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THURSDAY, FEBRUARY 8, 1872

THE FOUNDATION OF ZOOLOGICAL STATIONS

WHOEVER contemplates a little closely the state of Science at the present time, must be struck with the fact that, whilst in almost every other branch of public and private life co-operation has been established, and has worked out great results, its influence on the life of Science is but small and insignificant.

This may sound strange to all those who know the number of Scientific Societies, Academies, and Unions to be found in England, Germany, America, Italy, France, in short, everywhere where Science is cultivated at all. But if one looks into the life of these societies, there is not much co-operation to be found in them. They publish periodicals; but there are publishers who do quite as well as societies, and sometimes even better. They meet and talk science; but this does does not add much to the real progress of science. Sometimes they found museums or cabinets, and this is a better service; they establish a library for the use of their members, and this is perhaps the best they do altogether. A man may be fellow of twenty different societies, but that will not affect much the progress of the scientific work he does; if he is member of certain academies his reputation may be raised in the eyes of the outside public, but no essential help is afforded by that either to him or to his work, except in the case where such academy has some influence on the Government, as, for instance, the Royal Society. The Menagerie in the Regent's Park, established by the Zoological Society, is one of the solitary instances in which, the initiative being taken by a scientific body, an institution has been evolved, drawing immense revenue from the public pocket, which is for the most part spent upon scientific objects. It is the application of this method of securing support which will be strongly advocated in the present paper, as a practicable path for the future progress of biological research.

There is also another great society in Britain which does, perhaps, better work for science than any other. This society is the British Association for the Advancement of Science. Not only does its great and well-deserved reputation make it powerful and influential, but also the large sum of money it distributes annually for the direct progress of science. This influence is due principally to the fact that the best men in British Science participate with great eagerness in the meetings of the Association and lend to it all their personal authority and reputation. The considerable sum of money to be distributed is due to the great number of scientific and lay people that take part in its meetings.

The combination of these two elements ought to be imitated in every special branch of science. The times are past when great scientific men did not condescend to speak to a general public, and happily nobody believes any longer that science must be lowered and lost, because the general public looks at and hears a little of its inner life. Great scientific men have an immense influence upon the public, and that is an immense benefit to the public; on the other hand, the general public takes interest in, and pays money for the progress of science, and that is a great benefit for science.

The meetings of the British Association therefore are an essential step in the right direction for lending science the great help of co-operation. But a great deal more of it is needed if that element is to supersede by-and-by the old lines and ways of mere individual and disorganised action. Especially is co-operation wanted in the single sciences. Every one knows how great is the progress in meteorology and astronomy brought about by the possession of special laboratories and observatories. Even if all the universities were extinct at once, these sciences would go on perfectly well by the help of the observatories. Chemistry is aided by innumerable laboratories, erected for practical purposes. Mechanics governs the world and finds itself at home everywhere, involving by its special character many elements of co-operation.

Other sciences do not enjoy these privileges, though they want them perhaps even more than some of those that are in possession of them. Amongst the number of these sciences, perhaps the most neglected in the way of co-operation is Biology, that science which occupies at present such an eminent place in the public interest, and yet the most neglected, in so far as no other science feels at present the necessity of co-operation and organisation so much as biology. The reason is a very obvious one. Biology has undergone a complete revolution by Mr. Darwin's great work. This revolution has augmented the number of special problems in such enormous proportions that biology is now completely at a loss to solve all these problems by the aid of the means placed hitherto at its disposal, and looks pretty much like a boy who has suddenly grown in one year out of all his clothes, presenting the ridiculous aspect of a man in a child's dress. The thing which a father would do for his boy would be to go and buy another dress. This obviously was also the idea of Prof. Carl Vogt, who long since began an agitation for the establishment of a zoological laboratory at the sea-coast, of which agitation he wrote me in a letter the following account:—

"During the years 1844—1847 the plan for the establishment of an expedition was worked out at Paris by Milne-Edwards, and I participated in it. The object was the investigation of a coral-island, and the establishment of a station upon it for at least several years. The ship and the station should be furnished with all possible things, especially for dredging-work. The scheme fell to pieces owing to a question of etiquette. The commander of a man-of-war of the Royal Navy would not submit to the direction of a naturalist.

"As you know, I lived from 1850 to 1852 at Nice. The instruments for observation, which I bought by the money earned by literary work, consisted of a microscope, a surface net, and some large sugar-bottles. I tried at the time by the help of two deputies, my friends Valerio and Dunico, to bring about the foundation of a zoological station at Villafranca, asking only for some rooms in the empty buildings of the Darsena, and the establishment of some tanks in them. Nevertheless I had not the least success.

"In the year 1863 my friend Matteucci became Minister of Public Instruction in the kingdom of Italy. With him, as a physicist who especially dealt with physiological subjects, and who, understanding the necessities and wants

of physical science, intended to make important reforms, I easily arrived at a mutual understanding. It was his idea to elevate the studies in Italy by introducing foreign, especially German, scientific men into the chairs at the universities, who should teach the new generation of Italian students. I worked out for him a project for the erection of a zoological station at Naples, the most suitable place in Italy. The Casino Reale at Chiatamone was to be transformed and fitted up for such a purpose, and a little steam yacht for dredging was to be placed at the disposal of the station. The latter was in the meantime intended for a sort of school, connected with the whole system of public instruction, to form teachers of natural history for the whole kingdom. The plan was completely worked out and adopted by Matteucci and several others among the first scientific men of Italy. They applauded it heartily; Filippo de Filippi especially did everything he could to bring it into play, and talked about it, as he told me, to King Victor Emmanuel during a hunting-party. Matteucci afterwards left the ministry—Filippi and he are dead—the fate of the project is easily to be understood.

"Thus I had got round the Mediterranean. In January 1871 I was at Trieste delivering public lectures. On January 8 I published in the *New Free Press* two letters on 'Some Necessities and Wants of Scientific Investigation,' the subject of which presented itself to my mind when viewing some of the Austrian arrangements for public instruc tion. I may be allowed to say that my article met with universal approval; and some Triestian friends, amongst whom I may mention especially Field-Marshal Lieutenant v. Möring, at the time Governor of the Coast District, talked with me on it, and agreed that Trieste would be a very good place for the execution of my project. Möring himself directed my attention to some small buildings at Miramare, lying outside the park; we visited them together and talked about the necessary arrangements to be made. I worked out a fresh project, made rather special calculations on the money necessary for executing it, and sent all this to the Austrian Minister of Public Instruction, Herr v. Stremayr, with whom I spoke on the subject afterwards, when I passed through Vienna. As you know, I addressed at the same time Gegenbaur, Haeckel, and you, to approve my views and assist me. You sent me besides a letter from Darwin, who applauded much your own plan for erecting a station, and had even offered a subscription for it. I added all these letters to my memorial, which unfortunately had the same fate as the Italian: Stremayer left the ministry before he could do the least thing for the realisation of a plan which he thought exceedingly valuable."

Though Prof. Vogt did not succeed in carrying out his plan, there can be no doubt that his idea is the very one wanted for the present state of biology. A great number of other zoologists entertained it, but nobody knew how to execute it.

In the winter of 1868-69 I found myself at Messina, occupied with the investigation of the embryology of Crustacea. Together with my friend Miclucho-Maclay I often spoke of the necessity of establishing a zoological station on the coast of the Mediterranean, and we agreed to leave a considerable quantity of instruments, amongst which was a small aquarium furnishing a constant stream of water, to our successors in Messina. An Austrian squadron, just sailing round the globe with a considerable number of naturalists, amongst whom were Herr v. Scherger and others, stopped several days in the harbour of Messina, and caused me many thoughts about the great advantage such and other expeditions would derive from a net of scientific stations stretched over the whole globe.

But how to get anything like such stations built and kept up for years? I did not know at that time that Prof. Vogt had already tried to get assistance from several great governments, and had failed to succeed. But I did not even try to do anything like this, knowing beforehand that it would be useless. Zoology is at present in a rising condition, it has still to conquer the place it ought to occupy in the attention of the public by making itself indispensable to intellectual progress. As it is, governments will not easily be induced to sacrifice much money for the progress of this science.

I took another line. After some unsuccessful attempts to get money by collecting small sums, I combined the idea of founding a scientific station with the plan of building a great public aquarium at Naples. My calculation was, that by the entrance-fee of that aquarium the sums necessary for keeping up the station could easily be obtained, and that perhaps more than that would come out of it. I saw at a certain distance even the possibility of erecting other stations with the surplus of the Naples income, and of giving in such a way quite a new development to biological science, just that development which biology wanted after the great event of the Darwinian theory.

As soon as I had got a hold at Naples, I began to spread my ideas in letters and conversations. I [illegible] the pleasure of finding almost everybody in England and Germany quite ready to assist as much as possible. I brought the subject before the meeting of the British Association in Liverpool, and succeeded so far that a committee was appointed by Section D, composed of Prof. Rolleston, Dr. Sclater, and myself as secretary, under the name of "The Committee for the Foundation of Zoological Stations in Different Parts of the Globe."

This was during the war between Germany and France. While it lasted it was almost impossible to do anything in favour of the scheme I had got into my head, except thinking and meditating upon it as much as possible. But as soon as peace was made I proceeded again, as well with the negotiations at Naples as with agitation in other countries.

As secretary of the above-named committee, I gave a report to the meeting of the British Association at Edinburgh. I stated in that report that the establishment at Naples was now quite safe, so far as the permission of the Town Council was concerned; and that, in all probability, the station would be seen there in working order in January 1873. I added that I had got the assistance of my own Government, and I may add here that the Italian Government also assists me greatly. I proposed further in my report that the British Association might consider the opportunity given by the cessation of the annual grant to the Kew Obervatory, of building a zoological station at one of the most favourable places on the British coast. My idea in proposing this was based on the same considerations which had made me go to Naples. I thought it very convenient and very practicable to build a small station, for example, at Torquay or Plymouth, and to combine in such a station, in the same way as at

Naples, a laboratory with a larger aquarium for the public. The income of the latter in a place like Torquay, where there are so many residents and visitors at all times of the year, would completely suffice to keep up the laboratory, and pay a modest sum to a naturalist, who would be charged with the management of the station. Being unable to attend personally the meeting at Edinburgh, I could not give all the reasons which induced me to make this proposition. All the more I shall avail myself of the present opportunity to do so.

The present state of zoology requires, as stated above, new means of investigation. Systematism and simple faunistic researches fall very far short of the problems now ripe for solution. Two great departments of biological science go much ahead of all others, and these two are embryology and the study of the life of animals in relation to all those conditions which regard the struggle for existence and the action of natural selection.

If we speak first of the latter chapter, it is clear that past times have done much more in promoting knowledge about it than the present generation. It is rather out of fashion to study the habits and conditions of life of an animal. Systematism, the making of genera and species, have so much exceeded their legitimate grounds, that they have almost completely suppressed that other branch of natural history. We owe it to Mr. Darwin that he completely upset this one-sidedness, in proving, by his admirable treatises on the Domestication of Animals and Plants, on Sexual Selection, on the Fertilisation of Orchideæ by the Interference of Insects, of what fundamental importance these studies of the habits and conditions of animal life can be. He added not only an enormous number of hitherto unknown facts to the storehouse of science, but he showed what immense importance these facts gained by deriving from them the great principle of natural selection—a principle as grand as any in modern science. Very few zoologists (in naming Mr. Wallace and Mr. Bates, I do justice to these eminent men as two of those who promoted these studies independently of Mr. Darwin) have followed Mr. Darwin's lines in these departments. Nevertheless this must happen: it constitutes one of the most urgent necessities of biological study in our time, and it must not only be done for our domestic animals, and those that live most closely around us, but wherever animals are to be found, and so above all in that enormous field of animal life which occurs in the sea.

Every one will agree with me that we know scarcely any of the secrets of the life of the sea bottom. We have short notices on the habits of some fishes; but this is altogether insignificant compared with the immense bulk of things unknown to us in the same department. And of echinoderms, cuttle fish, jelly fish, polyps, &c., &c., our knowledge simply amounts to nothing.

Here an aquarium, under scientific guidance and superintendence, can work immense good and progress. And such an aquarium will do double service; first, it will attract the public and yield money; and then it will serve immediately and directly the progress of science, by giving the only possibility of knowing something about the habits and the life of marine animals.

But a zoological station with an aquarium will serve equally as much for the progress of embryology. Whoever looks at the development of biological science must see that, during the last ten years, embryology has made very important progress, not only in accumulating facts, but in rendering them serviceable to the progress of ideas and principles.

An offspring of the theory of descent is the maxim that the ontogenetical development is an abbreviated recapitulation of the phylogenetical development. This maxim, or law, if we choose to call it a law, gives enormous importance to embryology. By the help and application of it we may succeed in getting a deep insight into the history of animal life long before the geological record. The Cambrian and Silurian systems yield us already a fauna of so high perfection, and so complete a series of representatives of almost every great class of animals, that we could easily be led to believe in a waving up and down of animal creation, not in a constant progress, so comparatively small are the differences between the present fauna of the earth, and those which the geological record of all the strata makes known to us. Embryology, on the contrary, starts at the very beginning of organic life, tells us how out of simple organic matter cells became formed, how these cells took different functions, thus differentiating and organising the being that possessed them. Embryology further tells us how out of one form, one single form, whole classes came forth, and renders it possible for us to trace the lines of origin of every member of these classes, down to the common ancestor of all of them.

Systematists, looking out anxiously for the "natural system" of the animal kingdom, and turning to mere anatomical differences, may be compared to Sisyphus rolling his stone. They cannot succeed without taking to embryology. But embryological studies are among the most difficult in the whole range of biological science. Not only the interpretation of the facts, and the conclusions to be drawn from observation, require an immense amount of circumspection, caution, and critical ability; but even the simple statement of a fact, the mere act of observation, is often exceedingly difficult. How many monographs on the embryology of the chicken have been written since Caspar Friedrich Wolff published his immortal book against the doctrines of Haller. Pander, Baer, Remak, His, and many others, have treated the same subject, and still to-day there is uncertainty on the most fundamental questions. This is above all to be attributed to the mechanical difficulties of observation. And these difficulties do not exist only in the case of birds' eggs; they are the same for the eggs of almost all animals, especially for those of marine animals. These require a constant stream of salt water to keep them alive, a stream which is only to be had by the help of an aquarium. It is principally due to the absence of such aquariums that our knowledge of the development of fishes is still so rudimentary; for, though the works of Baer, Rathke, Vogt, Lereboullet, Kupffer, and others have taught us a good deal, nevertheless the essential parts of fish-embryology are still wanting. And this is the more to be regretted as it cannot be doubted that the eggs of fishes are, in many regards, preferable as objects for the investigation of general embryological facts to those of the birds. Considering only the fact that all other vertebrata have proceeded from fishes, most likely from shark-like animals, it will be of the greatest importance to acquire

convenient methods for investigating the embryology of these animals.

Besides, the enormous mass of other marine animals waits equally for the establishment of laboratories provided with aquariums, before the study of their embryology can safely, and with due prospect of success, be taken in hand. And that the common ancestors of all the higher animals have lived in the sea, and must have left the traces of their nature still in the embryos of marine animals, is more than likely. Every attempt, therefore, to get back to these ancestors, and to build up scientific genealogy, must lead to the investigation of the embryology of marine animals, must cause, in consequence, the desire of having laboratories near the coast, provided with tanks and continual streams of sea water, to overcome the mere mechanical difficulties of the study.

These are reasons of the most imperious nature to move all those who can do something, to combine their exertions for the foundation of zoological stations near the sea-coast.

