of articles on Egyptian chronology, which afterwards appeared in book form under the title "Horæ Ægyptiacæ." He began very early to lecture on Egyptology and numismatics, and in May 1864 made his first appearance in a Friday evening lecture at the Royal Institution. In 1877 he became Keeper of Coins, and during his twenty-two years' tenure of that post he saw through the press thirty-five most valuable catalogues of the collections under his charge. He was the author of the "Cities of Egypt," and of the articles on "Egypt," "Hieroglyphics," and "Numismatics," in the "Encyclopædia Britannica." With Miss Amelia B. Edwards, he was one of the founders of the Egypt Exploration Fund, of which he remained the honorary secretary to his death.

A NEW scientific society, composed chiefly of the professors and assistants in the Paris Natural History Museum, has just been founded. The society owes its existence to Prof. Milne-Edwards, the eminent director of the museum. It is proposed to hold monthly meetings, and to issue a *Bulletin des Naturalistes*, dealing with natural history matters.

THE Manchester Literary and Philosophical Society is fortunate in having Mr. Henry Wilde, F.R.S., for its president. Always one of the best of provincial societies, its usefulness is likely to increase, for Mr. Wilde has intimated his intention to endow the Society with the sum of eight thousand pounds, the annual income from which is to be devoted to various purposes in connection with its work.

THE history of the Museum of the Corporation of London, in the Guildhall, has never been written, although the collections housed therein are of very considerable interest and value. Taking occasion of the visit of the Essex Field Club on Saturday next, Mr. C. Welch, the Curator, will read a paper on the "Origin and Progress of the Guildhall Museum," to remedy this defect. The museum deserves to be better known and better housed than it is at present. A museum fully illustrating the ancient history of London might easily arise from the present collections, and would be a worthy object for achievement for the richest Corporation in the world.

THE Société Technique de l'Industrie du Gaz en France offers several prizes in connection with the Congress to be held during the present year. The *Journal* of the Society of Arts says that the prizes open to all include one of 10,000 francs (£400) offered to the inventor of an incandescent gas-burner showing marked superiority, to be handed in to the Society before April 1 in the present year, unless the committee exercise their power of extending the period for another year. The sum of 8000 francs (£320) will be devoted to various prizes to be awarded to the authors of the best papers on some subject connected with the gas industry, such as the mechanical *manutention* (handling) of coals, cokes, and the various substances used in gasworks, a study of water-gas, and the substitution of hydro-carbons for cannel coal. The papers must be written in French, and not bear the name of the author; but they must contain at the commencement a motto, which must be reproduced on a sealed envelope containing a declaration, signed by the author, that his work is unpublished, and that he will not make any other publication on the same subject within a year. The manuscripts, with sealed envelope, must be sent to the Society, 65 Rue de Provence, Paris, at least forty days before the period fixed for the Congress.

DURING the past week the severe frost has continued over the whole of these islands, and heavy falls of snow have occurred in all three countries. The distribution of pressure has been generally anticyclonic, biting easterly winds, and gales on our coasts. The following are a few of the lowest shade minima published in the *Daily Weather Report* of the Meteorological Office, since we last went to press:—

February	7	8	9	10	11	12	13
	°	°	°	°	°	°	°
Nairn	0	6	5	4	3	13	5
Loughborough	2	−5	−4	−1	1	4	2
London	12	10	11	13	20	14	15
Cambridge	6	6	7	7	13	15	15

In the neighbourhood of the metropolis some very low readings were recorded on the 8th instant: Wallington 2°·1, Croydon 5°·5, Tulse Hill 6°, Greenwich 6°·9; and in other parts of the country the following minima have been observed: −12° at Braemar, −8° at Stamford on the 8th, −5° at Glenlee on the 9th, and a still lower reading, viz. −17°, is said to have been observed at Braemar on the 11th instant. The reading of 6°·9 at Greenwich is the lowest but one in the last 50 years, a temperature of 6°·6 having been recorded on January 5, 1860. There had been no reading there lower than 10° in February during the same period, until the present frost, in which lower temperatures have occurred on two successive nights. In London such low temperatures rarely occur; a minimum of −5° was observed by Luke Howard on February 9, 1816. Another feature of the present frost has been the low daily maxima. On the 9th instant it did not exceed 20° at Tulse Hill. At Greenwich the maximum temperature on January 5, 1894, was 19°, which was then the lowest maximum observed there since 1841.

IN a paper read before the British Medical Association in 1889, Dr. A. C. Miller pointed out that, under certain circumstances, advantage might be derived from high level residence in the treatment of tuberculous conditions. A note, which has a bearing upon this view, is contributed by him to the *British Medical Journal*. The observers at the meteorological station on the summit of Ben Nevis are changed every three months or so. While on duty at the observatory, they are, as a matter