THURSDAY, MARCH 15, 1883

THE ZOOLOGICAL STATION IN NAPLES

THERE are few of those interested in biological studies who are not more or less familiar with the history and character of the great international laboratory on the shore of the Bay of Naples, which has had so profound an influence on the progress of zoology in the last nine years; scarcely a volume belonging to recent zoological literature, British or foreign, can be taken up, but the acknowledgment of indebtedness to the resources of the Naples station comes under the eye; the publications of the station are on the shelves of most scientific libraries; and many accounts of its organisation have appeared from time to time in scientific periodicals and even in the daily press. But the institution is much too interesting a topic of discussion to be easily exhausted; it is constantly developing and exhibiting new stages of existence. There is soon to be added a new department that of comparative physiology, the work of which will be carried on in a separate laboratory; and on the eve of an expansion so considerable, it is natural to reflect on the work the station has already accomplished, its present state of activity, and the probabilities of its future.

In no branch of zoological science has such rapid and important progress been made in recent years as in embryology, and the investigations into the development of marine forms of all classes by which this progress has been chiefly effected, have been in great part the result of the special facilities which the resources of the Naples station offer for this kind of research. The brilliant career of the lamented Francis Balfour was begun while he occupied, on the opening of the station in 1874, the table rented by Cambridge University. His stay on this occasion lasted from February to June, and resulted in the publication of his first paper, "On the Development of Elasmobranchs," in the *Quarterly Journal of Microscopical Science*. The material for the researches which he continued to carry on at Cambridge on his return was sent from the station. In 1875 he again spent some months at Naples, and again published the results of his work in the same *Quarterly Journal*, this time under the title "A Comparison of the Early Stages in the Development of Vertebrates." The following year he did not visit the station, but in 1877 he investigated there the spinal nerves of Amphioxus, and added to his work on Elasmobranchian embryology. These studies appeared in the *Journal of Anatomy and Physiology*, vols. x. and xi. In the preface to his "Monograph on the Development of Elasmobranchs," which, published in 1878, was at once recognised by all biologists as a classical work, Balfour gratefully acknowledges how much his researches owed to the resources of the zoological station and the support of its *personnel*. It is unnecessary to dilate here on the importance of Balfour's work; the significance of the discoveries which he made, such as the openings of the renal organs into the body cavity in Selachians as in Annelids, the epiblastic origin of the sympathetic system, the history of the blastopore in vertebrates, and its relation to the medullary canal, the head cavities, &c., and the masterly way in which he applied the results of his observations to the solution of the great problems of vertebrate morphology, have given him a place among those whose names mark epochs in the progress of science.

Another English name connected with work in the field of vertebrate embryology which does honour to the Naples station is that of Mr. Milnes Marshall, who has more than once occupied the British Association table. Much of our knowledge of the development of Salpa, the excentric relation of the vertebrates, is due to the work in the station of Professors Salensky and Todaro.

Molluscan embryology has benefited by the existence of the station through the work of Prof. Lankester and the Russian embryologist, Dr. Bobretzky. The former carried on researches in the laboratory in the spring of 1874, and obtained many of the important results which are embodied in his memoir "On the Development of Cephalopoda" (*Quart. Journ. Mic. Sci.* vol. xv.), and his paper "On the Development of Mollusca" (*Phil. Trans.* 1875). Dr. Bobretzky of Kiev occupied the Russian table in 1874, and applied the methods of technical histology to the study of the ova of various Gasteropods, Nassa, Fusus, &c., and of Loligo and other Cephalopods. His Russian memoir on the latter (Moscow, 1877) contains the most complete and reliable series of figures we have of the anatomy of Cephalopod embryos.

In the embryology of sponges, Prof. Oscar Schmidt of Strassburg has published the results of important researches carried on in the station in the years 1875 and 1877. Prof. Selenka of Erlangen worked out the development of various Holothuria at the Bavarian table in 1875, and of Echinidæ in 1879. The work of Dr. Carpenter on the development of Antedon (*Proc. Roy. Soc.* 1876) was done at the British Association table, and the contributions of Dr. Goette to the same subject are based on studies made in the station in 1875. One of the best known of recent studies in development which have proceeded from the station is that of Dr. Spengel, on Bonellia, published in 1879.

Leaving works of a strictly embryological character, we will mention some of the principal contributions to general morphology, which have taken their origin in the station. Prof. Grenacher's great work on the eyes of Arthropods, which forms one of the chief recent additions to our knowledge of the class, is based on researches begun at the Mecklenburg table in 1876. Dr. Hubrecht's researches on Nemertines were carried out at the Dutch table. The contributions to and confusions of Molluscan morphology, which we owe to Von Jhering, proceeded from work done in the station, and both are not without value in the progress towards truth. Dr. Spengel's important paper on the "Geruchsorgan der Mollusken" (*Zeitschr. f. wiss. Zool. Bot.* xxxv.), was produced while he was a member of the staff of the institution. The remarkable volume of the brothers Hertwig, "Die Actinien," describing a nervous system still existing in the primitive condition, was the result of an occupation of two of the German tables.

The honour of the discovery of Symbiosis in animals is shared by two zoologists, who both carried out their researches in the station, Mr. Geddes and Dr. Brandt; and the studies which the latter is still carrying on there have resulted in many other contributions to our knowledge of the Radiolarians.

The investigations of Von Koch into the relations of the skeleton in corals, Flemming's researches on the ova of Echinoderms, Metschnikoff's on Orthonectidæ, those of Dr. Vigelius on the anatomy of Cephalopoda, of Prof. Greef on Alciopidæ, are a few more examples of good work, of which some of the credit belongs to the station. Since the laboratory was opened more than 200 scientific workers have studied at its tables.

Besides this success which the institution has obtained as an international laboratory, it has also produced great results by its own individual activity. A vast amount of complete and careful work is devoted to the preparation of the series of monographs which commenced with the Ctenophoræ of Dr. Chun in 1880. Of these six have appeared—four zoological and two botanical—and a large number, embracing many important classes of animals, are far advanced towards completion. The Planarians, by Dr. Lang, will be received with interest on account of the discoveries and original views which his work has already produced. The Actiniæ are being worked out thoroughly, for the first time, by Dr. Andres. The Sponges, the Radiolarians, the Copepoda, and the Capitellidæ are also at present undergoing a complete study in the station, and two of the volumes already announced will treat of families of Algæ. An enterprise of such magnitude has never before been undertaken in the field of zoological investigation; only an organisation of the power and resources of the station at Naples could attempt it; an organisation which is able to offer to zoologists, of energy and zeal, unlimited material in the living condition, unlimited leisure for work, and immunity from all distractions save some slight duties connected with the routine of the laboratory.

The other two publications of the station are of a less colossal character. The *Mittheilungen* was begun in 1879, for the sake of publishing the numerous discoveries and new views which result from the work of the staff occupied with the "Fauna and Flora," or from the researches of those occupying the rented tables. The circulation has already reached 400 copies, and the few volumes which have appeared constitute a valuable addition to the literature of biology. In its pages are described the new processes in the *technique* of microscopical work which have been invented in the station, one of which, the method of preparing series of sections, devised by Dr. Giestrecht, and now used in every laboratory in Europe, is an improvement whose importance it is impossible to estimate too highly.

The object of the *Zoologischer Jahresbericht* was to supply a bibliographical report, which should not only give a list of published works but a *résumé* of the matter contained in each, and which should give perfect facilities for reference. The latter object is attained by means of two indices—one of the names of authors, the other of subjects. The English *Zoological Record* and the report of the *Archiv für Naturgeschichte* are devoted chiefly to systematic zoology; in the *Jahresbericht* every publication on anatomy, embryology, morphology, or physiology, is catalogued and summarised.

In contrast with the activity exhibited by the station in the directions which we have hitherto considered, activity whose results are as conspicuous as they are important, is the unobtrusive work of the department presided over by the energetic conservator, Salvatore Lo Bianco,—the department for the preservation and distribution of marine animals. All the material procured by the expeditions of the two steam launches, and the smaller boats belonging to the station, or by purchase from Neapolitan fishermen, passes first into the control of this department. Whatever is needed by the various occupants of the work-tables and by the scientific staff is selected and allotted according to applications made from day to day. The rest is either put into the tanks of the public aquarium, or preserved. Marvellous progress has been made in the art of preserving delicate and sensitive creatures in their naturally extended condition, and inland laboratories can be provided with specimens of Alcyonaria, Zoantharia, Medusæ, Ctenophora, Annelids, &c., which show the form if not the colour of the living animal, and in which all the organs are in a perfect condition for anatomical and generally even histological study.

There is scarcely a biological laboratory in Europe which has not had recourse to the preparing department of the Naples station in order to procure material for investigation or for teaching purposes. An example of the work of the department is to be exhibited in the approaching International Fisheries Exhibition—a most beautiful collection of preparations is now in the station, ready to be sent to London.

In connection with this department arrangements have been made with the naval authorities of Germany and Italy, by means of which an officer is sent from time to time to the station to learn the methods of obtaining and treating marine creatures for the purpose of scientific study; so that the cruises of war-ships in remote seas may contribute to valuable scientific results when each has an officer on board who understands what is of zoological interest and how it should be preserved.

In conclusion it will be of interest to give a few details concerning the finances and arrangements of the station. The annual income is between 5000*l.* and 6000*l.*, of which 1200*l.* is derived from the public aquarium, 1600*l.* from the rented tables, about 800*l.* from the sale of the publications, including 260 annual subscriptions of 50*s.* each for the monographs, 600*l.* from the preparation department, and 1500*l.* is the amount of the German Government subsidy.

The total number of those in the permanent service of the station is thirty-seven, of which eight comprise the scientific staff, and the rest are made up by the engineers under the direction of Mr. Petersen, the fishermen, and the conservator and his assistants. The number of tables at present rented is twenty-one, but the station has space for thirty. At the beginning only seven tables were taken, two each by Prussia, England, and Italy, and one by Holland. The School of Biology at Cambridge has derived much support and benefit from its connection with the station, and the taking of a table by Oxford would probably give to zoological studies there an impetus which is much needed. Of the few zoologists which Oxford produces, some have already had recourse to the British Association table. It is probable that some one of the many rich institutions in America will soon take a table for the use of American zoologists, many of whom, imperfectly acquainted with the organisation of the station, and therefore unaware that no table can be occupied unless taken either by a corporation or a private individual for a whole year, have applied for permission to work there. Last year Mr. Whitman, whose observations on the development of Clepsine are well known, received this permission under special circumstances by the courtesy of the staff, and carried out some excellent researches on Dicæmidæ, which are published in the last number of the *Mittheilungen*. Recently an increased number of similar applications have been received from American zoologists.

In speaking of the arrangements of the station, the perfection of the organisation for the supply of material, by means of the dredging and fishing of the gulf, cannot be too warmly praised or admired. Except in continuously bad weather, the beautiful and wonderful creatures comprising the rich Mediterranean fauna are brought in to the station in an abundance that is perfectly bewildering to a zoologist on his first visit. The possession of two steam launches, the larger of which, the *Johannes Müller*, was given by the Berlin Academy in 1877, while the smaller was purchased subsequently, gives to the fishing department the facilities for rapid locomotion and transport, without which such abundance and perfect condition of the living material could not be obtained; especially as some of the most fruitful localities are widely separated, and a great many of the creatures, including all pelagic forms, are of extreme sensitiveness and delicacy.

The zoological station, although only nine years have passed since its first opening, has become a necessity for the progress of zoology; its international character enables every country to contribute to its support and share in the benefits derived from it; it is a great organisation by which forces of various kinds are brought together to aid in the attainment of one great object, the investigation of the facts and phenomena of marine life in all its diversities, and their explanation in accordance with the principles of evolution. The progress which is brought about by the work actually done in the station is not more important than the indirect influence it exerts in various ways; its example has produced similar enterprises in various parts of the world; the benefit of the experience it gains extends to other centres of scientific research, and other branches of biology than marine zoology, and by its own vitality and its influence on the zoologists who study at its tables it has done much to sustain and develop the great impulse which the genius of Darwin gave to zoology twenty-three years ago. J. T. CUNNINGHAM

EPPING FOREST

THE House of Commons divided last Monday afternoon upon the Chingford and High Beech Railway Bill. An amendment was proposed by Mr. Bryce, Chairman of the Commons Preservation Society, and was supported by Mr. Thorold Rogers, Sir H. J. Selwin-Ibbetson, who framed the Epping Forest Act of 1878, Mr. Fowler, Mr. Firth, Mr. T. C. Baring, Lord Eustace Cecil, Mr. Ritchie, Mr. James, Mr. Caine, and Mr. Waddy. As a fitting sequel to Mr. Meldola's paper, which we published last week, the result of the division, which was announced amidst cheers, was: For the second reading, 82; against it, 230; majority against the Bill, 148. It is to be hoped that this will be the last attempt to tamper with what Mr. Bryce justly described as "a priceless heritage of the people of London."