When I therefore proposed, in the name of the Committee for the Foundation of Zoological Stations, the erection of such a station at Torquay, my principal object was to create a greater facility for English zoologists to execute scientific works of the above-mentioned nature. Without denying one moment the immense benefit zoology has always derived from English naturalists, one may justly lament that embryology has not found so many students in a country which has such great opportunities of following the study as, for example, has been the case in Germany. England abounds in splendid localities for the study of marine animals; the innumerable harbours, firths, and bays yield an immense material for the scientific observer. Students at the universities would have the easiest access to these localities, and would gain a great mass of information from them; but circumstances have directed almost the whole scientific spirit in another direction—almost all the biologists are occupied with the completion of the faunistic records of the English seas. The existence of a zoological station at Torquay must lead to a greater cultivation of the other branches of marine zoology by Englishmen, and must open also for foreign zoologists the opportunities yielded by the fauna of the south coast of England for carrying in studies in comparative anatomy and embryology.

It will be essential, not only for the progress of zoology in general, but also for the development of the whole scheme for the foundation of zoological stations, that those countries which contribute by their natural position most to the progress of marine zoology should be provided first with zoological stations. If zoological stations in other parts of the world outside Europe are to be founded, they will require above all zoologists to conduct them. Where are these at present to be found? Nowhere, I believe. If, therefore, the great object of my plan is to be attained, it will only be by gradually and consistently developing its base—the foundation of stations in Italy, Britain, France, Norway, and perhaps Spain or Portugal. With the help of these stations, zoologists may be educated who would be inclined to go to remoter places, such as, for instance, Capetown, Ceylon, Japan, or Australia, and conduct or work only for a couple or more years in the stations built in those countries. There can be no doubt that the benefit for science would be enormous if there existed efficient working stations in these countries; but to make them efficient the principal means is to give them well-instructed naturalists at their head, and this is at present not possible.

Therefore I take the opportunity of repeating once more that it seems to be essential to proceed with the foundation of a zoological station at Torquay, and to head that station by a young, laborious zoologist, who is already experienced in histological and embryological work. It cannot but be that science, and especially British science, will derive considerable benefit from such a proceeding.

Naples, Jan. 2 ANTON DOHRN

THE NATURAL HISTORY OF EGYPT AND MALTA

Notes of a Naturalist in the Nile Valley and Malta. By Andrew Leith Adams, M.B. (Edinburgh: Edmonston and Douglas, 1871.)

FEW men have better opportunities for furnishing valuable contributions to the Natural History of foreign parts than surgeons attached to the Army and Navy; an education in at least the rudiments of natural science, combined with abundant leisure, presenting means which are not at the disposal of all travellers. As a rule, we fear that this class of men have done but little for Science compared with what might have been expected of them. There are, however, some honourable exceptions, among them our present author, whose "Wanderings of a Naturalist in India" has been already given to the public, and who now publishes the results of the labours of his leisure hours and vacation rambles in the investigation of the archæology and natural history of the Lower Nile and Malta.

The most interesting portion of Dr. Adams's researches in Egypt and Nubia relates to the evidence as to the period when the northern portion of the African Continent became elevated above the sea. On this point he says:—

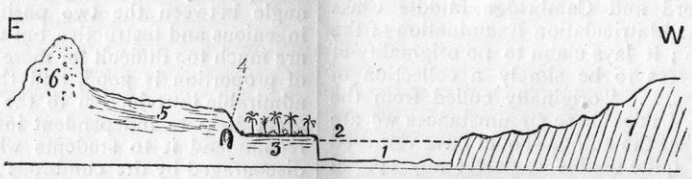
"The discovery of the common cockle and other marine shells far inland, and over vast tracts of Algeria and the desert of Sahara, even up to height of more than 900 ft. above the present level of the Mediterranean, and at a depth of 300 ft. below it, fully establishes the fact that a large portion of North Africa was, at no very distant period, covered by the ocean; moreover, that the highlands of Algeria, Tunis, Morocco, and Barbary, were at this period separated from Africa by sea, and that the submergence occurred during the modern or post-tertiary period. Further researches have also proved that the same description of phenomena are to be observed along the borders of the Red Sea. A question therefore suggested itself to me in 1863, whether or not Egypt and Nubia had participated in the same continental movements. Accordingly, no opportunities were omitted during our short sojourn in Lower Egypt in searching for similar evidences of upheaval and depression, but, owing to the flatness of the country, drifting of the desert sands, and great expanse of cultivation on the river's banks, and our rapid movements, I was unable to discover any traces. It was not until we approached the frontier of Nubia, and passed the first cataract, that favourable opportunities were presented. The Nile, now contracted by the porphyritic and sandstone rocks, flows between steep banks, and creating accumulations of alluvium and bendings and openings in

its course, the desert may be said to come down to its margin.

"Wherever these Nile deposits exist, there may be seen clusters of date and doom palms, and fields, whilst further back stand the mud-built villages of the natives; and still more inland are observed plateaus and terraces at variable levels, covered with finely rounded angular stones and drifted sand. These terrace cliffs continue, with broken intervals, from below the first cataract up to the extreme point attained by us at the top of the second cataract. The observer may have some difficulty at first in tracing these river terraces, but, after a little experience, there will be no trouble in making them out. Let him proceed from the river (1) across the alluvial plain (3), on which stands Der, the capital of Nubia, to the ruined temple (4) of Rameses the Great, on the verge of the cultivated tract, then mount the plateau immediately above (5), and wander inland until he gains a height of 130 ft. above the highest mark of the inundation (2), and commence digging among the stones, when he will come to a reddish-brown soil, highly impregnated with natron, which the natives collect for top-dressing on their fields below. There he will find abundance of Nile shells distributed throughout the soil from the margin of the cliff above the temple inland for upwards of a mile, and until the drifted sand of the desert makes it difficult or impossible to trace them further; indeed, the same appearances are observable along the right bank of the river throughout the distance just indicated. These fossil fluviatile shells belong to species nearly all of which have been proved to exist in the Nile at the present day, and comprise the following species, determined from specimens sent to the Geological Society of London, and examined by the late eminent conchologist Mr. S. P. Woodward:—*Unio lithophagus* (?) *Bulimus pullus*, *Paludina bulimoides*, *Aetheria semilunata*, *Cyrena fluminalis* and variety *trigona*, *Iridina nilotica*."

From these data Dr. Adams concludes that Egypt and Nubia participated in like movements with other portions of the Continent to the east and west; but whether or not, in common with them, they were entirely submerged under the sea at the same epoch, is not so clear, as no marine shells have yet turned up in either Egypt or Nubia.

At Malta, the author's researches were chiefly devoted to an investigation of the fossil mammalian remains in which this group of islands is so rich, for which purpose the British Association, at the suggestion of Dr. Falconer, Mr. Busk, and Captain Spratt, voted 60*l.* in 1863 in aid of his explorations. These Maltese mammalian remains are of unusual interest, comprising the *Hippopotamus Pentlandi*, an animal about as large as the existing Nile species; the *Elephas melitensis* of Falconer, or Pigmy



Maltese Elephant, not more than 4½ ft. in height; the still smaller *Elephas Falconeri* of Busk, the average height of which at the withers could not have exceeded 2½ to 3 ft.; a new large species, named by Dr. Adams, from the place of its discovery, *Elephas Mnaidræ*, the Gigantic Fossil Dormouse, *Myoxus melitensis*, described by Dr. Falconer to be "as big in comparison to the living dormouse as the bandicoot rat to a mouse," and the Hollow-jawed Dormouse, *Myoxus Cartei*, another new species detected by the author. Conspicuous among other vertebrate remains are those of the Gigantic Swan, *Cygnus Falconeri*, another large swan, several other species of land and water birds, at least two species of fresh-water turtles, and a lizard.

With regard to the recent Molluscan fauna, a small land-snail belonging to the genus *Helix* has been found near St. Paul's Bay, and on the bare limestone cliffs of the west highlands of Gozo two recent shells of the genus *Clausilia*, not apparently found in the adjoining continent or Sicily; and at present these represent the only living animals that can be said to be peculiar to the Maltese Islands. Lists of the fishes and birds of Malta are given at the end, the majority of the latter being birds of passage, with respect to the habits of which some interesting particulars are given.

We have no information with regard to the vegetable productions of the island, and this is to be regretted, as observations made during so long a residence would doubtless have elicited some new and interesting facts. The author, however, has probably acted wisely in not trusting to second-hand information which his own botanical knowledge would not have enabled him to verify. We find the well-known *Cynomorium* of Gozo, the *Fungus melitensis* of the Knights of St. John, a flowering plant, spoken of as a lichen.

The volume is illustrated with some well-executed woodcuts and lithographic plates, and we recommend it to all interested in the subject.

OUR BOOK SHELF

A Synonymic Catalogue of Diurnal Lepidoptera. By W. F. Kirby. (London: Van Voorst, 1871.)

THE great work on the "Genera of Diurnal Lepidoptera," by Doubleday and Hewitson, completed after the lamented death of the former by the assistance of Prof. Westwood, included under each genus a synonymic list of all the described species which the authors were able to determine. But more than twenty years have elapsed since the completion of this most valuable work, which still remains without a competitor either in this country or on the Continent, and thus our means of reference upon systematic matters connected with the beautiful and interesting group of butterflies generally, have remained at what must be regarded nowadays as a somewhat antiquated standpoint, whilst the business of describing has been carried on with the most astonishing energy. In Britain Doubleday's *collaborateur* Hewitson, and his successor Butler, have described an almost inconceivable multitude of new species, and a considerable number have also been added to the list by Bates and Wallace; whilst on the Continent the Brothers Felder and Dr. Herrich-Schäffer have been equally active. New views have also been put forward as to the natural sequence and limitation of the groups (families and subfamilies) into which the great Rhopalocerous tribe is divided, and the

whole face of this department of entomological science has undergone a wonderful change in the last twenty years.

Under these circumstances many an entomologist has no doubt often wished that a new "Genera of Diurnal Lepidoptera" would make its appearance; but such works are not to be lightly undertaken, and it may be long before we can hope to see a good, general, systematic treatise upon this group of insects. In the meanwhile we welcome Mr. Kirby's catalogue as a most important aid to the study of the Diurnal Lepidoptera. It is a complete catalogue of the described species of the group, amounting, as an estimate, to about 9,600 in number, and gives the synonyms both of the genera and species in a clear and easily-intelligible form. With the assistance thus offered to him by Mr. Kirby, the entomologist may easily ascertain what has been done by former writers in this department of his science, and it will be his own fault if he does not keep himself *au courant* with its future progress.

Criticism upon a work of this nature would be out of place here, and we can only cordially recommend the results of Mr. Kirby's most conscientious labours to the attention of all entomologists.

A Class-book of Inorganic Chemistry, with Tables of Chemical Analysis, and Directions for their Use. By D. Morris. B.A. (London: G. Phillip and Son, pp. 157.)

THIS work has been compiled for the use of students preparing for the Oxford and Cambridge Middle Class Examinations, and the Matriculation Examination of the University of London; it lays claim to no originality of treatment, and professes to be simply a collection of "enlarged notes," . . . "originally culled from the best modern books." Under these circumstances we are somewhat surprised that the author should have ventured to publish it; we are quite unable to detect any special merit in the book, and it is disfigured by many passages which show great want of exactness. Thus, we find "nitric acid, or nitric anhydride, N_2O_5;" "sulphate of potassium or dipotassic sulphate;" the formula of phosphate of calcium is written $3Ca_2PO_4$, of chloride of lime $CaOCl_2O$. We are told that "ammonium and sodium are distinguished by the smell of ammonia on the addition of caustic potash." "Pure water has no action upon the metal (lead), but water charged with air corrodes it, and the oxide of lead thus formed dissolves in the water." Among the redeeming qualities of the book may be mentioned the questions which are selected from various University examination papers, and the examples given worked out in the text; but with errors of the nature of those given above it is impossible to recommend the book to the student, or to regard it as a reliable source of information.

The Elements of Plane Geometry for the Use of Schools and Colleges. By Richard P. Wright, Teacher of Mathematics in University College School, London, formerly of Queenwood College, Hampshire. With a Preface by T. Archer Hirst, F.R.S., &c., late Professor of Mathematics in University College, London. Second Edition. (Longmans, 1871.)

THIS work would have been more correctly described as being "by Eugène Rouché and Ch. de Comberousse, translated and edited by Richard P. Wright," &c. But although Mr Wright can lay small claim to originality, he has shown judgment in the selection of an eminently logical and masterly treatise on geometry, and he has rendered it into clear and forcible English. The arrangement is excellent, and many of the conclusions for which Euclid found it necessary to reason geometrically on each particular case are treated generally by purely logical considerations. Many of the demonstrations, notably that of the *pons asinorum*, are far more simple and convincing than those in Euclid. The difficulty of the twelfth axiom is met by the easy axiom that *through a point without a line only one parallel can be drawn to that line.* In some points there seems to be an unnecessary alteration of the language of Euclid, as in the definition of a figure, "Surfaces and Lines or combinations of them." This definition seems to have been introduced to enable the authors to describe a *locus* as a figure; but it having been pointed out that a locus is not a figure, Mr. Wright has described it as a *line*, but has not restored the word figure to its ordinary acceptation. At the same time it is not quite correct to define a locus as *a line*, excluding such loci as a pair of parallel lines, the circumference of a circle with its centre, &c. Again, the word *circumference* is substituted for the word *circle* whenever the circumference only is intended. It is true that the word *circle* in Euclid is used in two different senses, but this leads to no ambiguity of ideas; while the use of the word *circumference* for *the circumference of a circle* only excludes its application to an ellipse or other closed curve. The word *angle* is not defined when first introduced, but we are told afterwards that it "may be regarded as the quantity of turning of a definite character around the vertex, which a movable line must receive in passing from the direction of one side to that of the other." We fail to see the force of the words "of a definite character," and would suggest the following definition: "When a straight line moves about a fixed point in itself so as to occupy a new position, the quantity of turning it has undergone is called the angle between the two positions." The exercises are ingenious and instructive, but those of the earlier chapters are much too difficult for mere beginners. The treatment of proportion is good, and the work as a whole is an admirable introduction to the higher mathematics, and a great help to independent investigation. We especially recommend it to students who have found themselves discouraged by the cumbrous form and initial difficulties of Euclid. The second edition contains the alterations suggested by a late eminent mathematician in the *Athenæum* on the appearance of the first edition, with the addition of the substance of the second book of Euclid, and in a few cases the demonstrations of Euclid have been restored. H. A. N.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

The Aurora Borealis of Feb. 4th

AFTER a rather long absence of auroral displays, a brilliant and many coloured example was seen here last night, February 4, not quite so vivid as that of October 1870, but coming next to it so far as my own experience goes.

At about 8 P.M., when the maximum development was reached, all the heavens were more or less covered with pink ascending streamers, except towards the north, which was characteristically dark and grey, first by means of a long low arch of blackness transparent to large stars, and then by the streamers which shot up from that and along its whole length, for they were green or grey only for several degress of their height, and only became pink as they neared the zenith, the region where the more precise phenomena occurred, as thus:—

1. The focus of the vertical streamers coming up from all azimuths was very constant among the stars, but was not in the zenith itself, being nearly 18° south and 5° east thereof.