It is inevitable from the growth of our great towns that the student of Nature dwelling in their midst must go farther and farther afield for the objects of his study. It seems, moreover, that our science is at present inadequate to prevent the lethal influence of smoke and acrid fumes from dealing destruction to vegetation over a wide region outside the actual boundaries of these towns. The sanitary necessity of open spaces has been amply demonstrated; but it was not as a mere open space or people's park that Parliament allowed the Corporation of London to acquire Epping Forest in 1878.

The so-called rights of those who had inclosed the Forest, were overridden in order that an expanse of natural and, in some senses, primeval forest might be secured for the benefit of all classes of the public free from encroachment for ever. Parliament directed that it was to be preserved "in its natural condition as a forest," and conferred upon a Committee—composed of some members of that Corporation which holds the manorial rights, together with four resident gentlemen as Verderers, elected nominally by the commoners—the position of Conservators.

Unfortunately Common Councilmen seem to share the popular ignorance as to what constitutes the natural aspect of a forest. Many people believe a forest to be a large wood or plantation, and the Conservators seem to have been mainly actuated by fears lest visitors should get their feet wet or find the Forest less amusing than other suburban resorts. Draining and roadmaking have been their main tasks with a view to maintain the natural aspect the Forest wore for centuries, while during the five years they have been in office no attempt has been made at reafforesting the now unsightly fallows that the intruders had reduced into an arable condition. Pieces of artificial water have been constructed, mostly with outlines reminding one of the so-called Round Pond in Kensington Gardens; pleasure-boats have been licensed upon them at a rental estimated at over 200*l*. per annum; free displays of fireworks in connection with a huge tavern, shooting-galleries, and steam-roundabouts have been authorised as contributing to a truly ideal forest.

These steps have of course been taken with the idea that the Conservators had the power to act in the way they think best calculated to elevate and refine the working-classes; but they are diametrically opposed to the spirit of the Act of 1878, which did not aim at establishing a tea-garden or at pandering to the lowest tastes of any class of the community.

As is seen from Mr. Meldola's article, the Essex Field Club and other scientific societies have more than once protested against such mismanagement; but the Conservators had not yet filled up the full measure of their iniquities. They must promote a railway, if not a tramway as well.

English public opinion is beginning to awaken to the idea that we have now almost as many railways as are required for any purposes but providing fees for directors and engineers and feeding the jealousies of rival companies. In the present session of Parliament the railway companies have evinced in the Bills they are promoting a partiality for common land that would be remarkable were not the reason for it sufficiently obvious. Common land can be had cheap; for it is everybody's business to oppose its spoliation, and everybody's business is proverbially nobody's. It is to be hoped, however, that the knell of these schemes was sounded on Monday last, when the House of Commons, on the motion of leading men of both parties, rejected the Chingford and High Beech Extension Bill, promoted by the Corporation and the Great Eastern Railway, by an overwhelming majority.

The House was fully aware that the line then proposed by Sir Thomas Chambers and Lord Claud Hamilton was only the first section of a longer one which would ultimately surround the Forest, and that it was intended to serve at first mainly as a feeder to another large tavern. All lovers of nature will rejoice that the collecting ground of Edward Forster, the Doubledays, and thousands of London naturalists less known to fame, has been rescued from destruction.

Authorities inform us that lopping and smoke have reduced the number of lichens and insects even during the last twenty years, and Conservatorial draining may have a similar effect upon other groups of organisms, so that the help of a railway in the work of devastation is certainly not required.

It is to be hoped that the verdict of Parliament will show the Conservators that forest management has a scientific basis and that their powers are not unlimited. It is equally desirable that the public interested in the Forest will form some organisation for its protection from encroachment and mismanagement in the future, so as to relieve a scientific body such as the Essex Field Club, which has borne the chief labour of opposition, from a task which, from its political and litigious character, must necessarily be uncongenial.

G. S. BOULGER

PERRY'S "PRACTICAL MECHANICS"

Practical Mechanics. By John Perry, M.E. (London: Cassell, Petter, and Galpin, 1883.)

THIS book is one of a series of manuals now being published by Messrs. Cassell and Co., intended for the use of technical students, and claims, to quote the preface, "to put before non-mathematical readers a *method* of studying mechanics," which, if carefully followed, will supply "a mental training of a kind not inferior to that the belief in which retains in our schools the study of ancient classics and Euclid." A principal feature of the method consists in "proving" the various formulæ of mechanics by quantitative experiments. Of these many are described in the book, several of which, such as those relating to torsion and other stresses, &c., are carried on in many physical laboratories, and belong rather to physics than to mechanics. Another feature of the method more novel than the last is the gathering together of a few of the definitions and elementary theorems of mechanics, such as the parallelogram of forces, in a chapter at the end of the book called a glossary. Even then no formal proofs are given, probably because they are unnecessary, since on p. 2 we are told that the reader "cannot know the parallelogram of forces till he has proved the truth of the law half a dozen times experimentally with his own hands."

This kind of proof is very different from the evidence usually tendered for the fundamental laws of mechanics, but we must not forget the class of readers, entirely different as they seem to be from any we have ever encountered, for whom the book is intended. We are reminded of this on p. vii., when we are told that "the standpoint of an experienced workman in the nineteenth century is very different from that of an Alexandrian philosopher or of an English schoolboy, and many men who energetically begin the study of Euclid give it up after a year or two in disgust, because at the end they have only arrived at results which they knew experimentally long ago."

Thus the empire of the Greeks in geometry must give place to the supremacy of the intelligence of the working man, and even Euclid himself must fall from his high estate to be compared and contrasted with the modern schoolboy. But this latest born of time apparently possesses even higher powers. If made "to work in wood and metal," "to gain experience in the use of machines and use drawing instruments and scales," he will arrive at a condition in which "he may regard the 47th proposition of the First Book of Euclid as axiomatic," and "he may think the important propositions in the Sixth Book as easy to believe in as those in the First." Truly here at last has been found in geometry a royal road. But when Prof. Perry has raised our opinion of the modern schoolboy and working man to this high eminence we feel a rude shock on reading the second page of the book, when we discover that these rarely gifted, ideal beings, so favoured of the gods in geometry, may perhaps not be able to apply to a practical example a simple algebraical rule.

In reading the book, especially in its earlier chapters, we are struck by the want of logical arrangement and of strictness in the definitions, by the frequent use of terms which have not been previously defined, or not adequately defined, and of writing so careless in its style as frequently to become unintelligible. The theory of friction, in the limited extent to which alone it is given, is inserted piecemeal into parts of the two first chapters and into the glossary, and the ordinary laws are not explicitly given until nearly the end of the book, but in their place we have the loose statements, "friction is proportional to load," and "friction is a passive force, which always helps the weaker to produce a balance." The English of the last sentence is as curious in character as that of one on p. 13, "This rubbing is a very slow motion."

The doctrine of the conservation of energy or of the conversion of energy into heat is nowhere explicitly given, although the theory is assumed in numerous applications. Can it be that the modern schoolboy, duly equipped, is able not only to surpass Pythagoras by regarding the 47th proposition of Euclid as axiomatic, but that he has come to view the great physical theory as equally self-evident? It must be so; otherwise, having only been told of energy as the equivalent of mechanical work (p. 5), he would not understand the meaning of the obscure sentence—"Every experiment we can make shows that energy is indestructible, and consequently, if I give energy to a machine, and find that none remains in it, it must all have been given out by the machine."

We find the leading laws of hydrostatics inserted in a paragraph on water, which is included in the chapter on materials, fifty pages after the uniform transmission of fluid pressure has been assumed in the article on the hydraulic press, and we are told (*note*, p. 75) that a cubic foot of water possesses, "in virtue of the steadiness of the motion, pressure or potential energy," &c. On p. 74 "total pressure" is used for resultant pressure. Nowhere throughout the book is the theory of the centre of gravity given, or the name even defined, yet the author—to the chagrin of any student who believes it—does not hesitate on p. 142 to preface with the words "it is evident" an application o he usual formulæ defining the position of the centre of gravity to the case in hand. The term "radius of g ration" is used on p. 144, but not defined until p. 196. The statement that "velocity is the speed with which a body moves" reminds one of Lord Palmerston's definition of an archdeacon, and we wonder what kind of notion will be gained of the motion of a body in a curve by any one who is told in a definition of centrifugal force that, "if a body is compelled to move in a curved path, it exerts a force directed outwards from the centre." We have also the following as a definition of the pitch circle:—"Two spur wheels enter some distance into one another, and the circle on one which touches a circle on the other, the diameters of these circles being proportional to the numbers of teeth on the wheels, is called the pitch circle." Could even the common sense of high quality, postulated of the readers of the book, enable them to select, from the infinite number of pairs of circles satisfying the above conditions, those which represent the pitch circles required?

In the rule for the differential pulley block we are surprised to find that the movable pulley rises through the whole, instead of half, the difference of the amounts of rope uncoiled from the two pulleys in the upper block. On p. 30 it is said:—"In the study of the motion of a slide valve it is much too usual to assume that the piston's motion is what is shown in Fig. 18 as pure harmonic motion." How shall we reconcile this with the information we have already received on the previous page that Fig. 18 (a skeleton drawing of a crank and connecting rod) does not represent pure (why not "simple?") harmonic motion except when the connecting rod is infinitely long?

In the rule which is inserted on p. 46 to find M, the constant should be twice that given, or about 59,500. On p. 64 our powers of comprehension are baffled in endeavouring to attach a meaning to the assurance that "50 foot-pounds is the total energy stored up in the wire *in the shape of a strain*." (The italics are ours.) In the rule given in Art. 192—we presume for *perfectly* elastic bodies—the momentum communicated from the one body to the other is just twice that stated.

We are told (p. 193) that the motion of a point in the balance of a watch is very nearly pure harmonic, if we suppose the point to move in a straight line instead of a circle, but we confess that the advantage of so describing the motion is not apparent, nor should we be disposed to call the friction in a twisted wire fluid friction (p. 199) because the friction in this case, as in that of fluids moving slowly, is proportional to the velocity.

The long array of mistakes given above, which by no means exhausts our list, forms a very serious accusation against the author.

His book has much disappointed us, for although some of the chapters, such as those on shear and twist, beams, graphical statics, and spiral springs, treat in a simple manner subjects which in parts present some difficulty, yet the defects to which we have alluded are far too grave to be compensated by any excellence in particular parts of the work. In the earlier chapters especially, the author has failed in the fundamental excellences of book-writing, in logical arrangement and clearness and exactness of expression, in just those qualities in fact in which he would have been most successful if he had aimed at writing more from "the standpoint of an Alexandrian philosopher." J. F. MAIN

OUR BOOK SHELF

Der Norske nord-hass-expedition, 1876-1878. VIII. Zoologi, Mollusca. I. *Buccinidæ*, ved Herman Friele. Med 6 plancher og 1 kart. 4to. (Christiania: Gröndahl and Sons, 1882.)

I HAVE already, in the *Annals and Magazine of Natural History* for this month, given some account of the scientific expeditions which were made by the Norwegian Government during the years 1876, 1877, and 1878, to explore the sea-bed lying between the coasts of Western and Upper Norway and Iceland, Jan Mayen, and Spitzbergen; and I also noticed the series of publications which embody the result of these expeditions, including the present volume. I now propose to say a few more words on the subject of Herr Friele's work.

The great family of *Buccinum*, which is treated in it, is most perplexing in a taxonomical point of view; and its generic type, *Buccinum undatum*, is so unusually prolific and abundant, and consequently so variable, that no two conchologists agree as to the number of species belonging to it. In a short paper of mine on the northern species of *Buccinum*, which appeared in the *Annals* for December 1880, I ventured to consider as varieties of that species and of *B. grœnlandicum* (which is probably also a variety of the polymorphous *B. undatum*) no fewer than 25 other so-called species. Such amalgamation will doubtless not be admitted by many conchologists; but the examination and careful comparison of an immense number of specimens from all parts of the North Atlantic which have fallen under my examination, warrant me in forming the above opinion. If we were to substitute the German word "geste'lt" or form for species, subspecies, and varieties, it might perhaps be a more safe and convenient mode of definition; but naturalists are not yet prepared to change the time-honoured system of Linnean and Lamarckian classification.