2. The red streamers varied from orange to rose-pink, red-rose, and damask-rose, or from strontium α, through calcium α, lithium α, and on to and beyond potassium α, that is, they did so to the naked eye, but the spectroscope knew no variety of reds amongst them; and I, having a very good referring spectrum in the lower part of the field of view, giving potassium α, lithium α, sodium α, citron acetylene and green acetylene, be-

sides the blue and violet, saw Angström's green aurora line perpetually over citron acetylene at W.L. 5579, and the red aurora line between sodium *a* and lithium *a*, but nearer to the latter, say at W.L. 6350.

3. Now, W.L. 6350 in the solar spectrum is a pretty bright scarlet red, so that orange could easily be made of it by the green aurora mixing therewith, and the spectroscope separates each of the two kinds of light with perfect ease But how came potassium red or W.L. 7700, *i.e.*, the blood red, lurid red, and tragedy red of painters to appear so markedly to the naked eye, and yet not be seen at all in the spectroscope, either as a new ingredient or an altered place of the red line? It would apparently be by the mixing up of rays and streamers of the *blackness* out of that long, low dark arch on the northern horizon. But when a spectroscope fails (as fail it must) to show a characteristic line for a region of blackness, what other instrument can we take to prove the case?

Excessively faint greenish and bluish lines appeared at wave lengths 5300, 5100 and 4900 nearly; but the main light in the spectroscope was to the extent of 8-tenths of the whole, that of the green line 5579, and of 1·7-tenths the red line 6350; while to the naked eye the splendour of the display and its variety consisted in triple mixtures of 5579, 6350, and the unknown dark medium. Could something be ascertained about that, if those who have good telescopic star spectroscopes were to observe a star when shining through one of these inky black arches?

At 9.30 P.M. when all the aurora had faded or passed away towards the south, where a few straggling pink patches still appeared, the northern horizon and its sky being now free from the black arch, as well as the green streamers, perfectly astonished me by the clear pellucid blue of a true starlight night-sky in a bright climate and clear atmosphere. Evidently the dark arch and streamers are as much a part of the aurora as the green and red lights, but how to investigate them—that is the question.

C. PIAZZI SMYTH

15, Royal Terrace, Edinburgh, Feb. 5

LAST evening an aurora of rather unusual brilliancy was seen here. I happened to be out with a friend in the country about sunset, when the sky was completely overcast and fine rain was falling. We noticed that darkness did not come on so quick as usual, and at 7 o'clock it was so light as to lead my friend to believe that the moon was shining above the clouds. Later in the evening slight breaks began to appear in the clouds, through which the first magnitude stars were just visible, and through these openings an intense red illumination appeared. The spectroscope gave from every part of the heavens a very bright line in the green, and another fainter one nearer the blue, together with a diffused light over the green and blue parts of the spectrum. The brightest part of the aurora was towards the S.W. From the large amount of light, although it was raining at the time, it must have been one of the brightest auroras that have been witnessed for years.

G. M. SEABROKE

Rugby, Feb. 5

COMING up the Channel on Sunday night last in the P. and O. screw-steamer *Delta*, about 9.40 P.M., I saw a very fine aurora. The sky was cloudy, which somewhat dimmed its brightness, but it was rather brilliant towards the N.

Having a Hoffman's direct vision spectroscope with me, I turned it towards the brightest red portion which lay towards the N.E., and with a moderate slit got a very sharp and distinct line in the green at or near the position of F in the solar spectrum. No other lines were visible. But on removing the telescope, and observing the spectrum with the naked eye, a fine crimson line revealed itself near C; the colour of it was exactly that of hydrogen *a*, as seen in a vacuum tube.

I also thought that there were faint traces of structure visible in the blue and violet, but of this I cannot be sure.

There had been traces of auroral phenomena visible early in the same evening. The green line was so distinct that unpractised observers saw it easily. The red line, however, was much fainter, and appeared to flicker.

I much regret that I had no means of recording the position of the lines.

R. J. FRISWELL

ABOUT six o'clock on Sunday evening the ruddy appearance of the upper clouds gave warning of an aurora in prospect, but I was not prepared for the magnificent sight which appeared on looking out an hour later. The higher part of the sky seemed covered with bright rose-coloured clouds, which, from the dark masses of clouds passing underneath, seemed continually to be shifting in position. Intervals of deep green appeared amongst the red, and these, when looked at with a spectroscope, gave a stronger light than their surroundings. Objects near were illuminated as if the moon had risen behind the clouds. I had a miniature spectroscope of Browning's, with which I examined the brightest parts, and obtained four lines—one very bright green, two very faint nebulous green bands, and one red line. Having a spirit lamp handy, in which were remnants of sodium, lithium, and sulphate of copper, I was able roughly to estimate the positions of the lines. The red was about a third from *D* towards the lithium line; the very bright green about a third from *D* to the copper line near *b*, the other faint green bands were more refrangible, and I should think their places were between *b* and *F*, and near *F*, but I could not get their positions so well as the other two; certainly the most refrangible was not so far as the violet-potassium line which I could see in the field.

The light green was present everywhere, the red only showed occasionally with very varying intensity, and the most refrangible green line was also continually varying, but it was brighter than the second green line.

The light around attained its maximum about a quarter to eight, and then very slowly diminished to about midnight, when it had nearly disappeared. A light drizzling rain was falling the whole time.

J. P. MACLEAR

Shanklin, Feb. 5

THERE has been a magnificent red aurora here this evening. I saw it first before twilight had quite disappeared, and at first thought it was the crimson of sunset unusually late. It was at its finest between six and seven; at that time there were columns of light shooting up from the horizon almost to the zenith, and occupying almost half the horizon from the E. of N. round by E. The crimson colour was variegated with bluish white in a way that I have not seen before The barometer was at about 29·45 inches, with a strong breeze from the south.

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim, Feb. 4

THERE was a fine display of aurora here yesterday evening. I first observed it about 5.30, just in the twilight, but it was then confused with the rays of the setting sun; as the darkness deepened the aurora came out alone, and was then extremely beautiful. It extended from the extreme N.E. to the extreme N.W., but from the reflection of the numerous clouds, appeared to have a much larger area. It was of a bright crimson colour, with the rays golden or orange, of which, however, only a very few were visible.

As the evening came on, about 8 o, the clouds gradually became thicker, and at last almost entirely covered the sky; the only effect then apparent was a deep red glow, which continued with unequal intensity until 11.45. and with all probability much later. At 9.35 there was a break in the clouds towards the E., when the aurora shone forth in all its splendour. The aurora was most certainly visible in daylight, just appearing as the twilight came on.

I have no doubt if the atmosphere had been clearer, we should have had a most magnificent display; as it was, the effect was really beautiful.

J. S. H.

Gloucester, Feb. 5

THERE has been a magnificent and extensive auroral display this evening, of which I beg to send you the following account.

After a very heavy fall of rain, which lasted in this part of the country from 1 o'clock P.M. until 5.30 o'clock, there were collected in the northern horizon numerous *cirro-stratus* clouds, which gradually at first, and afterwards rapidly, moved towards the E., with the strata to the S. As these were passing away, I saw, about midway between these clouds and the zenith a bright patch of pale red light, which became well defined by 6 o'clock. A few minutes after this appeared I saw in the N.W. another patch of red light, and by 6.15 there stretched from N., N.W., and N.E. three very broad streamers converging in the zenith, and forming a splendid crimson canopy, the streamers being quite separated, until meeting, by dark spaces. These slowly disappeared, and of a sudden there appeared a bluish-white streamer stretching N.E. to and passing the zenith by about 10°.

At this time I could see that the Pleiades were partly covered, although not hidden, by a part of this streamer. At 6.35 it faded away. At 6.40 light clouds began to rise in the W. and S.W., and as I recognised this phenomenon as auroral, having seen similar clouds on other occasions of auroral displays, I carefully watched them, and saw at 6.50, in the S.W., a crimson-coloured patch, undefined in shape, originating from the light clouds. At 6.55 there shot up from the S. beautiful red, crimson, and blue streamers, which converged in the zenith. At 6.58 other bands of crimson and blue arose due S., and joined the others in the zenith. At 7.0 I was quite astonished to see the aurora appear in the S.S.E., by which time the previous brilliant display in the S. had dimmed, and the whole of them formed a southern canopy. During this southern display, the northern parts were quite dark, with heavy looking clouds; but at 7.5 the clouds slightly broke up, and I saw a faint redness in the N.E., about 45° above the horizon. By this time the southern streamers and patches began to spread and assume a mottled appearance, which reached by 7.10 the N.W. At 7.15 the N.W. and E. were quite dark and cloudy, and there remained only slight traces of the aurora in the S.W. high up in the heavens, and by 8.35 it had entirely disappeared. JOHN JEREMIAH

Park, Tottenham, Feb. 4

DOUBTLESS many of your readers witnessed the magnificent aurora which occurred on Sunday, February 4. If any one else has noted the position of the radiant point, as seen from this station, the following observations, made somewhat roughly, from this place (lat. 53° 17′ 8″ N., long. 6° 10′ 22″ W., nearly) may be of use in determining approximately the height of that point above the earth.

At 7.15 (Greenwich time) its zenith distance was 23°; its bearing in azimuth 4° E. of S. At 7.30 its zenith distance was the same; its azimuth 15° E. of S. At 9.10 its zenith distance was 13°; its azimuth 1° W. of S. M. H. CLOSE

Newton Park, Blackrock, Dublin, Feb. 5

LAST evening (Sunday, Feb. 4) there was a brilliant display of aurora visible in North Devon with some unusual features. At 6 o'clock the sky was clear, except a cloud of deep rose aurora over Orion, and another detached portion toward the west. This soon developed into a cloudy arch of the same colour stretching from east to west; then, a little south of the zenith between the Pleiades and Aldebaran, this arch culminated to an obtuse point of white cloud, something like a broad gothic arch. The northern half of the heavens was quite clear, but a series of radiations towards the south, and spreading east and west, issued from this point. For some time it seemed doubtful whether it was aurora, or a peculiar appearance of the clouds caused by high air currents, and a refraction of light from the sun's rays in the higher regions of the atmosphere. At one time there was some appearance of spiral radiations, or drift of cloud from this point near the zenith, with a distinct but irregular gap of clear sky, somewhat similar to the Coalhole in the galaxy near the Southern Cross; but this did not last long, although the general appearance was continued for more than half an hour, with varying play of light, over a space of about 140° of the southern heavens, with pretty well-defined eastern and western boundaries of deep rose colour, culminating in the white focus near the Pleiades, which appeared the centre of action. The rose colour was chiefly confined to the eastern and western boundaries, with intermitting starts of whitish radiation toward the south. Occasionally well-defined streaks of a lighter tint crossed the western portion of the rosy cloud, which appeared to originate from the light of the sun, now, of course, far below the horizon. At length the eastern portion became less brilliant, but still Orion was enveloped in a steady rosy haze, although it gradually became fainter, until, a little before 7 o'clock, the rosy colour below Orion toward the eastern horizon became as brilliant as ever, and soon a straight broad ray of rose colour started up from the horizon. This was not curved or arched, like the whiter radiations which seemed to originate from near the zenith; nor was it, like them, intermittent and wavy; but had the appearance of a broad beam of rosy light originating below the horizon, and darting straight upward in a diagonal direction, proceeding over Castor and Pollux and Jupiter. Then the north side of this became of a peculiar light bluish green; if I may be allowed to coin a word, it was of a moonshiny colour. If the moon had been a few days younger, I should have thought it originated from the moon. This very peculiar and distinct broad beam or bar of light almost developed prismatic colours from its southern rosy edge to its northern bluish-green well defined border. There was also a somewhat indistinct tendency to the same prismatic appearance, spreading some little distance over the heavens on the south side of this beam near the zenith. The northern segment of the sky from Castor and Pollux to about direct west was still perfectly clear, both from cloud and aurora, right down to the horizon; there was a bank of cloud along the southern horizon. About 7 o'clock there was an appearance of rosy tint to the north of the peculiar straight bank spoken of, and this reached as far as the pointers in the Great Bear. About the same time there was a peculiar development of white cloud from the zenith toward the north-west, streaked and fringed with well defined radiations, and this gradually increased until the northern portion of the heavens, which had hitherto been quite clear, was covered to within 30° of the horizon, the border of this cloud being very distinctly and deeply serrated with fan-like shapes radiating from near the zenith. The phenomena I have described occupied more than an hour, and my attention was now drawn from it until after 8 o'clock, when the whole heavens were cloudy, but behind and between the clouds the rosy tint was still visible as an irregular arch stretching from north to west. As the clouds broke off the whitish wavy radiation could be occasionally seen still issuing from near the zenith, and across the western part of the rosy arch were occasionally seen the straight diagonal bars of a brighter shade, apparently caused by the light of the sun, but the clouds obscured most of the phenomena. At a last look near 9 o'clock the clouds had somewhat cleared, and there were two brilliant arches, more like the regular aurora from the north-west horizon towards the zenith, at right angles to the more cloudy arch, which had been visible for some time stretching from the north to the west. W. SYMONS

Barnstaple, Feb. 5

LAST evening (Sunday, February 4) the sky presented a weird and unusual aspect which at once struck the eye. A lurid tinge upon the clouds which hung around suggested the reflection of a distant fire, while scattered among these torn and broken masses of vapour having a white and phosphorescent appearance, and quickly altering and changing their forms, reminded me of a similar appearance preceding the great aurora of October 1870. Shortly some of these shining white clouds or vapours partly arranged themselves in columns from east to west, and at the same time appeared the characteristic patches of rose-coloured light which are seen in an auroral display.

About 8 o'clock the clouds had to a certain extent broken away, and the aurora shone out from behind heavy banks of clouds which rested on the western horizon, the north-eastern horizon being free from cloud and shining brightly with red light. And now, at about 8.15, was presented a most beautiful phenomenon. While looking upwards I saw a stellar-shaped mass of white light form in the clear blue sky immediately above my head, not by small clouds collecting, but apparently forming itself in the same way as a cloud forms by condensation in a clear sky on a mountain top, or a crystal shoots out in a transparent liquid, leaving, as I fancied, an almost traceable nucleus or centre with spear-like rays projecting from it; and from this in a few seconds shot forth diverging streamers of golden light, which descending met and mingled with the rosy patches of the aurora hanging about the horizon. The spaces of sky between the streamers were of a deep purple (the effect of contrast), and the display, though lasting a few minutes only, was equal if not excelling in beauty, though not in brilliancy, the grand display in 1870, before alluded to, in which latter case, however, the converging rays met in a ring or disc of white light of considerable size.

What struck me particularly was the aurora developing itself as from a centre in the clear sky, and the diverging streamers apparently shooting downwards, whereas in the ordinary way the streamers are seen to shoot up from the horizon and converge overhead. The effect may have been an illusion, but if so it was a very remarkable one. Examined with one of Mr. Browning's direct seven-prism spectroscopes, I saw the principal bright line in the green everywhere (the other lines were not visible), and noticed the peculiar flickering in that line which I noticed in 1870, and which has also I think been remarked by Sir John Herschel. The general aurora lasted for some time till lost in a clouded sky, and in fact rain was descending at one time while the aurora was quite bright. Strong wind prevailed during the

night. The aurora was probably extensive, as the evening, notwithstanding the clouds, was nearly as bright as moonlight.

Guildford, Feb. 5 T. RAND CAPRON

The Floods

Two of the largest districts which are most constantly flooded are, perhaps, Oxford and "The Plain of York." The same cause floods both these districts, namely, what Mr. Mackintosh has called "Colonel Greenwood's hard gorge and soft valley theory." Both these districts have been worn down by rain and rivers in the soft oolitic strata; and the Humber and the Thames have ever had, and have now, to force outlets through comparatively hard chalk gorges. The rain-flood waters, checked at these gorges, overflows and deposits alluvium behind the gorges. The same takes place in the soft strata of the Weald, behind the nine comparatively hard chalk gorges of the North and South Downs. GEORGE GREENWOOD

Brookwood Park, Alresford, Feb. 3

Zodiacal Light

THE evening of Feb. 2 being clear, after a long persistence of rainy cloud for many days, about 6.5 P.M. I began to notice the existence of a zodiacal light. Some time later, probably about 6.40, it was considerably brighter than any portion of the galaxy in sight at the time, though this might not have been the impression of an inattentive spectator, as the gradual melting away of its edges produced much less contrast with the ground of the sky than the better defined outline of the Milky Way. Its light was, in fact, so imperceptibly diffused that it was impossible to fix its boundaries or extent with any accuracy. Its general position was, however, undoubtedly a little below the square of Pegasus (where its upper edge fell short of α and γ), and beneath the three stars of Aries; but its light was here so enfeebled that its termination was quite uncertain, and it could only be said that the direction of its axis was towards the Pleiades. Its breadth where most brilliant, near Pegasus, might probably be estimated at 8° or 9°, from comparison with the distance from α to β, and with the length of the belt of Orion; but this determination was liable to great uncertainty. It was thought to show a ruddy tinge, not unlike the commencement of a crimson Aurora Borealis; this may have been a deception, but it was certainly redder or yellower than the galaxy. At 7 I examined it with a little pocket spectroscope, which shows very distinctly the greenish band of the aurora; but nothing of the kind was visible, nor could anything be traced beyond a slight increase of general light, which, in closing the slit, was extinguished long before the auroral band would have become imperceptible. It was still visible at 8.30. The phenomenon had been previously noticed, but with less distinctness, on Dec. 30 and Jan. 11.

T. W. WEBB

Hardwick Vicarage, Herefordshire

Magnetic Disturbance during Solar Eclipse

WITH the known relation existing between the sun and terrestrial magnetic disturbance, it is not surprising that some indication of a change in the earth's magnetism might be expected during a solar eclipse; and the case cited by the Rev. S. J. Perry, of its supposed observation by M. Lion, is not the first instance of the kind.

Shortly after the eclipse of 1870, Signor Diamilla Müller, of Florence, published a paper in the *Gazzetta Ufficiale*, No. 17, describing some magnetic observations made in Italy during the 21st, 22nd, and 23rd December, and from which it appeared that there was a slight variation in the curve of the 22nd, at the time of the eclipse, which did not appear in the curves of the preceding and subsequent days. Signor Müller at once concluded that the variation was produced by the eclipse; but it was pointed out by Senhor Capello, of the Lisbon Observatory, that the same disturbance was recorded by his self-recording instruments, but it occurred there some time before the totality. It was also recorded by the instruments here, and proved to be insignificant when compared with other disturbances continually observed.

A careful examination of the curves for the time of the 1860 eclipse has also failed to show any trace of a similar movement then occurring. G. MATHUS WHIPPLE

Kew Observatory, Feb 5

Circumpolar Lands

MR. HAMILTON, in NATURE of January 25, refers to a paper in which "the rising of the land at the *poles* is inferred as a necessary result of the cooling and contracting of the earth." He then goes on to give the substance of part of the paper, beginning as follows:—

"If a spheroid of equilibrium, in motion about an axis, contract uniformly in the direction of lines perpendicular to its surface, a new spheroid is produced, having a greater degree of eccentricity, because if equal portions are taken off the two diameters, the ratio of the equatorial diameter is increased. This is equivalent to a heaping up of matter around the *equator*."

The reasoning of this latter passage appears sound, but it contradicts the former one. As I have shown in my letter to which Mr. Hamilton replies, the facts, so far as known, appear to point to a relative increase of the *polar* diameter; he admits this, and then gives reasons for expecting a relative increase of the *equatorial* one. He must have made some oversight.

Old Forge, Dunmurry, Jan. 27 JOSEPH JOHN MURPHY

THE HISTORY OF PHOTOGRAPHY

I TRUST you will kindly allow me space for a few lines on the subject of some rare specimens connected with the History of Photography, now in the possession of Madame Nièpce de St. Victor, whose husband it will be remembered was the first to employ glass, and a transparent medium (albumen) for the purposes of photography, thus discovering, to a great extent, the process of Photography as it exists at the present day. The first glass negative, or rather *cliché*, Madame Nièpce possesses, as likewise prints executed in 1848.

Nièpce de St. Victor was likewise one of those who have worked hard to secure *natural colours* in the camera, some very perfect specimens—photographs of coloured dolls—which prove distinctly that the solution of the problem is not impossible, as many believe, are also included in the Nièpce collection, together with some results of early photo-engraving.

Madame Nièpce and family have been left, I regret to say, in very straitened circumstances, for the busy philosopher in his lifetime had but the pay of a subordinate officer in the French Army to subsist on. She has placed in the possession of the Photographic Society this valuable collection of her late husband, and it is proposed to exhibit it at the next meeting of the Society on the 13th inst., and any institution or individual desiring to become possessed of some of the specimens will be readily furnished with information by H. BADEN PRITCHARD

*GANOT'S PHYSICS**

GANOT'S Physics is so well known in this country that our task is very different from that of reviewing a new work, and we can do little more than compare this edition with the previous. It is unusual for any large scientific work to pass through five editions in about ten years, and the value of the book may be estimated by this fact. It has passed through more than twice the above number of editions in France, and has been translated into various European languages. In the present edition the type has been altered, and the size of the page somewhat increased, while twenty-eight new illustrations have been added, and the text has been augmented.

The doctrine of energy has of late been so largely developed that we are surprised to find so small an amount of space given to the subject. No more than two pages are devoted to it, while the term "transmutation of energy," does not appear in the index. Neither do we find the terms "Kinetics" and "Kinematics;" yet we imagine that the student who presented himself as a candidate for a Science Scholarship at any of our Uni-

* An Elementary Treatise on Physics, Experimental and Applied. Translated and Edited from Ganot's "Éléments de Physique," by E. Atkinson, Ph.D., F.C.S. Fifth Edition, Revised and Enlarged. 898 pp. 8vo. (London: Longmans and Co. 1872.)

versities, not knowing the meaning of these terms, might find himself quite at sea in some of the questions. Indeed we do not find much introduction of the terms of the Thomsonian Physics, and this is surely to be regretted; for just as the philosophy of Francis Bacon used to be called the "New Philosophy," so might the Natural Philosophy developed in the treatise of Tait and Thomson be called the "New Physics." The experimental science of the future must be based, we conceive, upon the system therein elaborated.

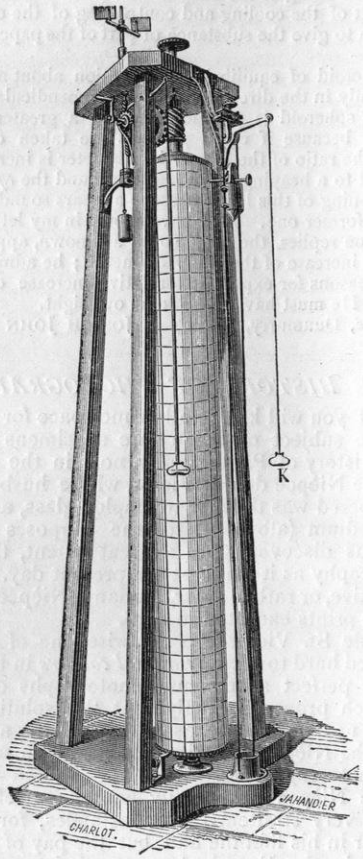


FIG. 1.

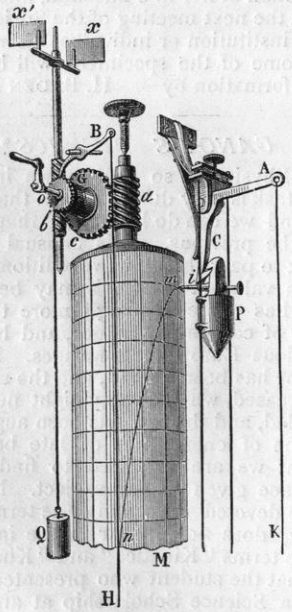


FIG. 2.

We are glad to notice a very good account of Morin's apparatus for demonstrating the laws of falling bodies (p. 49), which does not appear in the 1868 edition. The principle of this, it will be remembered, is to cause a falling body to trace its own path upon a rotating cylinder. The accompanying diagram (Figs. 1, 2) needs no explanation. The vanes are for the purpose of producing uniformity of motion in the revolving cylinder; the falling weight is a mass of iron, P, furnished with a pencil, which presses against the paper on the revolving cylinder. The curve traced can be proved to be a parabola, and the paths traversed in the direction of the descent are shown to vary directly as the squares of the lines in the direction of rotation.

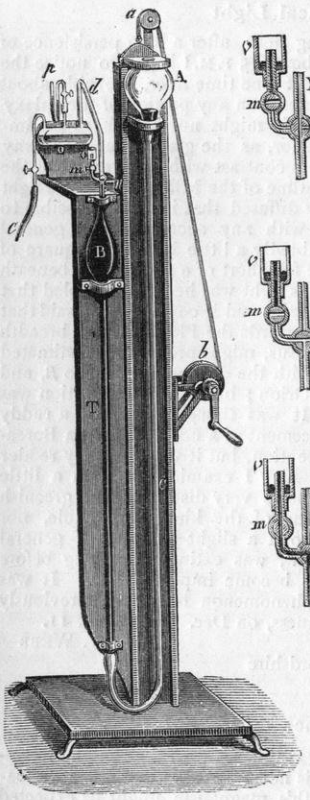


FIG. 3.

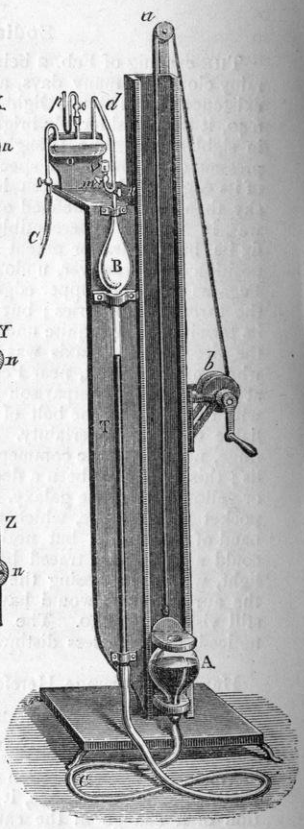


FIG. 4.

Under the head of "Endosmose of Gases" (p. 97) we find no account of the cause of diffusion of gases, the experiments of Graham, the determination of the relative velocity of atoms by Clausius, and the explanation of such facts as the rate of diffusion of hydrogen being four times greater than that of oxygen. But it may be argued that this rather belongs to Chemistry.

We are glad to see that the law which relates to the volume of gases under varying pressures is now called after its true discoverer, "Boyle's Law," but the experiment, demonstrating at once the incompressibility of fluids and the porosity of dense bodies, is, as usual, attributed to the members of the Accademia del Cimento, while it was in reality proved twenty years earlier with

a hollow sphere of lead by Francis Bacon. Again "Mariotte's Tube," as it is called (p. 120), is described and figured by Robert Boyle fourteen years before Mariotte mentions it. Morren's mercury pump for slow but accurate exhaustion is described and figured on p. 141 (Figs. 3, 4); by its means a vacuum of one-tenth of a millimetre of mercury may be obtained.

The Acoustics has been considerably augmented, for while in the 1868 edition it occupied fifty-two pages, it now fills fifty-five larger pages. We notice, among other things, an account and woodcut of König's stethoscope, and of his cylindrical resonator; of Helmholtz's apparatus for the synthesis of sounds; and various new woodcuts of manometric flames. We do not observe any mention of singing or sensitive flames. In the section devoted to heat, we do not find an account of Prof. Guthrie's experiments on the conduction of heat by liquids; or of the recent observations regarding the heat of the moon and certain stars; and the portion relating to the "Mechanical Equivalent of Heat" is still very meagre and insufficient.

The magnetism of iron ships might with advantage be alluded to in the account of Magnetism; and M. Noë's very powerful thermo-electric battery is also worthy of notice. On pp. 596 and 597 we are glad to observe capital figures and descriptions of the electrical machines of Bertsch and Carre; the latter appears to be a most desirable addition to the Physical Laboratory, as, even without a condenser, plates of 49 centimetres diameter give sparks 18 centimetres long, and the machine is not much affected by moisture. The apparatus figured on pp. 678—670 for demonstrating the attraction and repulsion of electric currents by currents, consists of new and improved forms of those devised by Ampère, and is extremely ingenious; as is also the form of solenoid described on p. 690. (Fig. 5.)

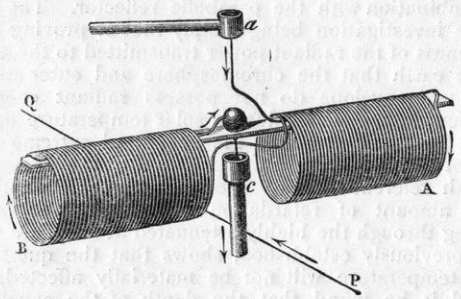


FIG. 5.

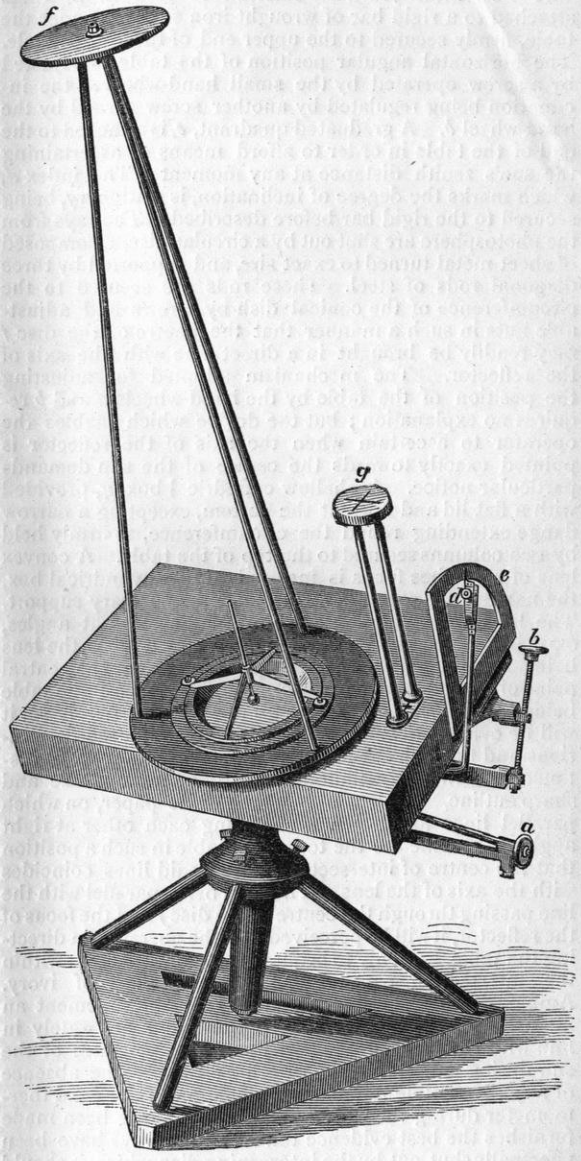
A few alterations in the text would be advisable if a table of errata is introduced; thus (p. 750) no explanation is given of the stoppage of a cube of copper when caused to rotate between the poles of a powerful electro-magnet, as soon as the magnet is made; neither is reference given to the explanation which in another form is given elsewhere. Again (p. 628) we read :— . . . "Kirchhoff has concluded that the motion of electricity in a wire in which it meets with no resistance is," &c. A very few clerical errors are observable :—p. 185, M. Costa should be M. *Corti;* p. 246, topmost line, "substances by which their action," &c., should read "*which by* their action;" p. 289, line ten from the top, p should be p'; and p. 524, line 4, we find "*plain* polarised light."