Herr Friele's work and the other publications to which I have referred are written in excellent English, as well as in his native language. The descriptions of new species are in Latin, which is scarcely so well adapted as English or French for the terminology of natural history at the present time; although his descriptions are far superior to the barbarous if not illiterate productions of Reeve and some other modern conchologists. The distinctive characters of new species are for the most part given in the same order, so that the description of one species can be more easily compared with that of a congener. This is an important and nearly indispensable desideratum. One new genus (*Jumala*) is proposed, having *Fusus Turtoni* for its type; and it appears to be based on Prof. G. O. Sars's description of the odontophore or dentition. Ten species are also for the first time described and figured, viz. one of *Jumala*, seven of *Neptunea*, and two of *Buccinum*. I regret that I must disagree with my friend the author as to the number of genera (six) into which he has divided the northern species of *Buccinidæ*. I should be disposed to attach more value to the operculum than to the odontophore as a generic character. Nor can I accept all his new species. The species which he considers my *Fusus curtus* is very different from the *F. Sabini* of Gray, or the *F. togatus* and *F. Pfaffi* of Mörch (all enumerated by Friele as synonyms); and I regard the last-named three species as the *F. ebur* of Mörch and not as my *F. Sarsi.* However, notwithstanding any trifling errors, if they be errors, the work of Herr Friele is not only admirable and valuable, but is imbued with that scientific merit and modesty which are peculiar to our fellow-workers in Scandinavia; and we shall look forward with great interest to the continuation of his papers on the Mollusca of the Norwegian North-Sea Expedition.

J. GWYN JEFFREYS

Tables for the Use of Students and Beginners in Vegetable Histology. By D. P. Penhallow, B.S., late Professor of Chemistry and Botany in the Imperial College of Agriculture, Japan. (Boston, 1882.)

THIS little work by no means meets the expectations which its title arouses. The author states, indeed, in his preface that the scope of the work is purposely limited, but the limits are so narrow that the work will not be of much use to the student who has a competent teacher, and it will not be of any use to the beginner who is attempting the study of vegetable histology by himself. The book deals simply with the micro-chemistry of plants; the reagents are enumerated, as are also the various substances to be met with in the cells, but no attempt is made to give an account of the mode of application of the reagents for the detection of the substances, and in certain important cases (the chloriodide of zinc, for example) the mode of preparation of the reagent is not given. Not a word is said about imbedding, nor is any mention made of staining. The general mode of treatment of the subject is thoroughly unpractical. For example, silica is said to appear in plants "as a transparent deposit"; but every histologist knows that the silica in a cell-wall can only be made evident by incinerating with nitric acid.

The priority which the author claims can hardly be granted in view of the fact that Poulsen's valuable "Microchemie" has been in the hands of European histologists for several years. The selection of literature given at the end also betrays the author's want of acquaintance with his subject, inasmuch as no mention is made of such important works as Dippel's "Mikroskop" and De Bary's "Vergleichende Anatomie."

LETTERS TO THE EDITOR

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[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

The Matter of Space

IN his paper on "The Matter of Space," in NATURE, vol. xxvii. p. 349, Mr. Charles Morris has given us an excellent exposition, and, as I believe, in general a perfectly correct one, of the fundamental laws and properties of matter and motion. But as I have for some time been investigating the views which he describes with exactly the results and consequences at which he has arrived (excepting only in one material difference to which I will presently return), a little outline of the mathematical form which I found that the discussion of the subject could receive, and to which it was accordingly submitted in my examinations of its scope and contours, will aid readers of Mr. Morris's paper, perhaps, in attaching clear ideas to some of the expressions which he uses, and in thereby discussing and estimating very easily and fairly the positive truth, in general, or in a few points, of the paper's considerations, the just degree of reliability at all events, which the marvellous maze of internetted motions possesses, which he has most tersely and graphically, and at least in the main, as it appears to me, correctly and truthfully described.

Angular momentum, or (for a particle of unit mass) the rate of description of sectorial areas, is, like actual energy, a quantity of two dimensions in space; it is in fact the vector-product of (or the quadrilateral area between) the two radii of the particle's orbit and hodograph. Tractive momentum, or the product of the unit-particle's radius-vector and the resolved part of the particle's velocity *along* (instead of across) the radius-vector, is equally a quadratic product (but differently estimated) of the two foregoing orbit and hodograph radii. It is not the rate of description of *an area*, like angular momentum, but the time-rate of the square on the orbit-radius. The time-rates of each of these momenta are similar to them in space-relation, and are respectively angular moment or twirl (of a force-couple) and tractive moment or wrest (of a motor-couple). But if a small step of angle is the ratio of a circular-arc step (or of a small step along its tangent) to the circle's radius, this being numerical, a twirl's work through this small step of angle is similar in space-relation to the twirl itself and to its time-effect, or angular momentum.

The same similitude in space-relation will exist between a wrest, or motor-couple, and its time-effect (or tractive momentum), and its small step of work, if, in imitation of the practice for a twirl's or force-couple's action, a wrest's space-step is defined to be the ratio of the particle's *step along* the radius to the orbit-radius. This counterpart of angle-step may be called a traction-step; and it is the small percentage of elongation which the radius undergoes. If this construction is assumed, there ensues from it a close, and evidently significant, analogy between the time-rate of *orbit-radius* square (which denotes at once, in space-relation, a *motor*-couple and its time- and space-effects) and the *hodograph-radius* square (which expresses simultaneously in space-relation a *force*-couple and its time- and space-effects). Although the square of the hodograph-radius signifies the square of the material point's velocity, or its *directed* actual energy, I conceive that the square of the orbit-radius represents a square of undirected velocity, or an undirected energy of "higgledy piggledy" motion of the material point; and its time-rate is *a horse-power of* the point's quaquaversal, or undirected actual energy. Viewed in this light, twirls or force-couples and their time- and space-effects are all graphically synonymous with actual directed energy; but wrests or motor-couples and *their* time- and space-effects are all graphically synonymous with *horse-power* of *undirected* actual energy. For these latter quantities Mr. Morris uses indifferently the various words, "momentum," "heat momentum," "heat velocity," "heat," "motor energy," "heat energy," "heat vibration," "centrifugal energy," and "centrifugal or motor vigour," of a moving point; but while they are all, as he rightly opines, convertible quantities in their relation to graphic space, yet the theory of force-couples with which (*mutato nomine*) they are equally convertible in the same space, teaches us that a twirl-group falls mechanically, according to its association with time and angle, into three distinct divisions, of an action (the couple) and its time- and space-effects (angular momentum and accumulated work). It is so also with the motor-couple's graphic-space measure, "vigour." In proper combinations with time and traction-ratio[1] it becomes either an action or a kind of momentum or a form of work. But in discussing these new quantities' properties two maxims of construction and interpretation must be kept constantly in view.

In the first place, we must not expect a motor-couple (although it tends to alter ϕ) which endows a point with undirected horse-power, to tend to lengthen or shorten the point's radius-vector *in the same way* that a force would do. If by their actions motor-couples can *in any way* oppose the action of a force or force-couple, it must be, not by exerting force themselves, but by giving rise to force where they act. Now motor-couples can no more act intelligibly upon a single point (to range a radius's extremities towards or from each other) than a force-couple can (to turn a radius's two ends round each other). Hence motor-couples must produce force in a material point in virtue of the point's being an aggregation of material points, or in other words the appearance of force is a sign of the compositeness of the material point upon which it acts. *Per contra*, forces can produce force-couples, or

[1] The integral of traction-ratio, $\int d\phi = \int \frac{dr}{r} = \log \frac{r}{c} = \phi$; I identify with Rankine's "thermodynamic function" (for which he uses the same symbol, ϕ) usually termed "entropy" in works on thermodynamics.

if properly combined can balance them, on a collection of material points, if certain internal conditions (always including conservation of force-effects and conservation of twirl-effects) of the component points' mutual force and couple-actions on each other, which we call certain static relations of the system, are fulfilled; and then we have forces on such an aggregation either giving rise to or holding in check force-couples acting on it. But no combination of force-couples, on the other hand, can either produce in the system, or resist in it, the action of a single force.

Now as a motor-couple and its parts exert time-flow of one form of energy, they differ from a force couple and its parts in the same way that these differ from uniform rotation and translation; and as it happens that while rotations can combine on a system to produce translation, and not the opposite arrangement, and just the reverse of this relation prevails in force-couples and their forces, so we may infer that in a system of connected points motor-couples would have the opposite property to force-couples, and in combination together on the system, instead of being produced by, they would either wholly or partially produce, a form of resultant of the nature of a motor-couple part. This kind of resultant, too, will exert a tendency on the system as a whole, with equal and similar intensity at all its points. Such a combination of motor-couples on a body, therefore, will in general communicate to it by their conjunction, not horse-power of undirected actual energy in the same manner as a single couple would, but some or no resultant couple-part, and some or no resultant couple, just as a set of forces, (or rotations) applied to a body may yield a mixed resultant of a force and couple (or of a rotation and translation), the couple in one case and the translation in the other both taking effect upon the body as a whole, since each is quite devoid of any particular point of application in the body. This property, which we may reasonably assign to motor-couples, of furnishing in combinations on a group of material points a dual resultant in general, and the condition that they exert singly a time-flow of undirected energy, are together the first maxim to be kept in view in discussing their effects; for the double-resultant's nature, of a congregation of motor-couples, in general resembles that of a screw's motion, which is partly translative along and partly rotative round a polar axis. Along a given line through the system therefore this resultant acts jointly, partly as a wrest, or residual motor-couple, and partly as a couple-half, of whose nature and effects no attempt, in what precedes, has yet been made to give an explanation.

Although such views as these of matter and motion largely invite investigation, it is rather their conformity to observation and to such slender mathematical evidence as is derivable from the laws of graphic space than any rigid demonstration of their validity which has led me to put faith in them. Where time and entropy (which linear dilatation is above surmised to be) clasp and bind undirected energy in new ties of space, so singularly like but yet distinct from the well-known ones which regulate the transformations of directed energy, intrusion into the mathematical avenues of the problem is almost warded off by the obduracy of the new inquiry, and only scattered fields of cultivation, occurring ever and again along his road, assure the venturesome wanderer in the new tract that the course before him still always lies in habitable regions.

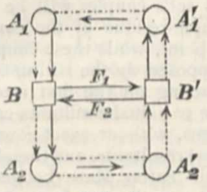
It would be presumptuous therefore to insist, until the mathematical field has been thoroughly explored, upon a preference of one view or hypothesis of motor-actions, as decidedly superior to another; but adopting, as Mr. Morris does, the opinion that the effects of motor-actions are conserved, and adding to this an assumption that in groups of points subjected to them the mutual conservation may not be (as it always is among the mechanical connecting forces of every piece of ponderable matter) perfect and complete in the system by itself, *without* reckoning on to it one other external point, then a material simplification of the views unfolded in his paper would, I believe, be introduced, by adopting a different hypothesis from that which Mr. Morris advances of the nature of the ether as an exceedingly attenuated form or "fourth state" of gross "gravitating" (or ponderable) matter.