These, however, are quite minor matters; the book was a good one at the outset of its career, and each succeeding edition has rendered it more and more complete. The above remarks are made rather as suggestions than in any spirit of adverse criticism. Ganot's Physics is a great addition to our scientific literature, and neither student nor *savant* could spare it from his library.

G. F. RODWELL

THE SOLAR ATMOSPHERE

THE object of the investigation discussed in NATURE (No. 101, pp. 449-452) being merely that of ascertaining whether the incandescent matter contained in the solar atmosphere transmits radiant heat of sufficient energy to admit of thermometric measurement, no particular statement was deemed necessary regarding the spectrum which appeared on the bulb of the focal thermometer after shutting out the rays from the photosphere



during the experiments. The appearance of this spectrum has in the meantime been carefully considered. Its extent and position suggest that the depth of the solar atmosphere far exceeds the limits hitherto assumed.

The accompanying illustration represents an apparatus constructed by the writer to facilitate the investigation. Evidently the expedient of shutting out the photosphere while examining the effect produced by the rays emanating from the chromosphere calls for means by which the sun

may be kept accurately in focus during the period required to complete the observations. The main features of the apparatus being shown by the illustration, a brief description will suffice. The parabolic reflector which concentrates the rays from the chromosphere (described in the previous article) is placed in the cavity of a conical dish of cast-iron, secured to the top of a table suspended on two horizontal journals, and revolving on a vertical axle. The latter, slightly taper, turns in a cast-iron socket which is bushed with brass and supported by three legs stepped on a triangular base, resting on friction-rollers. The horizontal journals referred to turn in bearings attached to a rigid bar of wrought-iron situated under the table, firmly secured to the upper end of the vertical axle. The horizontal angular position of the table is adjusted by a screw operated by the small hand-wheel *a*, the inclination being regulated by another screw turned by the hand-wheel *b*. A graduated quadrant, *e*, is attached to the end of the table in order to afford means of ascertaining the sun's zenith distance at any moment. The index *d*, which marks the degree of inclination, is stationary, being secured to the rigid bar before described. The rays from the photosphere are shut out by a circular disc, *f*, composed of sheet metal turned to exact size, and supported by three diagonal rods of steel. These rods are secured to the circumference of the conical dish by screws and adjustable nuts in such a manner that the centre of the disc *f* may readily be brought in a direct line with the axis of the reflector. The mechanism adopted for adjusting the position of the table by the hand-wheels *a* and *b* requires no explanation; but the device which enables the operator to ascertain when the axis of the reflector is pointed exactly towards the centre of the sun demands particular notice. A shallow cylindrical box, *g*, provided with a flat lid and open at the bottom, excepting a narrow flange extending round the circumference, is firmly held by two columns secured to the top of the table. A convex lens of 26 inches focus is inserted in the cylindrical box, the narrow flange mentioned affording necessary support. The lid is perforated by two openings at right angles, 0·05 inch wide, 2·5 inches long, forming a cross, the lens being so adjusted that its axis passes through the central point of intersection of the cross. The face of the table being turned at right angles to the sun, or nearly so, it will be evident that the rays passing through the perforations and through the lens will produce, at a certain distance, a brilliantly illuminated cross of small size and sharp outline. A piece of ivory, or white paper, on which parallel lines are drawn intersecting each other at right angles, is attached to the top of the table in such a position that the centre of intersection of the said lines coincides with the axis of the lens. This axis being parallel with the line passing through the centre of the disc *f* and the focus of the reflector, it will be perceived that the operator, in directing the table, has only to bring the illuminated cross within the intersecting parallel lines on the piece of ivory. Ample practice has shown that by this arrangement an attentive person can easily keep the disc *f* accurately in line with the focus of the reflector and the centre of the sun during any desirable length of time. The absence of any perceptible motion of the column of the focal thermometer during the experiments which have been made furnishes the best evidence that the sun's rays have been effectually shut out by the intervening disc, which, it should be remembered, is only large enough to screen the aperture of the reflector from the rays projected by the photosphere. It may be noticed that actinometric observations cannot be accurately made unless the instrument is attached to a table capable of being directed in the manner described; nor is it possible to measure the dynamic energy transmitted by solar radiation unless the calorimeter employed for the purpose faces the sun with the same precision as our parabolic reflector. It is worthy of notice that the lightness of the illustrated apparatus renders exact adjustment easy, since screws of small diameter and fine pitch may be employed. It only remains to be stated that in order to admit of accurate examination of the spectrum before referred to, the thermometer is removed during investigations which do not relate to temperature, a cylindrical stem of metal, 0·25 inch diameter, coated with lamp-black, being introduced in its place.

With reference to the result of recent experiments, it is proper to state that, at the present time, the sun's zenith distance being now nearly 60° at noon, no perceptible heating takes place in the focus of the parabolic reflector. The observations relating to temperature mentioned in the previous article, were made when the zenith distance was only one-third of what it is at present. The consequent increase of atmospheric depth, at this time, has completely changed the colour of the spectrum, and rendered the same so feeble that its extent cannot be determined. As seen last summer, before the earth had receded far from the aphelion, the termination of the spectrum reached so far down that an addition of 0·15 inch to the radius of the disc *f* would scarcely have shut it out. Now an addition of 0·15 inch to the radius of the disc corresponds to an angular distance of 9′ 45″; hence, assuming the radius of the photosphere to be 426,300 miles, the depth of the solar atmosphere cannot be less than 255,000 miles. And, judging from the appearance at the period referred to, there can be little doubt that a larger and more perfect reflector will enable us to trace the spectrum still further down. Consequently, a further enlargement of the disc *f* will be required to extinguish wholly the reflected light from the solar atmosphere. It is reasonable, therefore, to suppose that the depth of the solar atmosphere will ultimately be found to exceed very considerably the foregoing computation.

It has been suggested regarding the instituted investigations of the radiant heat transmitted by the chromosphere, that the thermo-electric pile ought to be employed in combination with the parabolic reflector. The object of the investigation being simply that of proving by the feebleness of the radiant power transmitted to the surface of the earth that the chromosphere and outer strata of the sun's envelope do not possess radiant energy of sufficient intensity to influence solar temperature as supposed by Secchi, tests of the suggested extreme nicety are not called for.

With reference to the effect of increased depth, the small amount of retardation suffered by the rays in passing through the highly attenuated atmosphere of the sun, previously established, shows that the question of solar temperature will not be materially affected, even should it be found that the depth of the envelope is greater than the radius of the photosphere.

J. ERICSSON

THE RIGIDITY OF THE EARTH

SIR WILLIAM THOMSON'S views regarding the rigidity of the earth have been hitherto received in silence by those who entertain different opinions from him; but it does not follow on this account that they regard his position as unassailable. It is more satisfactory to attempt to establish positive results in science, than to criticise the labours of others; but as Sir William Thomson, by his letter in NATURE for January 18, manifestly invites discussion, I hope I shall be excused for making the following remarks.

When nearly ten years since I saw the abstract in the Proceedings of the Royal Society which he appends to his letter, I resolved to suspend my judgment until I had an opportunity for reading his papers *in extenso*. To such of your readers as happen to be interested in this question, and who have not yet seen these publications, I would venture to recommend a similar course. In the

"Philosophical Transactions" for 1862, the memoir on the rigidity of the earth is fully printed, and immediately following it is another designated "dynamical problems regarding elastic spheroidal shells and spheroids of incompressible liquid." The conclusions arrived at in the first are essentially and admittedly dependent on the investigations presented in the second. Not long after they were published I gave my best attention to the study of both, and it soon appeared to me that the problems treated in the second could have no physical bearing on the question of the earth's structure. The very title of this memoir partly reveals its character in this respect. In order to apply the results obtained in this memoir to the earth, it is supposed to be a spheroidal homogeneous elastic shell filled with incompressible fluid; whereas in such an inquiry the earth can scarcely be supposed to be otherwise than a heterogeneous solid envelope containing a fluid whose properties are not inconsistent with those of fluids coming under our notice. Under this form I have treated the hypothesis in the "Philosophical Transactions" for 1851, and also in subsequent publications.

Incompressibility is not a property of any known fluid; and Neumann, when referring in his comprehensive treatise on geology to the influence of pressure in promoting the density of the interior parts of the earth, expresses what is very generally admitted among philosophical geologists as well as physical inquirers, when he says that "fluid bodies are endowed with *far more* compressibility than solids."* Hypotheses are often indispensable in physical inquiries where we are proceeding from the known to the unknown, but there are two conditions to which they should conform; first, they should be capable of verification by a comparison of the results to which they lead with those of observation, and secondly, they should not contradict established physical laws or the known properties of matter, unless the contradiction is specially explained and fully accounted for. The second of these conditions is clearly violated when the internal fluid of the earth is supposed to differ from all known fluids by being supposed to be incompressible. And this violation is especially flagrant when the solid matter enclosing the incompressible fluid is supposed to be at the same time elastic and therefore compressible, and when, moreover, the line of reasoning adopted as to the earth's internal structure pointedly depends upon these assumptions as to the properties of its fluid and solid portions. Sir William Thomson endeavours to prove, by a process of *reductio ad absurdum*, that the interior of the earth is for the most part or altogether solid; in other words, he supposes the interior to be fluid, and then tries to show that the tidal actions produced in this fluid by the sun and moon must cause oscillations in the crust which have not been observed. He may justly claim to have proved that the earth does not consist of an elastic solid envelope enclosing a mass of the ideal substance called an incompressible liquid, but he has not proved the point which he intended to establish, namely, the absence of an interior fluid nucleus endowed with the properties commonly attributed to fluids. He also supposes throughout his investigations, in the same manner as was supposed by Mr. Hopkins, that the transition from the solidity of the shell to the fluidity of the nucleus is not gradual but abrupt. Those who maintain the validity of the hypothesis of the interior fluidity of the earth are far from holding this opinion. On the contrary, all observations hitherto made on the materials of the earth lead to the conclusion that the solid shell is so constituted as to present first a superficial coating whose mechanical properties we can partly ascertain by direct experiment; secondly, a mass whose density and rigidity probably increase with the depth from the outer surface; thirdly, an interior coating in which the effects of pressure are resisted by those of temperature, and where an imperfectly fluid and pasty mass is in contact at one side with the solid shell, and on the other with the more perfect fluid. This mass should be manifestly much more yielding and compressible than the perfectly solidified shell; for if compression tends to increase the rigidity of solid matter, the middle division of the shell, as just described, should be more rigid than its superficial portion, and very much more rigid than the interior pasty mass. The work performed by small changes of shape in the fluid nucleus due to the action of exterior disturbing bodies should thus be expended partly in producing small variations of density among the compressible strata of which it is composed, and partly in changing the shape of the yielding matter of the inner surface of the shell. The deformations of a shell consisting of homogeneous elastic matter, such as steel acted upon by exterior forces, must be the resultants of all the elementary deformations among its particles summed up or integrated. It would behave somewhat like a vibrating bell; but such is not the behaviour to be expected in a mass of discontinuous and heterogeneous materials. Vibratory motions in such bodies are for the most part extinguished by interferences, or their amplitudes are at least very much reduced.

If the conclusions deduced by M. Perrey of Dijon from his voluminous labours so often referred to by Mr. Mallet in his Reports on Earthquakes, be correct, some connection between these disturbances and the phases of the moon seems to be established which may be due to such comparatively feeble vibratory actions. Sir William Thomson's conclusions rightly interpreted show that the constitution of the fluid nucleus and the nature of the materials of the shell must be essentially different from what he supposes in order to establish these conclusions. A person who never saw a railway train might as justly reason as to the impossibility of travelling in it at high rates of speed, by demonstrating that the shocks experienced by perfectly rigid carriages connected without any compressible arrangements would be too great for travellers to endure, if not too great for the permanent integrity of the carriages themselves. In assuming the incompressibility of the fluid nucleus for the purposes of his indirect demonstration of the rigidity of the earth, Sir William Thomson makes a *petitio principii* nearly as vital as shocks incident to influence of buffers in reasoning on the the omission of the railway carriages.

I am at a loss to know where any warrant was found for affixing the property of incompressibility to the supposed fluid nucleus of the earth; and those who maintain the hypothesis of the interior fluidity of the earth are entitled to repudiate an assumption fastened on that hypothesis not only in opposition to evidence derived from experiments on fluids, but in direct contradiction to the arguments employed by them in discussing the question of the earth's structure.

HENRY HENNESSY

* Lehrbuch der Geologie, i. p. 268, 2nd edition.

THE LANDSLIPS AT NORTHWICH

IN the "Notes" of the number of NATURE, for Jan. 25, I find one referring to the landslips at Northwich in Cheshire, by mistake called Nantwich. As the description given of these landslips and their cause is scarcely accurate, your readers may like to see a short account of them.

Northwich is the great centre of the Cheshire salt trade. The manufacture is principally carried on now at Northwich and Winsford, both towns lying in the valley of the River Weaver, though formerly Nantwich was engaged in this trade, and Middlewich still continues so to be. The position of the latter is indicated by its name, it lying between Northwich and Nantwich. The salt is found lying in two beds, called the upper and lower rock salt. The first bed is met with in the neighbourhood of Northwich at the depth of about forty yards, and

is twenty-five yards thick. Although brine springs had been known and worked as early as the time of the Norman Conquest or earlier, yet the bed of rock salt was only discovered in 1670 when searching for coal at Marbury, about a mile to the north of Northwich. During the last 200 years this rock salt has been worked, or to speak more correctly, for more than a century the upper bed was worked, when an agent of the Duke of Bridgewater sank lower still, and, after passing through about ten yards of hard clay and stone, with small veins of rock salt running through it, the lower bed of rock salt was discovered. This lower bed is between thirty and forty yards thick, but only about five yards of the purest of it is "got." This good portion lies at a depth of from 100 to 110 yards, according to the locality. In the neighbourhood of Winsford both beds are met with at a much greater depth. The whole of the rock salt obtained is got now from the lower bed, and last year it reached nearly 150,000 tons, probably the largest quantity ever obtained in one year. It may as well be said that this mining of rock salt has had nothing whatever to do with the subsidences spoken of, though the wording of the note would lead readers to expect the contrary. At present there is no danger to be expected from the lower bed of rock salt. The whole danger arises from the upper bed, as will be seen from the following account:—The salt trade of Cheshire is a very extensive one, and during the year 1871 upwards of 1,250,000 tons of white salt have been sent from the various works in that county. The whole of this immense quantity has been manufactured from a natural brine which is found in and around Northwich and Winsford, as well as in several other smaller places. This brine is produced by fresh water finding its way to the surface of the upper bed of rock salt, technically called the Rock Head. The fresh water dissolves the rock salt, and becomes saturated with salt. The ordinary proportion of pure salt in the brine is 25 per cent. To obtain the quantity of salt above mentioned, it would be necessary to pump 5,000,000 tons of brine. The pumping of brine is incessantly going on, and as a natural consequence the bed of rock salt is being gradually dissolved and pumped up. As the surface of the salt is eaten away, the land above it subsides. This subsidence is not spread over the whole surface, but seems to follow depressions in it, thus forming underground valleys with streams of brine running to the great centres of pumping. Wherever a stream of brine runs, there the subsidence occurs, and in many localities the sinking is very rapid and serious, but fortunately is almost always gradual and continuous. An immense lake, more than half a mile in length, and nearly as much in breadth, has been formed along the course of a small brook that ran into the river Weaver, and this lake is extending continually. Besides this gradual continuous sinking, which affects the town of Northwich very seriously, causing the removal and rebuilding of houses or the raising of them by screw-jacks in the American fashion, the raising of the streets and so on, there is a sudden sinking of large patches of ground, leaving large deep cavities such as described in your Note. These latter are more terrifying and dangerous. They are in the majority of cases caused by the falling-in of old disused mines in the upper bed of rock salt. These old mines were worked so as to leave but a thin crust of rock salt between the superincumbent layers of earth and the mines. The roof of the mine is supported by pillars of rock salt at intervals. Of course the weakest and most dangerous point is the old filled-up shaft. As most of these mines have been disused for nearly a century, the position of the old shafts is unknown. When the brine has eaten away the layer of rock salt left as a roof, the whole of the earth lying above falls into the mine, and an enormous crater-like hole, some 100 feet or more in depth, is formed, which in process of time becomes filled up with water, the mine itself being choked with earthy matter. In the immediate neighbourhood of Northwich there are a great number of these rock pit holes, as they are called, and it is nothing very unusual for one to fall in.

The rock miners, as they are called, were at work in the lower mine last year when one of these sudden subsidences occurred. They knew nothing of it. I have been myself under this hole, and it was a fearful one to look at when it first went in. There is no communication between the upper and lower beds, and the miners have about thirty yards of hard clayey stone and rock salt between them and the upper old mines. The subsidence more particularly alluded to in your Notes is not in the immediate neighbourhood of Northwich, but rather midway between Northwich and Winsford, near Marton Hall. It is rather difficult to know what is its cause, as there is no record of any mines ever being worked in that neighbourhood. The general belief is that the rock salt, which undoubtedly underlies the whole neighbourhood, has been gradually dissolved, and that a sinking has commenced as at Northwich; then that, owing to some peculiarity of the particular overlying strata—probably to their sandy nature, as quicksands are known to exist about Northwich—the earthy and sandy matter of the immediately overlying strata has been carried away by the brine streams till a large hollow has been formed. This has continued till the superincumbent mass could not be borne up any longer, and thus suddenly fell in, filling up the lower cavity, but opening a large crater-like pit from the surface.

A Government inspector has been to the neighbourhood, and his report is expected very shortly.

The whole neighbourhood of Northwich is well worthy of more attention than it has received, and it is surprising that our geologists have not been able to give a better account of the rock salt formation than has yet been done.

THOS. WARD

NOTES

WE are glad to be able to state that the severe sentence passed upon M. E. Reclus has been changed, in consequence of the representations of the scientific men of this and other countries, into the comparatively mild one of exile from France.

WE understand that the Chair of Anatomy in the new German University of Strasburg has been offered to, and declined by, Prof. Gegenbaur, who has done so much to raise the scientific reputation of the University of Jena. A similar offer has also been made to Gegenbaur's distinguished colleague, Haeckel, the result of which is not yet announced.

THE Master and Senior Fellows of St. John's College, Cambridge, have elected Mr. J. B. Bradbury, M.D., of Downing College, Linacre Lecturer in Medicine in the room of Dr. Paget, who has been elected Regius Professor of Physic.

THE Royal Commission on Scientific Instruction and the Advancement of Science recommenced their sittings yesterday.

THE two Smith's Prizes of the University of Cambridge have been this year awarded to the First and Second Wranglers respectively.

WE regret to learn that the Australian Eclipse Expedition has proved a failure, through the unfavourable state of the weather at the point of observation.

IT is with great regret we have to record the death on Wednesday, January 31, at Torquay, of Dr. G. E. Day, F.R.S., late Chandos Professor of Medicine in the University of St. Andrew, at the age of 56. Our columns have borne frequent evidence of the extent of Dr. Day's acquirements in many branches of

Natural History. He was one of the founders of the Pathological and Cavendish Societies.

THE name of Colonel Chesney, F.R.S., of the Royal Artillery, who died on Tuesday, the 30th ult., at his residence near Kilkeel, Co. Down, Ireland, in the 83rd year of his age, was almost more familiar to the last generation than to this. Among his various titles to eminence as traveller, *savan*, and military critic, he will be chiefly known as "the pioneer of the overland route to India." It is now nearly forty years since General, then Captain, Chesney returned from his explorations of the Euphrates for the purpose of establishing steam communication with India *viâ* Egypt and Asia Minor, to ask the Government to give him the command of an expedition. The demand was granted; two vessels, the *Tigris* and the *Euphrates*, were placed at his disposal. The indefatigable manner in which he prosecuted his scheme, in the face of many disappointments and discouragements, is well known. He has himself written the history of his travels and adventures; and the lines of communication now in existence bear witness to the practical value of his projects. General Chesney has for many years back enjoyed the repose which was the fitting reward of much arduous toil; and now leaves behind him the record of a useful, honourable, and well-spent life.

DR. WILLIAM BAIRD, F.R.S., whose death we recorded last week, after a long and painful illness, was born at Eccles, in Berwickshire, in the year 1803, educated at Edinburgh, and received in 1823 an appointment as surgeon from the East India Company. While in this office he visited India, China, and many other countries, the natural history of which he carefully studied. In 1831 he published a paper "On the Luminosity of the Sea," in *Loudon's Magazine of Natural History*, and from that time became a frequent contributor to the scientific journals, more especially to the "Transactions" of the Berwickshire Naturalists' Club. In 1838 he compiled a Cyclopædia of the Natural Sciences. In September 1845 he was appointed an Assistant in the Zoological Department of the British Museum, which office he filled till his death. In 1851 his monograph on the British Entomostracous Crustacea, a work of great ability and research, was published by the Ray Society. Between the years 1838 and 1863 he contributed a number of papers on the Entomostraca to the "Annals of Natural History," and the "Proceedings" of the Zoological Society. During the latter years of his life his attention was principally given to the Entozoa, of the then known species of which he had as early as 1843 drawn up a catalogue, which was published by the trustees of the British Museum. Numerous papers on the same subject were also contributed by him to the "Proceedings" of the Zoological Society, the "Transactions" of the Linnean Society, &c. Latterly he was engaged in preparing a general catalogue of the Entozoa, for which he had accumulated a vast amount of material. His knowledge of some other branches of natural history was equally extensive and profound, and his death will leave a gap among those who were acquainted with his varied acquirements, and the courtesy and readiness to assist displayed to all who sought his help or advice.

THE *Academy* records the death of Prof. Trendelenburg, of Berlin, who had attained a two-fold eminence as a philologist and Aristotelian commentator, and as an original thinker.

THE Waynflete Professorship of Chemistry at the University of Oxford, will shortly become vacant by the resignation, through ill-health, of Sir Benjamin Collins Brodie, Bart., M.A. The Waynflete Professorship of Chemistry was directed by the ordinance of the University Commissioners of 1854, relating to Magdalen College, to be founded in that college in lieu of certain prælectorships mentioned in its ancient statutes, and to be maintained by a stipend of 600*l.* per annum. The Professor is elected by the Chancellor of the University, the Visitor and President of the College, and the Presidents of the Royal Society and of the College of Physicians. Prof. Brodie was elected in 1865, and was the first professor under the new ordinance, having previously resigned the Aldrichian Professorship of Chemistry, which he had held since the resignation of the late Dr. Daubeny, and which chair was suppressed in 1866, the revenues being applied to the payment of a salary of a Demonstrator, and to the purchase of chemical apparatus or other means towards the study of chemistry in the University.

IN the *Gazette of India* is the following tribute to the memory of the late Archdeacon Pratt:—"The Governor-General in Council has received with deep regret official intimation of the death of the Venerable the Archdeacon of Calcutta, the Reverend J. H. Pratt, on the 28th ultimo, at Ghazeepore, in the North-Western Provinces. The Governor-General in Council cannot allow the death of Archdeacon Pratt to pass unnoticed by the Government which he served so long and so well. Mr. Pratt entered the service in the year 1838, and was appointed Archdeacon of Calcutta by the late Bishop Wilson on the 6th October, 1849. Under the ordinary rules of the service, Mr. Pratt would have retired in October, 1867, but so efficiently had he filled his high office in the Church, that he was solicited by Government, with the full approval of Her Majesty's Secretary of State, to continue to hold it. In adopting this course the Government was moved not only by its own appreciation of the Archdeacon's services, but the strong recommendation of the late Bishop Cotton, who bore testimony to Archdeacon Pratt's eminent scientific attainments and university distinctions, to the active part which he had taken in the management of the diocese, and in the promotion of all good works, and to his personal piety and high Christian character. At a later date Her Majesty's Secretary of State, in sanctioning the retention of Archdeacon Pratt in the service until October 1872, remarked:—'I cannot refrain from expressing the high sense I entertain, in common with the present Bishop of Calcutta, the Lieutenant-Governor of Bengal, and your Excellency in Council, of the zeal and ability with which he has for so many years faithfully and laboriously discharged the duties of his Office.' The Governor-General in Council feels assured that the death of the Venerable Archdeacon will be mourned by the entire Christian community in India."

IT is announced that Professor Flower will commence his annual Hunterian Lectures on Comparative Anatomy in the Theatre of the Royal College of Surgeons on Friday, the 16th inst., at four o'clock. The lectures will be continued at the same hour every Monday, Wednesday, and Friday until the 27th of March. The subjects to be embraced by the present course are the modifications of the organs of digestion, including the mouth, tongue, salivary glands, alimentary canal, liver, and pancreas. These will be treated of in detail in the various animals composing the class Mammalia, and if time should permit, a review of the principal variations of the same parts in the other Vertebrata will follow. The lectures will be illustrated as fully as possible by specimens from the Museum, and by diagrams, and it should be added, are open without fee to any gentleman presenting his card at the door.

THE *Times of India* calls attention to the very scant recognition which literary or scientific merit has received in conferring the distinction of the Star of India. Although the Order of the Star of India was established for the reward of good service of every kind, and the soldier, the civilian, the diplomatist were not considered, on the institution of the Order, to have any better claim to the decoration than the man of science or the man of letters, yet on the list there is at the present time scarcely a single representative of literature, science, or art. The *Times* strongly commends the claims of Dr. Forbes Watson and Dr George Smith to this distinction, for the admirable work done in bringing the English public face to face with the arts and manu-

factures of the East, services which have as yet received no recognition whatever from the Crown.

THE brilliant display of the aurora borealis, seen in London on Sunday night, of which various accounts will be found in our columns, appears to have been observed in France, as well as in Wales. Scotland, and Ireland. The phenomenon was seen in Turkey and also in Egypt. A telegram from Alexandria says that a large space of sky was illuminated for five hours. The report of the Meteorological Department on Monday notices the wide extent of the display, and adds, "a considerable change in the weather seems likely."

AT his inauguration as Rector of the University of Edinburgh on Monday last, Sir Wm. Stirling-Maxwell is reported to have made the following pertinent observations on the medical education of women:—"He was in favour of teaching women everything that they desired to learn, and for opening to them the doors of the highest oral instruction as wide as the doors of book-learning. As to medical education, he said that so long as women would minister to their sick children and husbands, he must hear some argument more convincing than he had yet heard why they were to be debarred from learning the scientific grounds of the art of which they were so often the empirical practitioners, or the docile and intelligent instruments."

THE *Academy* for February 1 contains a reply, by Prof. Helmholtz, to Prof. Jevons's article on "The Axioms of Geometry," in our issue for October 19.

WE learn from the *British Medical Journal* that the Brown Institution for Sick Animals is likely to commence at once a work of great public utility. Aided by a handsome grant from the Chambers of Agriculture, Profs. Sanderson and Klein, and Mr. Duguid, will undertake an extended series of observations on the treatment and comparative pathology of pleuro-pneumonia, an epizootic which commits the most costly ravages among our herds.

"JUSTICES' Justice" has become a proverb. Here is a sample of justices' science:—At Chelmsford the county magistrates declined to grant the use of the Shire-hall for a lecture on the sun, illustrated by experiments in spectrum analysis, on the ground that the electric light might endanger the safety of the building!

THE *American Naturalist* for January reprints a correspondence between the Commissioner of Agriculture for the United States' Government, and Prof. Asa Gray, and other botanists, respecting the dismissal of Dr. C. C. Parry from his office of botanist to the department, which appears to have been performed in a very summary manner, and on slight grounds.

MR. M. C. COOKE, the well-known mycologist, announces his intention, if the names of a sufficient number of subscribers can be obtained, to issue monthly a small journal, with illustrations, devoted absolutely to Cryptogamic Botany. It will serve as a sort of Appendix to the Lichen and Fungi Floras recently published, by recording and describing new species as they are found. Although British Cryptogamia will occupy the first place, it is intended to record from time to time what is doing abroad in all the Cryptogamic families (except ferns), and to keep the student acquainted with what is being published in foreign countries as well as his own. Monographs of genera and families, critical observations on species, and all kindred subjects, will receive attention. The co-operation is promised of the Rev. W. A. Leighton, Dr. Lauder Lindsay, Dr. Braithwaite, F. Kitton, and other specialists.

THE *Journal of Botany* states that a re-issue is in course of preparation of Lindley and Hutton's "Fossil Flora of Great Britain," originally published in 1837, and now very scarce. A supplementary volume will be added by Mr. Carruthers, which will contain a critical revision of the species in the original book, and figures and descriptions of all the important additions to fossil botany made during the last thirty-five years.

A CLEVER application of science to commercial purposes has been made by an Italian gentleman, M. Eugenio de Zuccato, of Padua. By means of the invention any number of copies of a manuscript or design, traced upon a varnished metal plate, may be produced in an ordinary copying press. The *modus operandi* is very simple. To the bed and upper plate of a press are attached wires leading from a small battery, so that when the top of the instrument is screwed down the two metal surfaces come into contact, and an electric current passes. An iron plate resting upon the bed of the press is coated with varnish, and upon this surface is written with a steel point any communication it is desired to copy. The letters having thus been formed in bare metal, a few sheets of copying paper are impregnated with an acid solution of prussiate of potash, and placed upon the scratched plate, which is then subjected to pressure in the copying press. An electric current passes wherever the metal has been left bare (where the writing is therefore), and the prussiate solution acting upon the iron, there is found prussiate of iron, or Prussian blue characters, corresponding to those scratched upon the plate. The number of copies that may be produced by this electro-chemical action is almost unlimited, and the formation of the Prussian blue lines is, of course, instantaneous. The patent, which is, we believe, the property of Messrs. Waterlow and Sons, forms a remarkable instance of science serving as handmaiden to the man of business.

IT will be remembered that a process of engraving by means of a forcible jet of sand was recently invented in America by Mr. Tilghman, and applied to photography, a gelatine relief being used as the mask or shield containing the design. The *Photographic News* states that a further modification has been patented by Mr. Morse, who uses a new method of propelling the sand. He provides a simple box or hopper, from which depends a small tube about 8ft. long, and no machinery whatever beyond this is used. A mixture of corundum and emery, in the form of powder, is placed in the hopper and allowed to descend through the tube. The object to be engraved is held under the extremity of the tube, so that the engraving powder will fall upon it, and in a few minutes' time the most splendid ornamental designs are cut, with marvellous exactitude and surprising beauty. An American paper says:—"We have seen engraved effects, produced by this process, upon glass and silver ware, that altogether surpass anything that has ever been attempted by the most skilled hand labour. This simple and beautiful invention promises to revolutionise the art of plate and glass engraving. By its use the adornment of all kinds of wares, in the most superb manner, may be qnickly accomplished, at a tithe of the cost of the ordinary methods."