If Nature's course could be retraced to the beginning of time, we may suppose in that *gouffre* of antiquity ether to have been differentiated from gross matter in this way, that whereas internal conservation of motor-effects suffices to weld a group of material points into a resultant yielding system, then, no limits of smallness being imposed upon the group, it is allowable to define a point (in the language of graphic space) of gross or ponderable "gravitating" matter as an originally differentiated mass of aërilian points, upon which the dual resultant of the conjoined motor-couples on the aërilian points will take effect. A part of this resultant is a couple-half, about which we know nothing; and we may reasonably suppose it to be attractive and repulsive force acting on the baric point. The other part of the resultant is an unbalanced motor-couple, only susceptible of conservation as to its effects by an equal and opposite one in some other similar mass or aërilian assemblage. A certain integrity can, I conceive, be imparted to this first hoard of scaffolding of the new theory's construction, by locating the conserving couples, of which the motor couples supposed to be aboriginally welded together are the counter-equivalents, not in a single, but partly in one, and partly in another, set of free-moving aërilian points in such a way that, while the resultant motor-*couple* is balanced by the first set, the *force*-resultant of the massed couples' combination, will be balanced *through* a counter-equivalent force-resultant in another mass-point *by* the free motor-couples of the other aërilian set. The residue of this set's couples will be occupied in opposing the unbalanced couple-residue of the couples massed together in the second baric point, while these couples' transmittent force-resultant will be opposed *by* the still uncompensated portion of the motor-couples acting on the first free-moving set. Perfect compensation of the two dual resultants cannot then take place under these conditions, without exact counter-equivalence of the half-couple (or force-) resultants, and therefore also exact counter-equivalence in their native state between the two groups of motor-couples acting on the two free aërilian sets; at least, if we assume massed and moored aërilian points to have been all originally endowed in pairs with equal counter-couples, and if their modes of collection into mass-points and of producing force-resultants were aboriginally all alike.

In our present undeveloped knowledge of the mathematical properties of tractive or motor-couples, and of their random-energy horse-powers' geometrical relations to the common mechanical modes of exertion of directed energy in forces and couples, it would be premature and vain to speculate as Mr. Morris does, I believe too boldly and fearlessly, in his paper, upon Nature's established order of progressive collection of baric points into "spheres," or into the atoms and molecules which further build up atmospheres, suns, planets, and all ponderable bodies. My views diverge here from his in, at least, one salient point, that the ether (as we must still in sober science term his "interspheral matter") is held, in his opinion, to be ponderable or "gravitating," and to be endowed with a vigour of motion which exempts it from yielding to its vigour of gravitation. By thus identifying "interspheral matter's" or the ether's particles with those of matter "employing its motion secondarily about new centres of gravity" (of *really* gravitating or ponderable "spheres"), the way is barred at once of explaining the ultimate sources of attractive and repulsive force by exercises of motor "vigour." But further than this we must evidently abandon definitely all reasonable hope of constructing out of particles' "incessant leaps in nodes of an interminable network of motions, affecting in long motor lines myriads of interspheral particles," any intelligible framework of the important laws of radiation, magnetism, and electricity which we know that a clear comprehension of the "interspheral" ether's real constitution would immediately unfold to us, if its real nature and that of its relations to ponderable matter were rightly understood. In the form therefore in which Mr. Morris's theory presents itself to us, it fails completely (by only the slightest possible illusion, as I venture to submit, in the choice of its principal hypothesis) in attaining the admirably well pursued and well nigh compassed object of its otherwise exhaustively clear and excellently propounded arguments and demonstrations.

In the view which I have here advanced, massed assemblages of aërilian points form irrevocably the points of gross or ponderable matter, while an equal number of moored points, inseparably connected two and two with the former ones, form bound aërilian assemblages equally untransformable and forming active individual parts of the unchanging ether. That the latter points, unlike those of the massed group, may rove at large in graphic space, does not preclude them from all occupying a common point in another space domain, just as a number of balloons may be all at one height, whatever the courses of their tracks upon a map may be. Nor, again, does an encounter of two balloons' courses on a map necessarily entail collision between the two balloons, since at the time they may be at different heights. It is thus quite conceivable that, in a scale of space foreign to our graphic measures, the free roving aërilian set may all occupy a common place in this foreign scale of space, and that a massed and a moored aërilian point may have the same position in graphic space without impinging on each other, as such points are not at the time at one and the same place in the foreign space. The moored or bound ether may thus traverse the space occupied by the massed ether of gross matter without mutual interference; but, whether superposed or not in ordinary space, the pair of ether sets which compensate resultant actions of two gross-clustered sets of a pair of points of baric matter, will form, however they may mingle graphically, two orbs of ether exerting each (corporately) exactly counter-equal free-orb couples.

If for example the baric points B B′ are urged towards each other with a ponderomotive force or flow of ordinary baric momentum F_1, by the motor actions on them of two ether-orbs A_1 A_1' in counter equal intensities, force-momentum only will be



transferred from A_1 to A_1'; while the tractive momentum (or as we may presume, the heat-energy) accompanying it will only be transferred from A_1 to B, and a similar transfer of thermal energy or tractive-momentum will at the same time take place from B′ to A_1'.

Should it, in the next place, be required to oppose the action F_1 by an equal counter-force F_2, a pair of ether-orbs A_2 A_2' must be superadded to those already urging B and B_1', so as to urge them in the opposite direction. It will be seen from the figure that the total effect of this and of the previous orb-pair's actions will simply be that the pair of ether-orbs connected with B will transmit motor energy from one to the other (from A_1 to A_2), and the other ether-pair will also transfer an equal amount of energy contrariwise from one orb to the other, without any leakage of ordinary momentum occurring at B and B_1', by the neutralised action, into the channel B B′.

Newcastle-on-Tyne, February 10 A. S. HERSCHEL

(*To be continued.*)

Terrestrial Radiation and Prof. Tyndall's Observations

IN NATURE, vol. xxvii. p. 377, I see a notice on Prof. Tyndall's observations on terrestrial radiation, with the author's concluding remarks, that meteorologists should not be offended by his saying that from outsiders equipped with the necessary physical knowledge they may expect valuable aid towards introducing order and causality among their observations. May I be permitted to state that Prof. Tyndall will give no offence, at least to the meteorologists whose works are advancing this science at the present time.

Prof. Tyndall tries to prove by his observations the extreme importance of vapour of water as a check to terrestrial radiation, and he mentions the much greater difference between a thermometer in the air four feet from the ground and another on cotton wool on a morning when snow was lying on the ground than on other nights, equally clear, but with higher temperatures of the air and no snow. Now it is well known that, *pari passu*, a surface of snow will be colder than a surface without, because (1) snow is an excellent radiator; (2) because, as a very bad conductor, it shelters the surface from the influence of the higher temperature of the soil. In the observation on December 10, the thermometer on cotton wool was so cold because it was under the influence of the cold radiated by the snow, and besides immersed, so to say, in the coldest stratum of air near the ground. To my mind, the manner in which the observation was conducted does not prove what Prof. Tyndall advances. To isolate, so to say, the influence on radiation of the atmosphere itself, he should have placed, between two poles, at some feet above the ground, a plank, and on it his cotton wool and thermometer. No doubt that this thermometer, isolated from the snow, should have shown a higher temperature than his thermometer placed on the surface on cotton wool.

Prof. Tyndall lays great stress on the fact that the difference between the temperature in the air and on the ground was less in clear nights with a higher temperature and greater quantity of vapour of water in the air, and sees in this a confirmation of his opinion on the great influence of vapour of water in checking radiation. I do also see in this the influence of vapour of water, *but not of its absolute quantity*, but of *relative humidity*. Once the dew-point is attained, the cooling of the thermometer on the ground is arrested. The whole question between Prof. Tyndall and many physicists and meteorologists is this: nobody negates the influence of vapour of water on terrestrial radiation, but Prof. Tyndall ascribes this influence to vapour in the gaseous state, while his opponents hold the opinion that in this state vapour of water has a diathermacy scarcely different from dry air, while, condensed in small ice crystals or water droplets, it really interposes a very efficient screen to terrestrial radiation, even if, which sometimes is the case, it is perfectly transparent to light, *i.e.* invisible to our eye. Another influence of water on terrestrial radiation is admitted by all: that is, that of the latent heat in the deposition of dew and hoar frost.

If we wish to make meteorological observations bearing on the question, the following *modus operandi* should be adopted: (1) observations should be made in climates where, with a tension of vapour greater than that which obtains in England in winter, the relative humidity is yet so small that there is no dew on clear nights, or at least it appears rather late; (2) three thermometers placed on cotton wool, but at different heights above the ground should be observed, say one on the ground, and the others at heights, say from 10–100 feet above.

If Prof. Tyndall's views are right, the highest of the thermometers should show by far the lowest temperature, as it is not screened from radiation by the vapour of water diffused in the lowest stratum of air. I think every meteorologist will express the opinion that there will be scarcely a difference in this case. As to the observations in different climates, those made where the relative humidity is low should give no greater difference between the thermometer in the air and on the wool than the observations in England on clear nights, with the same vapour tension, if Prof. Tyndall's hypothesis be admitted. I think we have already many observations which prove that, with vapour-tensions much above 0″·181 (or 4·6 mm.), *i.e.* above that of saturation at 32° F., terrestrial radiation is very great, if only the sky is clear and the relative humidity small. No doubt the decrease of the temperature of the air from the midday maximum to the night minimum is caused by terrestrial radiation. I give some figures from the observations at Biskra, in the Algerian Sahara.[1]

	Difference of daily max. and min.	Mean temperature.	Tension of vapour.	Relative humidity.	Amount of cloud.
January ...	25·4 ...	56·8 ...	0·264 ...	61 ...	1·6
August ...	39·2 ...	89·6 ...	0·557 ...	40 ...	0·8
October ...	35·6 ...	68·4 ...	0·432 ...	58 ...	0·9

In an arid climate in low latitude the non-periodic variations are but small, and the difference between the maxima and minima is very near to the daily range of temperature. As the amount of cloud is very small in all three months taken here, the conditions for terrestrial radiation are very favourable. If vapour of water in the gaseous state impeded terrestrial radiation so much as stated by Prof. Tyndall, we should expect to find the daily range smaller in August than in January, on account of the double amount of vapour in the air. The reverse is the case, the daily range being by 14·8 greater in August than in January. Has anybody observed a daily range of 39·2 in England, be the amount of cloud and the vapour-tension ever so small?

I must add that in all observations bearing on terrestrial radiation we must not forget that other substances besides water in its three states may interpose a screen to radiation. I mean especially dust and smoke of all kinds. Now far from large cities, there are many reasons why in winter, especially when the ground is covered with snow, the air will hold less of these impurities than in summer, as in winter there are no fires of forests and peat-bogs, there is little inorganic dust, because the humidity of the soil, and still more so the snow, prevent it; organic dust, germines, &c., are also absent, or present in very small quantities, on account of the small amount of plant and lower animal life. The absence of dust and smoke explains the great purity of the air in winter, so favourable to solar and terrestrial radia-

[1] "Annales du Bureau Central Météorologique de France," 1879, vol. ii.

tion, as well as the purity of the air at great heights, especially above the snow-line.

Prof. Tyndall has certainly lost sight of this when he attributes the diathermacy of the air in winter only to the small amount of vapour of water. The same is the case when he points to the relatively small nocturnal radiation on clear nights in many tropical countries. In the case of many of them, besides dust and smoke, the *high relative humidity* has much to do with the small amount of cooling during the night. What quantities of latent heat are liberated by the formation of dew in humid climates of low latitudes, and how much the nocturnal cooling must be impeded by it, everybody can imagine who has been in these countries, or only read scientific travels to them.

A. Woeikof

Diurnal Variation in the Velocity of the Wind

The observations discussed in Mr. Buchan's interesting article on this subject leave little to be desired, and with most of the conclusions meteorologists in general will agree. I am surprised, however, to find such an eminent authority accounting for the large diurnal oscillation on land, solely on the ground of its being due "to the superheating of the surface of the ground, and to the ascensional movement of the air consequent thereon, which tend to reduce the effects of friction and viscosity of the air."

There may perhaps be more hidden within this sentence than appears from the wording of it; but, taking it as it stands, it certainly omits what I believe to be the most important factor in the whole result, viz., *the interchange of motion between the upper and lower layers of the atmosphere, occasioned* by the ascensional movements during the day over superheated land. This has been most clearly shown by Dr. Köppen in an article in the Austrian *Zeitschrift für Meteorologie*,[1] by successive rejection of inefficient causes, to be the only means by which such increase of velocity could be occasioned near the earth's surface.

It is not clear, moreover, how the ascension currents could otherwise diminish the friction of the air enough to account for such a large diurnal increase of velocity. The effect of the increased temperature alone, would certainly be to increase the friction, but as Köppen shows from Meyer's formula for the coefficient of gaseous friction, the daily range of temperature would only cause the friction of the air to vary from ½ to 1 per cent. of its whole amount,[2] so that this factor is evidently without any appreciable influence on the diurnal period.