A CATALOGUE is printed of the Meteoric Collection of Mr. Charles Upham Shepard deposited in the Wood's Building of Amherst College, Mass., U.S.A. It comprises 146 litholites or meteoric stones, which are considered unquestionably authentic, from all parts of the world, the time of fall varying from the year 1492 to 1871, and 93 siderites or meteoric irons, which fell between 1735 and 1870. The total weight of the collection is above twelve hundred pounds. The heaviest iron, that of Aeriotopos, weighs 438 pounds; the smallest, that of Otsego, half an ounce. The largest entire stone, that of New Concord, weighs 52 pounds; the smallest, from Hessle, less than 50 grains. The whole number of specimens exceeds five hundred. The collection embraces, besides numerous casts, an extensive series of doubtful meteorites, in which all the principal irons and stones of this descriptionare represented.

SCIENTIFIC INTELLIGENCE FROM AMERICA *

THE statement, by Professor J. D. Whitney, of the present condition of the geological survey of California, lately presented to the Governor of the State, gives a gratifying picture of the activity and success in accomplishing the objects for which the exploration was authorised. The State Geologist remarks that less has been done than he had hoped, in consequence of the suspension of the appropriations by a preceding Legislature. Since the work was resumed, however, as the result of renewed appropriations by the Legislature of 1869, the survey has been carried on as rapidly as the nature of the service would allow. Among the points particularly engaging the attention of the State Geologist was the completion of the topographical map of California, it being readily understood that this must be a necessary preliminary to a geological map. The survey of Central California was considered especially interesting and important, embracing, as it does, that portion of the State from Owen's Lake on the south to Lassen's Peak on the north, or between 36° and 40° 30′ north and south, and 117° 30′ and 123° east and west, the whole area comprising about one-third of the State, with probably ninety-five per cent. of the population residing in it. Of the portion included within these limits, represented upon four maps, three are entirely drawn and partially engraved, while the fourth is two-thirds drawn, with the field-work of the remaining third yet to be done. A preliminary map, however, of the whole of California, on a scale of eighteen miles to an inch, has been drawn, in compliance with the wish of the community, and will soon be ready for distribution. Besides these, other works connected with the same subject are reported by the State Geologist, being the new editions of the Yosemite Guide-book, and the publication of the first volume of the "Ornithology of California," which is characterised as a work exquisitely illustrated and admirably printed. The remaining volumes of the series of reports are so far completed as only to wait the continuance of appropriations to place them in hand and secure their early appearance. Arrangements have also been made with Mr. Lesquereux to work up the fossil plants of California, and with Dr. Leidy and Prof. Meek in regard to the fossils. Prof. Brewer, of the Survey, is well advanced in the work on the Botany of California, which, when completed, will doubtless be used extensively as a text-book. It is much to be hoped that very liberal appropriations will be made for these important objects, since its chief and his assistants are known to be among the very best specialists in America, and their work has commanded the highest respect among naturalists at home and abroad. The reports themselves are models of perfection in regard to typography and general execution, and are not to be surpassed by the finest European works, whether published by governments or private parties. It may be stated as a well-known fact that much interest has been excited throughout the scientific circles of Europe by the character of the work done under the auspices of the State, and the utmost admiration expressed in regard to its liberality and enterprise; this example being commended to European governments as eminently worthy of their imitation.—A letter from Captain Buddington, the sailing-master of Captain Hall's vessel, the *Polaris*, dated at Upernavik, reports that the party were in good health and spirits; and that Mr. Chester, the first mate, had gone up the coast to bring down Hans Christian, Dr. Kane's Esquimaux hunter, who was to join the expedition.—Among the many works published by the United States government, or at its expense, there are few that exceed in intrinsic value, as well as in beauty, the volumes hitherto printed belonging to the series of reports made by Mr. Clarence King, at his geological and other explorations of the region along the fortieth parallel of latitude. This expedition is still occupied in carrying out the work assigned to it by the engineer department of the army, while reports are now being made of such portions of the work as have been completed. It is nearly a year since the volume upon the mining industry of the Sierra Nevada and other mineral regions of the West was published, as prepared mainly by Mr. J. D. Hague (one of Mr. King's assistants), but including articles by Mr. King himself, and other members of the corps. This was accompanied by a large atlas of plates, and contained full details of all the methods of metallurgical operations and manipulations, together with drawings of machinery, plans of mines, sketches of mining geology, &c. This book has been received with great favour everywhere, and has redounded greatly to the credit of the United States, first in authorising the research, and then in publishing the results in so superior a style. We now have to chronicle the appearance of another volume of the series—namely, the Botany, as prepared under the direction of Mr. Sereno Watson, the botanist of the expedition. This constitutes volume five of Mr. King's reports, and number eighteen of the professional papers of the engineer department of the army. The work embraces a report upon the geography, meteorology, and physics of the region explored as connected with the general botany of the country, catalogues of the known plants investigated, descriptions of new genera and species, and various appendices; these accompanied by forty plates of new or rare species. Another volume of the series is now in press, and will include the zoological portion, as furnished by Mr. Robert Ridgway. This will probably appear in the course of a few months.—The scientific tendency of the age, manifested in the continual springing up of new associations in different parts of the country, receives an additional illustration in the estabiishment of the Natural History Society of Marquette, Michigan, whtch was organised during the month of December, under the presidency of Dr. Hewitt.

* Communicated by the Scientific Editor of *Harper's Weekly*.

ON THE CARPAL AND TARSAL BONES OF BIRDS *

THE author stated that he had followed with great interest the work of Huxley, Cope, Morse, and others, in tracing out the ornithic characters in the Dinosauria. While following these relations he had noticed a marked difference in the characters of the carpus and tarsus of the two classes. It seemed strange that a group of bones so persistent in the reptiles as well as in the mammalia should be so obscure or wanting in birds. Owen objects to the term tarso-metatarse, as he believes the existence of a tarsus has not been demonstrated. W. K. Parker, in 1861, on the osteology of Balæniceps, questions if the lower articular portion of the tibia is not the homologue of the mammalian astragalus and not an epiphysis. Gegenbaur has now shown that in one stage of the young bird there is a proximal tarsal ossicle, and a distal tarsal ossicle, the first one anchylosing with the tibia, the distal one likewise anchylosing with the metatarse. Thus, the term tarso-metatarse is quite proper. While this was a great step toward a proper understanding of these parts, Mr. Morse believed that a nearer relation would be found in the discovery of another proximal tarsal bone. In those reptiles he had examined, whatever the number of tarsal bones, there were always in the proximal series one corresponding to the tibia, and another corresponding to the fibula. He had found this feature in birds. In studying the embryos of the eave swallow, bank swallow, king bird, sand piper, blackbird, cow blackbird, bluebird, chirping sparrow, yellow warbler, and Wilson's thrush, he had found three distinct tarsal bones, two in the proximal series answering to the tibia and fibula, and one in the distal series. The first two early anchylose, and present an hour-glass-shaped articular surface as Prof. Cope has described in the astragalus of Lælaps. The final anchylosis of these conjoined ossicles with the tibia, formed the bicondylar trochlea so peculiar to the distal end of a bird's tibia. The distal tarsal ossicle became united with the proximal ends of the metatarse, as has been shown. In the carpus he had found four perfectly distinct ossicles, the distal carpal bones becoming united to the base of the mid and outer metacarpals, the other two remaining free, though the ulnar carpal in some cases anchylosed with the ulna. In the king bird and yellow warbler, he had found a fifth carpal on the radial side.

* Abstract of paper by Prof. E. S. Morse, read at the Indianapolis meeting of the American Association for the Advancement of Science. Reprinted from the *American Naturalist*.

SCIENTIFIC SERIALS

THE *Journal of Anatomy and Physiology*, Second series. No. ix., November 1871.—The first article in this number is by Prof. Humphry, "On the Anatomy of the Muscles and Nerves of *Cryptobranchus Japonicus*," an animal which has been only rarely dissected. The muscular system presents no points of great peculiarity or interest, resembling very closely that of other *Urodela*. With respect to the nerves, no trace of the third, fourth, or sixth cranial could be found in either orbit, though the third and fourth, both of very small size, were found in the cranial cavity; previous dissectors had described the sixth as a

branch from the fifth in the orbit, but this could not be found in the present specimen. The three divisions of the fifth cranial nerve were distinct, but the ophthalmic and supra maxillary left the skull by a common foramen. The vagus gave off branches answering to the spinal accessory, and also a large lateral nerve which ran back along the body, giving off no branches until it reached the great lateral muscles of the tail, and in that differing from the corresponding nerve of fishes. The spinal nerves resembled in most points those of man very closely, the brachial and crural plexuses were, however, much more simple, which Prof. Humphry thinks is associated with a less perfect specialisation of the action of the limb muscles; and below knee and elbow the course of the nerve trunks in the fore and hind limbs was almost identical.—The next paper is by Prof. Flower, "On the composition of the Carpus of the Dog." The os centrale had previously never been recognised in Carnivora, and both Cuvier and Owen regarded it, in those animals in which it is present, as a dismemberment of some element of the carpus; Gegenbaur, however, regarded it as itself a true carpal element, though never able to discover the state of things in those cases in which it was absent. However, in the skeleton of a dog six weeks old, Prof. Flower finds that the so-called scapholunar bone consists of three distinct pieces, viz., a distinct scaphoid and lunar, and a third piece evidently answering to the os centrale; thus confirming the view that the latter is a true primitive carpal element.—Dr. Messenger Bradley gives an account of the brain of an idiot, who during life could taste and hear well, and could repeat a few words in a parrot-like manner, but was congenitally blind, and never recognised any one, or, although not paralysed, made any attempt at locomotion. His bones were extremely fragile, fracturing invariably if he jerked a limb against the bed. The brain when removed weighed twenty-eight ounces: most of the fissures and lobes of the cerebrum were present, but (notwithstanding the small size of the hemispheres) were relatively small. The island of Reil was small and very simple. The corpora quadrigemina were very small, which is interesting, taken in connection with his blindness. The cerebellum was relatively large, the vermiform process was imperfect, the pyramid and short commissure entirely absent, and the left hemisphere considerably lighter than the right. The bones throughout the body when examined microscopically were found permeated with oil drops and granular matter, but when these were washed away normal bone structure could be made out, except an unusually large size of the Haversian canals.—Prof. Young contributes some facts in the anatomy of the shoulder girdle of birds, showing that the only movement of the humerus in flight which is anatomically possible, is that in a figure of eight.—A short description by Mr. Watson, of the digestive, circulatory, and respiratory organs of the Indian elephant, follows.—The action of the chlorides of platinum, iridium, and palladium when introduced into the blood of dogs is the subject of an interesting paper by Dr. Blake, of San Francisco.—Prof. Turner describes the variations of nerves in the human body which he has lately met with, and then follows a paper by Prof. Struthers on the Great Fin Whale, the most interesting points being a careful account of the muscles of the fore-limb, helping to clear up some points as to the homologies of the bones; and the discovery, for the first time in this species, of a bony rudiment of the femur, though Prof. Flower had previously noticed a cartilaginous one.—Mr. Garrod gives some observations made on himself showing that the exposure of the nude body to a temperature below 70° F. causes a rise in the internal temperature of the body; which is greater the lower the temperature of the surrounding air down to 45°, the lowest point at which observations have been made. This he attributes to a contraction of the cutaneous vessels driving the blood inwards, and also lessening the conducting power of the skin. Exposure to a temperature of 70° causes no rise.—A detailed description of the anatomy of the Malayan Tapir, by Dr. Murie, and of the muscles and nerves of the chimpanzee and anubis, by Mr. Champneys, do not admit of a short abstract being given of either of them.—The Report of the Progress of Physiology, by Drs. Brunton and Ferrier, is very full, and contains short accounts of many matters of great interest. The anatomy report is postponed.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, January 24.—Mr. Joseph Prestwich, F.R.S., president, in the chair.—The following communications were read:—(1) "On the Foraminifera of the Family Rotalinæ (Carpenter) found in the Cretaceous Formations, with Notes on their Tertiary and Recent Representatives," by Prof. T. Rupert Jones, and Mr. W. K. Parker, F.R.S. The authors enumerated the Rotalinæ which have been found in the Cretaceous rocks of Europe, and showed by tabular synopses the range of the species and notable varieties in the different formations of the Cretaceous system. For the comparison of the Tertiary Rotalinæ with those of the Cretaceous period the following Tertiary formations were selected:—the Kessenberg beds in the Northern Alps, the Paris Tertiaries, the London Clay, the Tertiary beds of the Vienna Basin, and the English and Antwerp Crags. The authors also enumerated the recent Foraminifera of the Atlantic Ocean. The authors stated that of *Planorbulina* several species and important varieties of the compact, conical form occur throughout the Cretaceous series, and that those of the Nautiloid group are still more abundant. The plano-convex forms are represented throughout the series by *P.* (*Truncatulina*) *lobatula*; but the flat concentric growths had not yet come in. *Planorbulina* extends down to the Lias and Trias. *Pulvinulina repanda* is feebly represented in the uppermost Chalk, but forms of the "*Menardii*" group abound throughout the series. Species of the "*elegans*" group are peculiarly characteristic of the Gault, and some of the "*Schreibersii*" group are scattered throughout. These two groups extend far back in the Secondary period. The typical *Rotalia Beccarii* is not a Cretaceous form, but the nearly allied *R. umbilicata* is common. *Tinoporus* and *Patellina* occur at several stages; *Calcarina* only in the Upper Chalk. The above-mentioned types are for the most part still living, but the "*auricula*" group of *Pulvinulina* is wanting in the Cretaceous series, as also are *Spirillina* and *Cymbalopora*, except that the latter occurs in the Maestricht Chalk. *Discorbina* and *Calcarina* make their first appearance in the uppermost Chalk. The chief distinction between the Cretaceous and the existing Rotalinæ was said to consist in the progressively increasing number of modifications. The authors concluded by disputing the propriety of regarding the Atlantic ooze as homologous with the Chalk. The president suggested the possibility of some of the minute Foraminifera being transported fossils derived from earlier beds than those in which they are now found. Dr. Carpenter observed that the mode of examination to be adopted with Foraminifera was different in character from that which was applicable to higher organisms. The range in variation was so great that an imperfect examination of Nummulites had sufficed to make M. d'Archiac reduce the number of species by one half; and all the speaker's subsequent studies had impressed upon him the variety in form and in sculpturing of surface on individuals of the same species. When out of some thousands of specimens of *Operculina*, say, a dozen pronounced forms had been selected, such as by themselves seemed well marked and distinct, it might turn out that after all there was but one species present with intermediate varieties connecting all these different forms. He thought the same held good with Rotalinæ, and that there were osculant forms which might connect, not only the species, but even the genera into which they had been subdivided. This fact had an important bearing on their genetic succession, especially as it appeared that some of the best-marked types were due to the conditions under which they lived. The temperature in tropical seas differed in accordance with the depth so much, that when 2,000 fathoms were reached a degree of cold was attained such as was to be found in high latitudes; and in consequence the deep-sea forms in tropical latitudes assumed the dwarfed character of those in shallower seas and nearer the pole. He suggested caution in drawing inferences from forms so subject to modification, both spontaneous and due to the depth of the sea, especially as connected with abundance of food. Prof. Ramsay remarked that geologists would be pleased to find Foraminifera exhibiting, like other organisms, changes in some degree connected with the lapse of time. These low forms, however, could hardly afford criteria for judging of the age of geological formations, while at the same time such ample means were afforded by the higher organisms for coming to a conclusion. He cited, for instance, the Cephalopoda, as proving how different were the more important forms of marine life in Cretaceous times from those of the present day. He thought that no one who had thoroughly studied the forms of ancient life would be led to ignore the differences they presented, as a whole, from those now existing.—Prof. Jones, in reply, observed that the question of whether the Foraminifera in a given bed were derived or not was to be solved partly by their condition and partly by their relative proportions, but that in most