In the paper already referred to, Dr. Köppen has gone into the whole question most minutely, and a perusal of it will, I think, convince most persons, that the chief factor in causing the diurnal increase of wind-velocity over land is the intermixture of air (*luft-austausch*) resulting from the uprise of heated air from the surface, and the consequent downfall of cooled air to it, "bringing down with it," as Espy told the British Association in 1840, "the motion which it has above, and which is known to be greater than that which the air has in contact with the asperities of the earth's surface."

Among the facts cited by Köppen in favour of his theory may be noted the following:—

1. The fact that in Europe the ratio of the velocity of the wind to the gradient, is greater for N.E. winds and in summer than for S.W. winds and in winter; together with the circumstance that the temperature decrement, and therefore also the facility with which local ascension and descension currents may be formed, is greater under the former conditions than under the latter.

2. That simultaneously with the diurnal increase in the velocity of the lower layers of the atmosphere, those above appear to be retarded.

3. That on stations near the earth's surface the curve of absolute humidity reaches its minimum about the time of maximum wind-velocity, while at elevated stations, such as the Faulhorn, the humidity reaches its maximum at the same time.

In fact it may be concluded, as Köppen graphically puts it, "that the greater the difference of the temperature of the air in a vertical direction, the smaller are the differences in the humidity, barometric pressure, and motion of the air, and that in the early hours of the afternoon the inhabitants of plains are placed to a certain extent on a higher, and the dwellers of Alpine heights on a lower, level, relatively to these elements."

E. Douglas Archibald

[1] "Die tagliche periode der Geschwindigkeit und Richtung des Windes," September heft, 1879.

[2] Meyer's formula in English measure is $\eta = \eta_o (1 + \cdot 0014 t)$, where η η_o are the friction coefficients at $t°$ and 32° Fahr. respectively.

The Large Meteor of March 2, 1883

The meteor described by Mr. R. W. S. Griffith in the last number of Nature was also observed at Bristol and Bath. At the latter place it was seen by Mr. J. L. Stothert at 9h. 33m. 40s., passing in the direction from α Hydræ to η Canis Majoris. The brilliancy of the meteor was equal to twice that of Venus; colour yellow; motion slow; no train. Comparing this observation with that obtained by Mr. Griffith, it would seem that the meteor probably belonged to a radiant point near Lyra, rising in the north-north-east at the time of its appearance. A meteor shower was observed by the writer on March 14, 1877, between 14h. 12m. and 15h. 43m. from the point α 277°, δ 25°+, the members of which were somewhat slow and devoid of streaks or trains, and the fireball of March 2 last appears to have belonged to the same stream.

It would be important to hear of additional observations of this meteor. Its considerable brightness, and the fact that it appeared at a time when it must have been widely observed, lead me to hope that many other records of its path have been preserved. In all such cases it is very desirable to give the R.A. and Dec. + or − of the beginning- and end-points of the observed path. Descriptions by the stars or compass-bearings are likely to be less accurate, and are often difficult to reduce.

In the *Observatory* for September, 1879, p. 129, I mentioned that "during the first four days of March fireballs have been very numerous, especially on the 1st, 2nd, and 4th." This meteoric epoch is therefore well confirmed by the fireball of the 2nd inst. which it is hoped will aid us in determining one of the chief radiant points of the date.

W. F. Denning

Bristol, March 12

A very brilliant meteor was seen here on March 2 at 9.35 p.m. It burst forth in the immediate neighbourhood of Sirius, and passed downwards to the west at about an angle of 40° from the perpendicular, disappearing after a course of about 25°. Its light was so strong as to make the distant trees, fields, and hedges perfectly visible, brighter than the brightest moonlight. Its colours also were very decided, changing quickly, much as does Sirius to the naked eye, but showing more of the violet at first, and afterwards more of the red.

J. L. J.

Capel, Surrey

On the Movements of Air in Fissures and the Barometer

I should be glad to add to my article "On the Movements of Air in Fissures and the Barometer" (Nature, vol. xxvii. p. 375) a reference to an instrument devised by Mr. Whitehouse, and described in 1871 before the Royal Society (*Proc. Roy. Soc.* vol. xix. p. 491). The apparatus, which was intended to record minute variations of atmospheric pressure, consisted of two hydraulic chambers, connected by a tube or siphon, and buried in the ground. One of the chambers was left open at the top and exposed to atmospheric pressure, the other was closed and removed from such pressure; the difference in the level of the water in the two was a measure of the variation in the atmospheric pressure. This instrument reproduces those conditions to which the oscillation of the water-level in certain chalk-wells, coincident with the barometic changes, has been attributed. It was believed by the inventor that by its aid he had been able to detect atmospheric waves or pulsations at a distance from a storm-centre; it has not however come into scientific use.

I may further add to my brief allusion to colliery explosions a reference to the paper by R. H. Scott, M.A., F.R.S., and W. Galloway, Mining Engineer, entitled "On the Connection between Explosions in Collieries and Weather" (*Proc. Roy. Soc.* vol. xx. p. 292, 1872).

A. Strahan

28, Jermyn Street, March 10

THE PITT-RIVERS COLLECTION

It will be remembered that some time past Major-General Pitt-Rivers, F.R.S., most munificently offered his far-famed Anthropological Collection to the University of Oxford on the condition that the University should erect a building adequate to contain it and display it properly. On Wednesday, the 7th ult., a vote was passed by Convocation authorising the Curators of the Univerity

Chest to expend a sum of 7500*l.* on the erection of an annex to the east side of the present University Museum to contain the collection and to provide the requisite cases and fittings; a vote of thanks to General Pitt-Rivers was also passed.

This most important collection, therefore, which commenced its public existence at Bethnal Green, and has so long been exhibited at South Kensington, will rest finally at Oxford, where it cannot fail to be studied with ever increasing interest and benefit to learning generally. The title of the collection as the "Pitt-Rivers Collection" is to be maintained, and the developmental and gradational system of arrangement devised by the donor, and carried out by him in the greater part of the collection, with such valuable and interesting results is to be retained. The new building, which will be provided with two galleries, will be entered by two doorways at different levels from the present University Museum.

The delegates of the Museum have elected Dr. E. B. Tylor to be Keeper of the Museum in place of the late Prof. Henry Smith, so that the new collection, as well as the anthropological collection of the late Prof. Rolleston, will fall into the hands of the man most suited to arrange and explain them.

JOHN RICHARD GREEN

THE death of Mr. Green, at the early age of forty-five years, we regard as a serious loss not only to historical literature but to science. We have frequently maintained that science has no peculiar sphere, that every field of human research is capable of scientific treatment. As we pointed out in reviewing Mr. Green's famous "Short History" and his "Making of England," he has the credit of having been the first historian who appreciated the function of science in a State, or the moulding power of the environment of a people. Not only so, but he distinctly aimed at showing that the history of a people is simply an evolution dependent for its course and outcome on the action and reaction between the entity and its surroundings. This conception of the function of the historian was probably even more distinctly brought out in the "Geography of the British Isles," by Mr. Green and his accomplished and congenial wife. As we pointed out in our notice of the "Short History" moreover, Mr. Green not only wrote his "History" on a scientific method, but gave large space in that history to a record of the progress of science and of scientific societies, as distinct and influential elements in the life of our nation. Indeed he may be regarded as the first historian who, breaking away from the old conventional methods of writing history from the outside, and thus mistaking the shell for the kernel, adopted the method of the physical geographer as distinct from the mere topographer, and, penetrating deep beneath the surface, traced the forces which have actuated the nation and brought it to its present standpoint. Although the impulse given by Mr. Green to historical study will certainly bear fruit, his loss cannot be overestimated. His "Making of England" was evidently only a prelude to a series of volumes in which he intended to show in minute detail the interaction between the various elements that go to make up the life of these islands,—the ethnical and moral elements on the one hand, and the encompassing physical elements on the other. Happily he has left behind him in a nearly complete state a second volume on "The Coming of the Northmen," which brings his scheme down to the point when it may be said that all the forces were in the field, the continued action of which has gone to make up the England of to-day. Since Mr. Green's death ample testimony has been borne to his rigidly scientific method of work, and the patience with which he wrote and rewrote ere his own severely critical standard was reached. It will be difficult to find a successor to Mr. Green so far as stirring eloquence of style is concerned, but we trust that his scientific method may find favour, and that historians in future will endeavour to trace the life of a nation as he did, after the manner of the biologist and physical geographer.

THE BOTANY OF THE "CHALLENGER" EXPEDITION

FROM time to time various contributions to the Botany of the *Challenger* Expedition have been published in the *Journal* of the Linnean Society, chiefly in the fourteenth and fifteenth volumes; but hitherto no part of the botanical results has appeared in the series of sumptuous volumes in which are recorded the discoveries and observations of the expedition. The Government have at length decided to devote one volume of about 350 pages and fifty plates to the elucidation of the flora of the more interesting countries visited, which the writer of the present article has undertaken with the assistance and under the superintendence of Sir Joseph D. Hooker. There can be no doubt that the Government are right in their estimate of the relatively small importance of the results obtained in botany as compared with those obtained in other branches of science; yet we think we shall be able to show that the botanical collections are sufficient to form the basis of a most interesting volume. It is almost superfluous to state that the botanist of such an expedition has little chance of exhausting the flora of any of the numerous countries or regions visited; and the task of elaborating the materials seemed at first an unpromising one. At many of the places visited, and especially some of the more interesting ones, the stay was too short and the means inadequate for making and drying large collections of plants. Nevertheless the naturalist, Mr. H. N. Moseley, seems to have lost no opportunity, having collected in almost every place touched at. Unfortunately the plants of the least-known countries, such as the Aru and Admiralty Islands, reached England in a very much damaged condition. But imperfect as they are, they include a large proportion of novelties, and indicate a flora rich in endemic species. The best collections, so far as number and quality of the specimens are concerned, are those from Chili, Juan Fernandez, Japan, the Sandwich Islands, &c.; yet they contain little or nothing new to science, and by no means fully represent the vegetation of the several countries. There remain the collections made in the remote islets of the Atlantic and Southern Oceans, which, with what was previously known, afford material for a practically complete flora of these isolated spots, so interesting to the student of the distribution of plants and animals. And it has been decided that this shall be the scope of the work.

The Bermudas, the oldest English colony, come first in the arrangement adopted. These islands, having an area of about one-seventh of that of the Isle of Wight, are situated about six hundred miles from the American continent, and although settled as long ago as 1612, nothing approaching a complete and critical account of their vegetation has hitherto been published. The flora is a poor one, especially in regard to number of species, and is evidently of comparatively recent origin, being in this respect in striking contrast to that of various other Atlantic islands—that of St. Helena, for example. The indigenous element has been, almost without exception, derived from the West Indies and the extreme south-east of the mainland of North America. By the indigenous element we mean those species which have reached the islands independently of human agency, direct or indirect. With unimportant, though rather numerous, exceptions, the indigenous and introduced elements are easily distinguished. A remarkable feature in the vegetation is the almost total absence of endemic forms. The possible important exceptions are the native palms. There are two or possibly three species, of which one belongs to the genus Sabal. Without due investigation, it has been generally accepted as a fact that there was only one indigenous palm, and that this was identical with the Sabal Palmetto of south-eastern North America; but in elaborating the palms for the "*Genera Plantarum*," Sir Joseph Hooker became aware that the imperfect herbarium specimens in this country represent two species, one of them at least evidently different from *Sabal Palmetto.* Several historical passages in Sir J. H. Lefroy's work on the Bermudas confirm this view. Thus, in one place it is recorded that the only food certain fishermen took out to sea with them on a given occasion was "Palmitoe berries"; and in another place that the workmen did not hesitate to share this fruit with pigs and other animals, and even preferred it to bread to eat with their meat. Every effort is being made to obtain material this season to set this question at rest. The earliest references we find to the vegetable productions of these islands are in the "Historye of the Bermudaes," edited by Sir J. H. Lefroy, and some of these are valuable, because they enable us to say with certainty that one species of *Opuntia*, for example, existed in abundance previous to the settlement of the islands.