cases sufficient data existed on which to found a judgment. He agreed with Dr. Carpenter as to the existence of extreme modifications, and it had been his object to ignore such as seem due to ordinary and local causes, and to group the forms in accordance with certain characteristics. Whether the classification was right or wrong, it was necessary, for the sake of increasing knowledge, that fossils of this kind should be arranged in groups; and whether these were to be regarded as truly generic was a minor consideration. In forming their types and subtypes the authors had carefully avoided minor differences; but they still thought that the modifications which were capable of being substantiated were significant of a great lapse of time. A variation once established never returned completely to the original type. In *Globigerina*, he stated that there were in Cretaceous times 8 forms, in Tertiary 12, at the present time 14; and these modifications he regarded as equivalent to the specific changes in higher animals.—(2.) "On the Infralias in Yorkshire," by the Rev. J. F. Blake. The Infralias, *i.e.*, the zones of *Ammonites planorbis* and *Am. angulatus*, have been recorded hitherto only from Redcar, to the beds at which place the author referred; but the chief object of the paper was to describe some sections at Cliff, near Market Weighton, where these and lower beds are well exposed, and have yielded a numerous suite of fossils. He considered, however, that these beds did not belong to the typical Yorkshire area, but were the thin end of the series which stretches across England. He supposed there had been a barrier in Carboniferous times, which had separated the coal-fields of Yorkshire and Durham, prevented the continuity of the Permian beds, and curved round the secondary rocks to the north of it, to form the real Yorkshire basin, while these beds at Cliff were immediately to the south of it. The sections described were six in number, the first pit yielding the great majority of the fossils, and the third showing best the succession of the beds. The fossils could be mostly identified with known forms, and showed a striking similarity to the Hettangian fauna. In all the clays of the Infralias Foraminifera were numerous and varied. The section in pit No. 3 showed, commencing at the top:—1. Stone bed with *Am. angulatus* (the fossiliferous bed of pit No. 1). 2. Thick clays, with bands of stone characterised by *Am. Johnstoni*. 3. One band of clay with *Am. planorbis*. 4. Thin-bedded stones and clays, some of them oyster-bands. 5. Clays without Foraminifera, and with impressions of *Anatina* (White Lias). The *Avicula contorta* series is not reached, nor are there any signs of the bone-bed, as the junction with the Keuper marls, which are found three miles off, is not seen. The paper was followed by references to the fossils mentioned, including the description of those that are considered new. Prof. Duncan remarked that English geologists had been backward in receiving the term Infralias, which he had suggested with respect to the Sutton Down beds some years ago, and the propriety of which was shown by the term having been applied to the same beds by French geologists at a still earlier period. As to the White Lias, he regarded it as a mere local deposit, not to be found out of England. He traced the existence of the Infralias from Luxembourg through France into South Wales, where corals were abundant. In Yorkshire, though one fine coral had been found, the Ammonites seemed to point to a difference in condition. Mr. Hughes remarked that the lithological character of the beds, as described by the author, did not agree with that of the Infralias in the S.W. of England or the N. of Italy, and that the palæontological evidence which had been laid before the Society did not confirm the view that they were Infralias, the author having especially noticed the absence of *Avicula contorta* where he expected that it should occur. Also, by reference to the author's section, Mr. Hughes pointed out that below what he described as Infralias he drew other beds which were not Trias, the author having explained that some beds which had been called Trias were only stained beds of Liassic age.—The Rev. J. F. Blake, in reply, acknowledged the difference between the Yorkshire section and those of the neighbourhood of Bath, but insisted on the similarity of the fossils.

Linnean Society, February 1.—Dr. J. D. Hooker, F.R.S., vice-president, in the chair. "On the Classification and Distribution of Compositæ," by G. Bentham, F.R.S., president. The order Compositæ, or Synantheræ, is remarkable, not only from its enormous size, but from its extremely natural and well-marked characters, there being not a single instance in which it is doubtful whether a plant should be referred to this order or not. All the essential characters of the androecium, pistil, structure of the fruit, structure of the seed, and inflorescence are absolutely constant throughout the 10,000 species comprised within it. This very fact, however, renders its sub-division into tribes and genera a matter of extreme difficulty, the systematist being compelled to adopt characters as generic, which, in other orders, would hardly be considered as even specific. After briefly reviewing the labours of Linnæus, Jussieu, Cassini, Don, Lessing, Schultz Bipontinus, De Candolle, Asa Gray, Hildebrand, Delpino, and other botanists who have paid special attention to this subject, the author spoke of the special opportunities he had had in the preparation of the "Genera Plantarum," in conjunction with Dr. Hooker, for examining himself nearly the whole of the genera comprised within the limits of the order, and then proceeded to the consideration of the value of the several characters available for the distinction of genera and tribes: 1. Sexual differences in the florets contained in the capitulum, which may either have both the male and the female organs perfect, or the female organs sterile in the central florets, or the male organs or both sets abortive or wanting in the marginal florets. These distinctions formed the basis of Linnæus's order, but have been considered of less and less importance by subsequent writers. The author finds them sometimes constant in large genera or subtribes, sometimes variable in closely-allied species. 2. Di- and tri-morphism, very rare in Compositæ, except as connected with sexual differences. 3. Differences in the pistil. The ovary and ovule are uniform throughout the order, and the style nearly so when it acts only as the female organ; but the modifications of its extremity, in so far as they are destined to sweep the pollen out of the anther tube, supply some of the most important differential characters for genera, and even for tribes. These characters, first brought forward by Cassini, formed the basis of Lessing's and De Candolle's classifications, but have in many instances been too implicitly relied upon. 4. Differences in the fruit and its pappus. The structure of the fruit and seed is uniform in the order, but the outer shape of the achene and its ribs, angles, or wings have been made much use of, especially by Schultz Bipontinus, and the pappus presents such infinite variations so easily observed that it has been applied to the distinction of innumerable genera often very artificial. 5. Differences in the androecium. The male organs are as uniform in their structure, number, insertion, and relative position as other essential parts of the flower, but appendages often observed at the base of the anthers, usually called tails, having no apparent function to perform, are, however, so constant in their presence or absence, as to supply most valuable tribual characters. 6. Differences in the corolla, which, though uniform as to essential points in its structure and position, shows modifications of the limb or lamina, which are of great importance as distinctive characters: (1) the pentamerous ligula of Cichoraceæ truncate at the end with five short equal teeth; (2) the regular tubular corolla, either slender and equal to the end, or expanded upwards into an equally toothed or lobed limb; (3) the bilabiate corolla, in which the two inner lobes forming the inner lip are usually shorter or smaller or more deeply divided than the three outer; and (4) the trimerous ligulate corolla forming the ray of most heterogamous capitula, in which the two inner lobes are deficient or rarely represented by minute slender teeth. 7. Differences in the calyx. This organ is so reduced as to supply no characters except such as are derived from the ribs and pappus of the ripe fruit, and are considered under that head. 8. Differences in the ultimate inflorescence and bracts, *i.e.*, in the capitulum, its involucre, receptacle, and paleæ, the modifications of which acquire a great degree of constancy and consequent importance in the distinction of genera or even of tribes, as might be expected from the increased functions imposed upon them by the abortion of the calyx. 9. Differences in foliage. There is no type of foliage in Compositæ which may not be found in several other orders, although the leaves are never compound with articulate leaflets, but the opposition or alternation of the leaves are of great assistance as characters of some of the tribes, differences in habit, stature, and general inflorescence, rarely giving absolute characters excepting where numerous capitula are crowded on a common receptacle into a kind of compound capitulum. 10. Differences in geographical distribution, which, if considered in as far as it may be attributed to origin independently of climatological considerations and modern colonisations, may be of great use in determining natural genera. In the portion of the paper now laid before the society and read in abstract the author enters into considerable detail with regard to the above several series of available characters, and concludes with a summary of the thirteen tribes which he has adopted for the "Genera Plantarum,"

reserving for a future meeting the second part relating to the geographical distribution of the order.

Chemical Society, February 1.—Dr. Frankland, F.R.S., president, in the chair.—When the ordinary business of the Society had been transacted, a note "On the crystalline principle of Barbadoes aloes" was read by the author, Dr. W. A. Tilden, in which he described anew derivative of aloïn. This is chloraloïn, which crystallises from boiling-water in yellow silky needles, bearing considerable resemblance to the corresponding bromime compound bromaloïn.—Dr. C. R. A. Wright then read an elaborate paper "On the relations between the atomic hypothesis and the condensed symbolic expression of chemical facts and changes known as dissected (structural) formulæ," in the first part of which he showed the possibility of expressing chemical facts without reference to the atomic theory; and in the second examined how far these facts could be accounted for by the atomic hypothesis. A long and very interesting discussion ensued, in which some of the speakers advocated the employment of the atomic theory to a greater or less extent, as promoting the progress of chemical science, whilst others desired its abolition.

PARIS

Academy of Sciences, January 29.—A note by M. J. Boussinesq on the integration of the equation with partial derivatives of the isostatic cylinders produced in a homogeneous and ductile solid, was presented by M. de Saint-Venant.—M. A. Ledieu read a note containing objections to the marine gyroscope proposed by M. E. Dubois at the meeting of January 22.—M. J. A. Serret presented a memoir on the pendulum of Léon Foucault.—M. Jamin presented a note by MM. A. Cornu and E. Mercadier on melodic musical intervals, confirmatory of their previous results.—A note by M. J. Violle on the induction currents produced in the polar masses of Foucault's apparatus was read.—M. Daubrée presented a note by M. Peslin on the bands of the solar spectrum, in which the author indicates a very simple relation between the most important bands.—M. Delaunay communicated a note by M. Fron on the prevision of certain earthquakes.—A further note by Father Secchi, on the temperature of the sun, was read, in which the author still maintains his opinion as to the enormous temperature of that body.—A note by M. E. Liais on absolute meridian observations in the low latitudes of the southern hemisphere was read, with especial reference to the observatory of Rio de Janeiro. Upon this paper MM. Le Verrier and Laugier made some remarks.—M. S. Meunier communicated a paper on the methods which concur in demonstrating the stratigraphy of Meteorites.—M. Delaunay made some remarks upon the note presented to the last meeting of the Academy by M. Renou with regard to the Meteorological Manual of the Paris Observatory for 1872, and presented to the Academy the first number of a monthly Meteorological Bulletin published by the Observatory.—M. P. Thenard presented some observations upon the preservation of wines by heating, in connection with a recent note by M. Balard. He claimed the discovery of the action of heat upon wines for MM. Appert and de Verguette.—M. Chevreul read a note upon the investigations upon dyeing carried out by M. Paul Havrez; MM. Monteféore-Levi and Kunzel presented a reply to a claim of priority made by MM. de Ruolz and Fontenay with respect to the discovery of phosphorus bronze and its employment in the manufacture of ordnance; M. Wurtz presented a note by M. L. C. Coppet on the supersaturation of the solution of chloride of sodium; and M. C. Bernard communicated a note on the analysis of the gases of the blood by MM. A. Estor and C. Saint-Pierre.—The lively discussion commenced two or three meetings ago on fermentation and heterogeny was reopened by a long paper on fermentations by M. E. Fremy, and continued by MM. Balard and Wurtz.—M. C. Martins read an important paper on the normal position of the hand in man and in the vertebrate series.

BOOKS RECEIVED

English.—The Highlands of Central India: Capt. J. Forsyth (Longmans).—Rude Stone Monuments in all Countries: J. Fergusson (J. Murray).—Hints and Facts on the Origin of Man: P. Melia (Longmans).—A Dictionary of Chemistry, Supplement: H. Watts (Longmans).—Gandeamus: Humorous Poems translated from the German by C. G. Leland (Trübner).—Geometrical Conic Sections: J. S. Jackson (Macmillans).—Arithmetic in Theory and Practice: J. Brook Smith (Macmillans).—Worms, a Series of Lectures on Practical Helminthology: Dr. T. S. Cobbold (Churchill).

Foreign.—Medizinische Jahrbücher, 1871; Heft 4: S. Stricker.—Mittheilungen der Naturforschenden Gesellschaft in Berne, 1870.—Nouveaux Mémoires de la Société Helvétique des Sciences Naturelles en Berne, Vol. xxiv.—Beiträge zur Kritik der Darwinsche Lehre: Dr. E. Askenasy.

DIARY

THURSDAY, February 8.

Royal Society, at 8.30.—Experiments concerning the Evolution of Life from Lifeless Matter: W. N. Hartley.—Experiments on the Directive Power of Large Steel Magnets, of Bars of Magnetised Soft Iron, and of Galvanic Coils, in their Action on External Small Magnets; with Appendix, containing an Investigation of the Attraction of a Galvanic Coil on a Small Magnetic Mass: James Stuart, M.A.

Society of Antiquaries, 8.30.—On the Hunnebedden of Holland: A. W. Franks.—On an Inscribed Saxon Knife; J. Evans, F.R.S.—On a Sword Found in Spain: Col. Lane Fox.

Mathematical Society, at 8.—On the Factors of the Differences of Powers, with especial reference to a theorem of Fermat's: W. Barrett Davis.—On an Algebraical Form and the Geometry of its dual connection with a polygon, plane, or spherical: T. Cotterill.

FRIDAY, February 9.

Astronomical Society, at 3.—Anniversary Meeting.

Royal Institution, at 3.—On Sleep: Prof. Humphry, F.R.S.

Quekett Microscopical Club, at 8.

SATURDAY, February 10.

Royal Institution, at 3.—On the Theatre in Shakespeare's Time: Wm. B. Donne.

SUNDAY, February 11.

Sunday Lecture Society, at 4.—On the Skeleton of the Higher Vertebrates: Dr. T. S. Cobbold, F.R.S.

MONDAY, February 12.

Geographical Society, at 8.30.

London Institution, at 4.—Elementary Chemistry: Prof. Odling, F.R.S.

TUESDAY, February 13.

Royal Institution, at 3.—On the Circulatory and Nervous Systems: Dr. W. Rutherford, F.R.S.E.

Photographic Society, at 8.—Anniversary Meeting.—On a Comparison of the Different Modes of Plate Cleaning: Dr Anthony. The Nièpce de St. Victor specimens will be shown.

WEDNESDAY, February 14.

Society of Arts, at 8.—On the Study of Economic Botany: J. Collins.

THURSDAY, February 15.

Royal Institution, at 3.—On the Chemistry of Alkalies and Alkali Manufacture; Prof. Odling, F.R.S.

Royal Society, at 8.30.

Society of Antiquaries, at 8.30.

Linnean Society, at 8.—On a Chinese Artichoke Gall: A. Müller, F.L.S.—On the Habits, Structure, &c., of the three-banded Armadillo: Dr. J. Murie, F.L.S.—Comparative Geographical Distribution of Butterflies and Birds: W. F. Kirby.

Chemical Society, at 8.

CONTENTS

NOTICE

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