François André Michaux was the first botanist who visited the Bermudas. In his case it was unintentional, the fortunes of war having been the cause of his spending a week there in 1806. He published an interesting sketch of the vegetation, though the following extract reveals a want of exactitude: "Parmi ces plantes [*i.e.* les plantes naturelles au pays] on en trouve plusieurs de l'ancien continent, qui ne paroissent pas de nature à y avoir été transportées: telles sont *Verbascum thapsus*, *Anagallis arvensis*, *Mercurialis annua*, *Leontodon taraxacum*, *Plantago major*, *Gentiana nana*, *Oxalis acetosella*, &c." The two last names must have been a slip of the pen. Since Michaux's time two imperfect lists of Bermudan plants have been published, both in 1873. One, by J. M. Jones, F.L.S., is marred by some rather gross errors in classification and nomenclature, yet it contains some interesting information. The other, by Dr. J. Rein, was prepared with greater care, and contains 128 species of introduced and indigenous flowering plants and ferns, besides upwards of 100 algæ. Altogether Mr. Moseley collected 162 species of plants. In addition to these is a considerable number sent to Kew by Sir J. H. Lefroy during his governorship of the islands, making a total of about 320 species that occur in a wild state. These may be classified as follows: indigenous, 130; probably indigenous, 57; certainly introduced, 133. The last number would be higher if we included solitary waifs of other species.

Next in order of the *Challenger* collections come those of St. Paul's Rocks and the island of Fernando Noronha, in which Mr. Moseley collected about sixty species, including a new species of *Oxalis*, one new Asclepiad, and one fig, &c. Had permission to collect objects of natural history not been withdrawn after the first evening, there is no doubt this collection would have been an important one.

Proceeding southward and taking the other islets on our way, we have Ascension, St. Helena, Trinidad (off the coast of Brazil, in about 20° 30′ S. lat.), Tristan d'Acunha, and the neighbouring islets Inaccessible and Nightingale; and thence southward and eastward, Gough Island, Lindsay and Bouvet Islands, Prince Edward and Marion Islands, the Crozets, Kerguelen Island, the Heard group, St. Paul and New Amsterdam. With the exception perhaps of Kerguelen Island, the published accounts of the botany of these oceanic islets are all most imperfect and scattered. We are unaware of any complete enumeration of the exceedingly meagre indigenous flora of Ascension. St. Helena has fared better; but the fifty or so indigenous species are lost amongst the 1000 species of introduced plants enumerated in Mr. Melliss's book "St. Helena," the botanical value of which consists chiefly in the figures of the endemic plants. Moreover Mr. Melliss did not elaborate the synonymy of the flora, and some of the Cyperaceæ were undetermined, whilst a few, we believe, were omitted.

The island of Trinidad is rather farther from the coast of Brazil than the Bermudas are from North Carolina, and very little is known of its vegetation. On the outward voyage of Sir J. Ross's Antarctic Expedition, Sir Joseph Hooker and some of the other officers landed on a small rocky cove, where they were unable to scale the barrier cliffs, so they could not penetrate to the interior of the island, and they brought away only one fern (*Polypodium lepidopteris*) and one sedge (*Fimbristylis*, sp.), though there were tree-ferns and other trees, in sight from the ship, on another part of the island. In 1874 Dr. Ralph Copeland, of the Dunecht Observatory, who accompanied one of the transit expeditions, landed on the east side of the island, and succeeded in reaching the elevated centre, where he found several ferns in great luxuriance, and collected a few scraps of plants, including a new tree-fern. The most interesting plant, however, was *Asplenium compressum*, a fern previously known only from St. Helena, though Melliss, by some unfortunate slip, records it from South Africa, Madagascar, &c. Dr. Copeland further states that, although most of the valleys of the north side of the island contained enormous numbers of dead trees, not a single living one was to be seen, except near the highest points. They appeared to have been dead many years and were mostly overturned. He was unable to investigate the phenomenon, but suggests that they may have been destroyed by goats, though he adds not a mammal of any kind was seen.

Tristan d'Acunha itself was explored by Dupetit Thouars in 1793, and he described the plants in a paper which he read before the *Institut* of France in 1803. The next botanist who visited the island was Carmichael, who published an enumeration of the plants he collected in the *Transactions* of the Linnean Society. Mr. Moseley botanised the same island and the neighbouring Nightingale and Inaccessible Islands, and collected not only those previously known, but also some new species of Cyperaceæ. Previously, too, *Gnaphalium pyramidale*, Thouars, was unknown at Kew, or rather a young plant of it collected by Carmichael could not be identified as such with certainty.

We have little space left, so we can merely mention the groups of islets in the Southern Ocean. Mr. Moseley added considerably to our knowledge of the flora of Marion Island and the Heard Group, and Kerguelen Island, whilst the Americans, Germans, and French, of their respective expeditions, investigated the Crozets and New Amsterdam and St. Paul's Islands. Kerguelen Island, the largest by far of all these oceanic islets, being about eighty miles in diameter, has been explored by the naturalists of the English, German, and American transit expeditions, and the results published. One of the most interesting discoveries of late years connected with the vegetation of these islets was made by the late Capt. Goodenough, about ten years ago, when he collected *Phylica arborea* in Amsterdam Island, till then only known in the island of Tristan d'Acunha, separated therefrom by ninety degrees of longitude, which in this latitude are equal to a distance of about 4700 miles. Mr. Moseley also found it abundantly in Inaccessible and Nightingale Islands. *Phylica arborea* is likewise remarkable in being the only plant of these southern islets that is arboreous in habit, though at the outside it is only about twenty feet high in the most sheltered localities.

W. Botting Hemsley

THE SHAPES OF LEAVES[1]

II.—*Extreme and Intermediate Types*

WHERE access to carbonic acid and sunlight is habitually unimpeded by the competition of other plants in any direction, the leaf of each species tends to assume a completely rounded form; the conditions are evenly distributed on every side of it. Such absolute freedom to assume the fullest foliar perfection is best found on the surface of the water. Hence most water-plants which have leaves lolling on the surface assume a

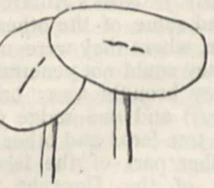


FIG. 10.—*Lemna minor.*

more or less distinctly rounded shape, the venation and other details remaining in accordance with the ancestral habit. Foliage of this character is found in the water-lilies and many other aquatic plants. The little entire lenticular fronds of the common duckweed, *Lemna minor* (Fig. 10), which coats all our small ponds and ditches, form an excellent example of the type in question. Here the shape is almost orbicular; the edge is entire; and the smallness of each separate frond is due to the minuteness of the plant and the obvious necessities of its situation. In the waterlilies we get a similar example on a much

FIG. 11.—*Nelumbium speciosum.*

larger scale, for these plants recline on broader and more permanent sheets of water, and draw nourishment from their large rhizome, sunk securely in the mud beneath, and annually accumulating a rich store of food-stuffs for the growing foliage.

Mr. Herbert Spencer (by whose kind permission two accompanying diagrams are copied from "The Principles of Biology") points out a distinction between the shapes adopted by such plants, according to their relations to a central axis. In the sacred lotus, *Nelumbium speciosum* (Fig. 11), the leaves grow up on long and independent footstalks, without definite subordination to any such axis; and they therefore assume an almost perfectly symmetrical peltate form. In the *Victoria regia* (Fig. 12) the footstalks, though radiating almost horizontally from a centre, are long enough to keep the leaves quite remote from one another; and here they assume an almost symmetrically peltate shape, but with a bilateralness indicated by a long seam over the line of the footstalk. The leaves of our own white waterlily, *Nymphæa alba* (Fig. 13), are more closely clustered, and have less room to expand transversely than longitudinally; hence they are somewhat longer than broad, and have a cleft where the *Victoria regia* has only a seam. *Limnanthemum* shows the same type on a smaller scale.

Among land plants, the conditions under which leaves

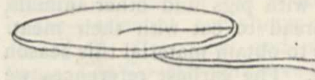


FIG. 12.—*Victoria regia.*

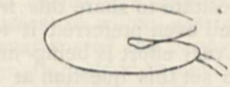


FIG. 13.—*Nymphæa alba.*

can fill out to the full rounded shape occur less frequently than among floating aquatic species; still, even here a very interesting set of gradations may be observed. The best example of all is that given by the common American May-apple, *Podophyllum peltatum*, where the separate radical leaves grow straight up from a stout rootstock on very thick and tall stalks, so as to overshadow all the other vegetation; and they assume a regular, circular, peltate form, exactly like a Japanese parasol. The radical leaves of our own English *Cotyledon umbilicus* (Fig. 14), springing from a perennial rootstock, for the most part on bare walls or unoccupied hedgerows, are able similarly to expand without interference, and catch carbonic acid and sunlight to their hearts' content. Hence they are orbicular and peltate, though they retain the characteristic crenate edge of most flat-leaved Crassulaceæ.

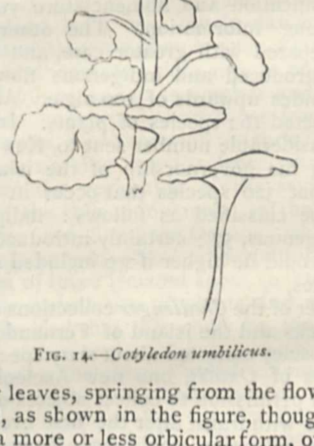


FIG. 14.—*Cotyledon umbilicus.*

But the upper leaves, springing from the flower-stalk, are more bilateral, as shown in the figure, though even these round out to a more or less orbicular form, owing to their exceptional access to air and light. The so-called garden nasturtium, *Tropæolum majus*, with leaves growing out at right angles into open space, has also peltate leaves, as has likewise the usually aquatic *Hydrocotyle*.

When the plant sends up leaves from a rich buried rootstock, so tall as to overshadow the surrounding vegetation, but subordinated to a common centre, they usually assume the reniform shape. This type is particularly well seen in the various coltsfoots—for example, in *Tussilago farfara*, *T. petasites*, and *T. fragrans* (Fig. 15). Similar types occur in *Asarabacca*, and in the marsh marigold, *Caltha palustris*. Extremely similar to the leaf of *Caltha*, though on a smaller scale, is that of one true buttercup,

[1] Continued from p. 442.

Ranunculus ficaria, the lesser celandine, which produces its foliage in early spring from buried tubers, and so anticipates other plants, having the air all to itself for a couple of months, after which it gets overshadowed by later comers. The same type recurs pretty closely in the radical leaves of its allies, *R. auricomus* and *R. parviflorus*, as also somewhat more remotely in the ivy-leaved crowfoot, *R. hederaceus*, which creeps, unimpeded, over soft mud. Many early spring plants have lower or radical leaves at least of this reniform type, because they grow in comparatively unoccupied ground. As an example, take ground-ivy, *Nepeta glechoma* (Fig. 16). The violets represent a closely similar case. Many of these plants,

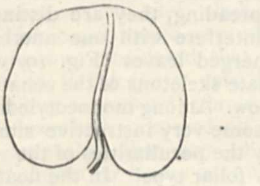


FIG. 15.—Typical leaf of *Tussilago* genus.

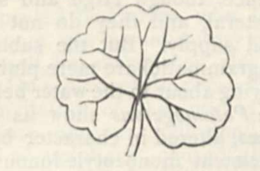


FIG. 16.—*Nepeta glecoma*.

however, produce later on, when foliage grows thicker, much more lanceolate leaves. In the burdocks, docks, &c., this type is persistent.

On the other hand, where the distribution of carbonic acid is most scanty, or where the competition is fiercest, or where the competing plants are supplied with no reserve to enable them to send up shoots which overtop their competitors, immense subdivision into leaflets takes place, and these leaflets are often almost or quite filiform. The extent to which leaflets are subdivided depends upon the relative paucity of carbon in their environment; the general resulting form depends mainly upon the inherited type of venation. Among submerged aquatic plants, the

FIG. 17.—*Chærophyllum silvestre*.

filiform condition is habitual, because carbonic acid is so comparatively scarce in water. Among British species, the water violet, *Hottonia palustris*, is a good example. All terrestrial primroses have undivided foliage; but in *Hottonia* the leaves, still preserving the pinnate character of the venation, as in the common primrose, are cut into very deep segments, forming a close mass of narrow, linear, waving threads, more like a *Chara* than a flowering plant at a first glance. *Utricularia* shows the same result with a different ground-plan. In *Myriophyllum*, water milfoil, we have whorls of leaves each minutely subdivided into hair-like pinnate segments, and moving freely through their still ponds in search of stray carbon particles diffused in the water. *Hippuris* has the separate leaves undivided, but attains the same result by crowding its long, thin, linear blades in whorls of ten or twelve, so as closely to resemble an *Equisetum*. Our common *Ceratophyllum* looks at first sight much like water-milfoil, but here the whorled leaves, instead of being pinnately divided, are repeatedly forked into subulate or capillary segments, the result of a branching rather than of a pinnate venation. Other instances will occur at once to every botanist.

On land we get very much the same condition of things

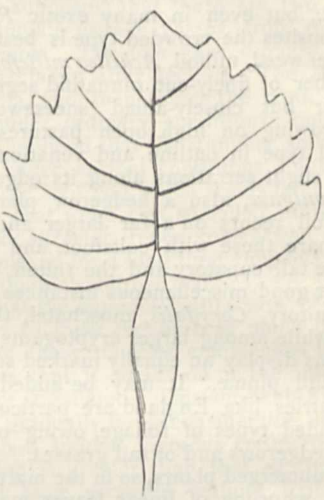


FIG. 18.—Floating leaf of *Trapa natans*.

in the fierce competition that goes on for the carbon of the air between the small matted undergrowth of every thicket and hedgerow. The common weedy plants, and especially the annuals or non-bulbous perennials, which grow under such conditions, cannot afford material to push broad leaves above their neighbours' heads, and they are therefore compelled to fight among themselves for every passing particle of carbon. Hence they are usually very minutely subdivided, though in a less waving and capillary manner than the submerged species; their

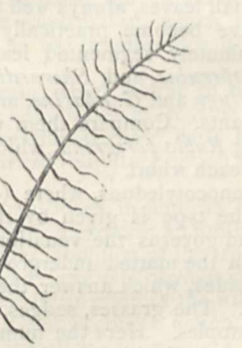


FIG. 19.—Submerged leaf of *Trapa natans*.

leaflets are oftener flat, and definitely exposed on their upper surface to the sunlight. That essentially weedy family, the Umbellates, contains a great number of such highly segmented hedgerow leaves. Common wild chervil, *Chærophyllum silvestre* (Fig. 17), forms a familiar example: other cases are *C. temulum*, *Sison Amomum*, many *Carums*, *Œnanthes*, *Pimpinellas*, *Daucus*, *Caucalis*, &c., all of which belong by habit to greatly overgrown localities. Compare these with the free-growing, almost orbicular, radical leaves of *Astrantia* and *Sanicula*, in the same family; or with the still freer peltate leaves of *Hydrocotyle;* or again with the divided but more broadly segmented leaves of those tall open-field species, cow-parsnip, *Heracleum sphondylium*, and Alexanders, *Smyrnium olusatrum*, which have only to compete against the grasses and clovers; or, finally, with the large waterside forms, *Apium graveoleus*, *Sium latifolium*, and *Angelica silvestris*. So, too, take the much segmented herb—Robert, *Geranium Robertianum*, of all our hedgerows, growing side by side with the like-minded chervils and carrots, and compare it with that persistent rounded geraniaceous type which recurs, not only in our English *G. molle*, &c., but even in many exotic *Pelargoniums*. Among composites the crowded type is best exemplified by that thicket weed, milfoil, *Achillea millefolium*, with its infinite number of finely-cut, pinnatifid segments; while in the taller but closely-allied sneezewort, *Achillea ptarmica*, growing on high open pastures, we get the same general type in outline and venation, only entire save for the slight serrations along its edge. In tansy, *Tanacetum vulgare*, also a hedgerow plant, the same type as milfoil recurs on a far larger and handsomer scale. Compare these with coltsfoot and burdock, or even with the tall eupatory and the tufted, close-packed daisy. Other good miscellaneous instances of the weedy type are fumitory, *Corydalis*, moschatel, the camomile group, &c.; while among larger cryptogams the majority of thicket ferns display an equally marked subdivision of the fronds and pinnæ. It may be added that highly civilised countries like England are particularly rich in these subdivided types of foliage, owing to the predominance of hedgerows and of tall grasses.

As in the submerged plants, so in the matted terrestrial undergrowth, whorling of linear leaves may practically answer the same purpose as minute segmentation. Some plants solve the difficulty of catching stray carbon in the one way, and some solve it in the other. Each adopts the easiest modification of its own ancestral type. For example, take the stellate tribe. Their tropical allies, the larger Rubiaceæ, have simple, usually entire, opposite leaves, with interpetiolar stipules. In the small, weedy, northern forms however, the interpetiolar stipules have grown out into linear leaf-like foliar organs, forming with the true leaves an apparent whorl of six members. Sometimes, too, the whorl is enlarged to as many as eight leaves, and sometimes reduced to four. These thick whorls of small leaves, always well turned outward to the sunlight, have become practically analogous in their action to minutely segmented leaflets, in our English *Galiums*, *Asperulas*, and *Sherardia*. Two of them at least, *G. mollugo* and *G. aparine*, are extremely common hedgerow plants. Compare them with the broad-leaved free-climbing *Rubia peregrina*, which has only four large members to each whorl.

Among monocotyledons, where (as will be afterwards explained) the type is given by the peculiarity of the cotyledon and governs the venation, minute subdivision is replaced in the matted undergrowth by single, linear, lanceolate blades, which answer the selfsame purpose in the long run. The grasses, sedges, and woodrushes are sufficient examples. Here the numerous leaves, all long and narrow, and all with long thin flower stems, strive to overtop one another, and run up side by side to a considerable height. They may be compared with the large rich leaves of the bulbous lilies, tulips, amaryllids, and orchids. In both cases the type is the same, but the development is different. Plants that consort much with the grasses, as for example ribwort plantain, though wholly unlike in type, are apt to be drawn up and assimilated to them, not merely in general character, but even in venation and mode of fertilisation. Other grass-like dicotyledons are found among the *Polygonums*, *Armerias*, *Bupleurums*, pinks, &c., all under similar circumstances to those of the grasses themselves.

Intermediate types between these two extremes of entire obicularity and minute subdivision occur everywhere. Compare, from this point of view, the common meadow buttercups, which grow in fully occupied meadows, with *Caltha* and the lesser celandine. Compare, again, the mallows on the one hand with the peas on the other, or the docks with the crucifers. Throughout these intermediates, various stages can be easily observed. For example, the South European water-chestnut, *Trapa natans*, beautifully illustrates the gradations which have finally given us our own *Hippuris* and *Myriophyllum* from an Onagraceous or Saxifrage ancestor. It has a number of floating leaves (Fig. 18) supported by bladder-like petioles filled with air, and arranged radially round the stem. Hence, though large and spreading, they are distinctly bilateral, and they do not interfere with one another's food supply. But the submerged leaves (Fig. 19, very diagrammatic) are mere pinnate skeletons of the venation, waving about in the water below. Among monocotyledons, the *Potamogetons* show us some very instructive similar cases, altered in character by the peculiarities of the very persistent monocotyledonous foliar type. In the floating leaves of *P. natans* they come as near the waterlilies as a monocotyledon can reasonably expect to do; in *P. pectinatus*, the wholly submerged leaves look like long blades of grass, proceeding from the thread-like stems.

Less minutely subdivided than the hedgerow plants are a large class of somewhat weedy forms, well typified by our smaller English crucifers. These are often pinnately divided to a considerable extent, as in *Cardamine hirsuta* and *Senebiera didyma*. Compare them with the taller kinds, such as cabbage and charlock. Much the same type reappears in the lowly forms of Papilionaceæ, as for example in *Anthyllis*, *Astragalus*, *Ornithopus*, *Hippocrepis*, &c. On the other hand, in the tall climbing *Vicias*, and still more in *Lathyrus*, the leaflets, having more carbon, more sun, and less competition, fill out rounder, and generally decrease in number, the upper ones being transformed into tendrils. But in the very grass-encumbered clover-like types, *Ononis*, *Medicago*, *Melilotus*, *Trigonella*, and, above all, *Trifolium* itself, the leaflets are dwarfed and reduced to three, the lower members being suppressed, and only the three terminal ones left, so as to raise them on a long footstalk up to the air and sunshine. Compare the very similar leaflets of wood-sorrel. Again, look at the various conditions under which the following Rosaceous plants grow: pear, blackthorn, strawberry, cinquefoil, silver-weed, great burnet, salad burnet, and compare some of them with clover, lady's-fingers, and *Hippocrepis*. The comparison tells its own tale at once.

Finally, we must briefly allude to a large class of tufted plants, usually with entire, ovate, obovate, or ovate-lanceolate leaves, which grow in a rosette from a centre, and insure themselves a good supply of carbon and of light by keeping under all competitors with their close tufts. Of these, our common daisy forms an excellent example: notice the tight way it fits itself against the ground so as to prevent grass from growing beneath it. Another good case in point is *Plantago media:* compare form and habit with those of *P. major* and *P. lanceolata*. To the same class, more or less, may be referred *Arabis thaliana* and many crucifers, London Pride, the common primrose, *Hieracium pilosella*, &c.; and, with more pinnate, lyrate, or prickly leaves, the young thistles, and the radical foliage of many ligulate composites.

The shapes of leaves thus depend upon the average surrounding conditions, modifying a given ancestral type. How these ancestral types themselves were first developed we shall have to inquire in our next paper.

GRANT ALLEN

(*To be continued.*)

ON THE NATURE OF INHIBITION, AND THE ACTION OF DRUGS UPON IT[1]

III.

THE first important contribution to our knowledge of inhibitory centres in the brain and spinal cord was that of Setchenow. He found that when the cerebral lobes in a frog were removed, voluntary motion was abolished, but reflex action became somewhat more marked. On removal of the optic lobes, the reflex action became very greatly increased, and if, instead of removing them they were stimulated either chemically by a grain of salt laid upon them, or electrically, reflex action in the limbs was greatly retarded or completely abolished.

These experiments were repeated by Herzen, who, like Setchenow, considered that there was no inhibitory mechanism in the spinal cord itself, but disbelieved also in inhibitory centres in the brain. He explained the depression of reflex which occurred on irritation of the optic lobes by supposing that any intense nervous irritation, no matter whether it was central or peripheral, caused great depression of reflex action both when the brain was intact and when it was divided, as in Setchenow's experiments. Setchenow again repeated his experiments, and came to the conclusion that it was uncertain whether the inhibitory mechanism could be excited reflexly from the periphery. He made, also, a sharp distinction between tactile and painful impressions upon the skin. For tactile impressions he considered that there was no inhibitory mechanism in the brain. Further investigations still, showed that both chemical and electrical irritation would excite the inhibitory apparatus, and he, therefore, considered that both excito-motor and depressor fibres were present in the same nerve-trunk.[2] Goltz found, in opposition to Setchenow, that there was an inhibitory apparatus for tactile reflexes also in the frog's brain, but this he found in the cerebral lobes,[3] while Setchenow denied any inhibitory function to that part of the brain altogether.

He found also, however, like Herzen, that complete abolition of reflex action could be produced by powerful irritation of any peripheral sensory nerve, and considers that the irritation is conveyed to the reflex centre, and diminishes or destroys its excitability for the original stimulus, without supposing that there is any special inhibitory centre.

Lewisson found that by powerfully compressing the neck, or by squeezing the feet, or some other part of the body of a frog, or by irritation of the cutaneous or muscular nerves, or by electricity, the reflex excitability could be much depressed. He found, however, that unless the irritation was strong it produced stimulation both of the reflex and motor centres of the brain instead of depression.[4]

The general conclusion to which all these experiments, as well as those of Fick,[5] Freusberg, and others lead is, either that the nerves contain both excito-motor and reflex depressing fibres, or that excitement and depression can be produced by the same nerves under different conditions.

Freusberg,[6] who discusses the question of inhibition in an able and thorough manner, comes to the conclusion that all instances of inhibition including the different effects of weak and powerful stimuli applied to the same nerve, and also the inhibitory effects of stimulation of different nerves on each other, are not due to specific inhibitory centres, but to a remarkable property of the central nervous system, which does not allow of its different parts being simultaneously set in action by different causes. This conclusion, although it may be nearer the truth than the hypothesis of separate inhibitory centres, is not satisfactory, for it still leaves us in the dark regarding the way in which the central nervous system comes to possess the remarkable properties which he attributes to it.

Setchenow explains the increased rapidity of reflex action after section of the cord below the medulla oblongata, by supposing that there are two paths along which the stimulus usually passes, from the sensory to the motor tracts. The one goes directly across, and this is the path taken after section. The other goes up to the medulla, and then down the cord. This is the path taken under ordinary conditions; but besides the apparent unlikelihood that the stimulus should take this longer path under normal conditions, an objection has been raised to it by Cyon which seems fatal.

Cyon finds that when the so-called inhibitory centres are stimulated, although reflex contraction of the leg is apparently delayed for a long time, this delay is to a great extent only apparent and not real.[1]

It is true that the vigorous contraction of the muscles which suffices to raise the limb is much delayed, but a contraction of these muscles commences at very nearly the same time that it would do if the inhibitory apparatus were not stimulated. This shortening of the muscle goes on very gradually for a considerable time, and then culminates in a sudden vigorous contraction, the total height of which is greater than that of the contraction which would have occurred without irritation of the inhibitory centres. It is very difficult to explain this result on the ordinary hypothesis, but easy enough on that of interference. According to it we suppose that a stimulus applied to the foot has been transmitted as usual from the sensory to the motor cells of the cord, and thence to the muscles, so as to initiate contraction in them. This stimulus would correspond to the first half wave in the diagram (Fig. 2). The subsequent waves of stimulation which would have proceeded from the motor ganglia have been interfered with by the stimuli passing down from the so-called inhibitory centre, but their times being not arranged so that each wave from the brain should fall half a wavelength behind that in the cord, the stimuli at length cease to interfere, and the contraction, which has gone on gradually increasing as the interference diminishes, at last finishes abruptly.

The part of the brain which ought to correspond in higher animals to the optic lobes in frogs is the corpora quadrigemina, but irritation of these parts has not been found to have any marked inhibitory action upon reflexes in the limbs.[2]

Irritation of the frontal lobes in puppies has, however, been found by Simonoff[3] to exercise an inhibitory action; but, according to Ferrier, abolition of the frontal lobes in monkeys does not produce any very obvious effect upon the animal.[4] We know that by an effort of the will, we are able either to increase or diminish reflex action, and it might appear probable that irritation of the motor tracts in the cerebrum might have an inhibitory action on reflexes. Irritation of the cerebral motor areas has not been found to exercise any definite inhibitory action upon reflexes, but on the other hand Exner[5] has found, if a stimulus be applied simultaneously to a motor area in the brain and to an extremity, the two stimuli aid one another, and produce a greater effect than they would separately. As irritation

[1] Continued from p. 439.
[2] Uber die elektr. und chem. Reizung der sensiblen Ruckenmarksnerven des Frosches, 1868. Quoted by v. Boetticher, *op. cit.* p. 6.
[3] Goltz, *op. cit.* p. 42.
[4] Lewisson, "Ueber Hemmung der Thätigkeit der motor. Nervencentren durch Reizung sensibler Nerven," Archiv. f. Anatomie u. Physiol. 1869.
[5] Fick, Verhandlungen der physikalisch medicinischen Gesellschaft zu Wurzburg, April 23, 1870.
[6] Freusberg, "Ueber die Erregung u. Hemmung d. Thätigkeit d. nervösen Centralorgane," Pflüger's Archiv. x. 174.

[1] Cyon, Ludwig's Festgabe, p. clxviii.
[2] Setschenow Physiologische Studien über die Hemmungs-mechanismen für die Reflexthätigkeit des Rückenmarkes im Gehirn des Frosches, p. 3 (Berlin: Hirschwald, 1863).
[3] Simonoff, Arch. f. Anat. u. Phys. p. 545, 1866.
[4] Ferrier, Functions of the Brain, p. 230 (London, 1876).
[5] Exner, Pflüger's Archiv. xxviii. 487.

of the cerebral motor areas, therefore, does not exercise a definite inhibitory action upon reflexes, but does under certain conditions markedly increase them, one might expect that their removal would diminish reflex action. Such a diminution actually occurs when they are destroyed in disease, but when the brain is removed layer by layer in operations upon animals, it is usually found that the reflex increases in proportion to the quantity removed. When the whole brain is removed, the reflex action is greater than when it is present, and as the cord is cut away layer by layer, the excitability of the seg nent below appears to be increased; each layer, as has already been mentioned, appearing to have an inhibitory influence on the one below it. But this is not always the case, because we sometimes find on removal of the various parts of the brain or of the spinal cord that the section completely abolishes reflex action for the time.

We are accustomed frequently to cloak our ignorance of the true cause of this abolition by saying it is due to the shock of operation or something of that sort; but looking the facts fairly in the face, we find that sometimes removal of the upper part of the brain or spinal cord causes increase and sometimes diminution of reflex-action in the parts below. At present we have no satisfactory explanation of this phenomenon, but if we suppose in the one case the nervous matter to have been removed in such a way as to cause an interference of the stimuli passing along from cell to cell, and in the other to cause a coincidence, we can readily understand the occurrence of the two different conditions. Moreover, we have said several times, that inhibition or stimulation are only relative conditions depending on the length of path along which the stimulus has to travel, and the rapidity with which it travels. The length of path remaining the same, the occurrence of stimulation or inhibition depends upon the rapidity of passage of the stimulus. The same length of path which is just sufficient to throw successive impulses of a slowly travelling stimulation half a wave-length behind the other, and produce inhibition, may be just sufficient to throw the vibrations of another more rapidly transmitted stimulus a whole wave-length behind, and produce increased instead of diminished action.

If the hypothesis that inhibition is produced by interference be true, we shall be able to test it by seeing whether stimulation of certain nerves which, under the ordinary conditions produce inhibition, do so when the rate of transmission of nervous impulses is altered. The length of path being the same, if we alter the rapidity of transmission it is probable that as the rapidity diminishes, the inhibition will be converted into stimulation, again possibly passing into inhibition, according as the stimuli, which we normally suppose to be half a wave-length behind each other, are thrown a whole wave-length, or a wave-length and a half behind each other. At a certain period, also, the waves of stimulation will be neither a whole nor a half wave-length behind each other, but the fraction of a wave-length. In such cases we shall neither have constant coincidence, nor constant interference, but we shall have rhythmical coincidence and rhythmical interference, the result of which will be that we shall neither get constant motion, nor constant arrest of motion, but alternate motion and rest. In other words we shall neither have complete rest nor tonic contractions, but intermittent or clonic contractions. Now this condition is exactly what we do find when one sciatic of a frog is irritated twenty-four hours after it has been exposed. We have already mentioned that when irritated immediately after exposure it had the effect simply of abolishing reflex action in the other leg; but the same irritation applied in the same manner after many hours, instead of causing arrest in the other leg, causes clonic convulsions.[1]

This occurrence is very hard to explain on the ordinary hypothesis of separate and distinct inhibitory centres, but it agrees perfectly with the hypothesis that inhibition and stimulation are merely relative conditions.

I have repeated Nothnagel's experiments, but I have not got the same results. Irritation of the sciatic nerve indeed caused a certain diminution in reflex at first, but irritation after twenty-four hours caused no clonic convulsions, it merely appeared somewhat to stimulate reflex action in the other leg. The reason of this discrepancy in our results is probably that the temperature was different in the two cases. Nothnagel's results were published in March, and his experiments were probably performed during cold weather, while mine were done during very mild weather. If the effects which he noticed were due to definite inhibitory centres in the spinal cord similar experiments should have had similar results in his hands and mine If on the other hand the effects simply depend on the rate of the transmission of nervous impulses it is easy to understand why the results were different in the two cases.

There are also certain phenomena connected with the action of drugs on the spinal cord which are almost inexplicable on the ordinary hypothesis, but which are readily explained on that of interference. Thus belladonna when given to frogs causes gradually increasing weakness of respiration and movement, until at length voluntary and respiratory movements are entirely abolished, and the afferent and efferent nerves are greatly weakened. Later still, both afferent and efferent nerves are completely paralysed, and the only sign of vitality is an occasional and hardly perceptible beat of the heart and retention of irritability in the striated muscles. The animal appears to be dead, and was believed to be dead, until Fraser made the observation that if allowed to remain in this condition for four or five days, the apparent death passed away and was succeeded by a state of spinal excitement. The forearms passed from a state of complete flaccidity to one of rigid tonic contraction. The respiratory movements reappeared; the cardiac action became stronger, and the posterior extremities extended. In this condition a touch upon the skin caused violent tetanus usually opisthotonic, lasting from two to ten seconds, and succeeded by a series of clonic spasms. A little later still the convulsions change their character and become emprosthotonic. These symptoms are due to the action of the poison upon the spinal cord itself, for they continue independently in the parts connected with each segment of the cord when it has been divided.

This action may be imitated by a combination of a paralysing and exciting agent such as strychnia and methyl-strychnia. Fraser concludes that the effects of large doses of atropia just described are due to a combined stimulant and paralysing action of the substance on the cord, and that the difference in the relations of these effects to each other, which are seen in different species of animals, may be explained by this combination acting on special varieties of organisation.

T. LAUDER BRUNTON

(To be continued.)

[1] Nothnagel, Centralblatt f. d. med. Wiss. March 28, 1869, p. 211.

NOTES

THE Queen has signified her intention of opening the International Fisheries Exhibition, at South Kensington, on Saturday, May 12.

BARON NORDENSKJÖLD writes to us that he has definitely settled to start for the interior from Auleitsivik Fjord on the west coast, and then, in September, to go round Cape Farewell along the east coast to the north.

A MOST interesting letter has been received at Kew Observatory from Mr. Cooksley, of Capt. Dawson's expedition to Fort Rae. They arrived on August 30, started the meteorologica observations on September 1, and the magnetical observations on September 3. Apparently all was well at the date of the letter, December 19, 1882.

Mr. William Henry M. Christie, F.R.S., Astronomer Royal, has been elected by the Committee to be a Member of the Athenæum Club, under Rule 2, which provides for the admission of persons distinguished in literature, science, or the arts, or for public services.

M. Dumas was not able to be present at Monday's sitting of the Academy of Sciences. His recovery is not quite so rapid as it was hoped and expected to be.

In the Civil Service Estimates for 1883-4 the total vote for education, science, and art amounts to £4,748,556, a net increase of £165,531 over the previous year.

The sixth International Congress of Orientalists will be opened at Leyden on September 10 next.

Mr. Milne, who has recently returned to his post in Japan, has suggested to the Japanese Government the great utility of establishing a series of observations for the study of earthquakes; earth-tremors; earth-pulsations; earth-oscillations, or permanent changes of level; terrestrial magnetism; fluctuations of underground water; earth temperatures; eruptive phenomena, &c. We trust that the Japanese Government will see it to be their interest, in a land of earthquakes, as well as the interest of science, to take the advice of Mr. Milne, who has already done so much for seismology. Mr. Milne writes that he is more and more convinced that there are "earthquakes" of so slow period that neither observers nor ordinary instruments record them. The Japanese papers report that a volcano in the Asuma Yuma range has burst out.

Mr. A. H. Keane has been elected Corresponding Member of the Italian Anthropological Society.

Mr. Robert Lindsay has been appointed Curator of the Edinburgh Botanic Garden.

A special general meeting of members only of the Association for the Improvement of Geometrical Teaching will be held at 8 p.m., on March 20, at University College, (1) to authorise the publication of Books i. and ii. of the Elementary Geometry as revised by the committee; (2) to appoint three trustees of the property of the Association.

The Institution of Naval Architects began its annual meeting yesterday, and continues to-day and to-morrow. Among the papers in the programme are the following:—On certain points of importance in the construction of ships of war, by Capt. G. H. Noel, R.N.; The influence of the Board of Trade rules for boilers upon the commercial marine, by J. T. Milton; Sea-going torpedo-boats, by M. J. A. Normand; Some experiments to test the resistance of a first-class torpedo boat, by A. F. Yarrow; On the modes of estimating the strains to which steamers are subject, by Wigham Richardson; On the extinctive effect of free water on the rolling of ships, by P. Watts; A description of a method of investigation of screw propeller efficiency, by H. B. Froude; The speed and form of steamships considered in relation to length of voyage, by James Hamilton; On fog-signalling, by J. MacFarlane Gray; Method of obtaining the desired displacement in designing ships, by R. Zimmermann.

The Royal Commissioners for Technical Education—Messrs. Samuelson, M.P., Woodall, M.P., P. Magnus, and Swire Smith—accompanied by Mr. G. R. Redgrave (secretary), visited Birmingham on March 8, and devoted several days to a careful inspection of the Mason College, Midland Institute, &c. The Commissioners were much interested in the system of practical science instruction which is being carried on in the Board Schools under the direction of Mr. Jerome Harrison, F.G.S., and both heard lessons given in the new Icknield Street Schools, and examined the newly built laboratory, &c. We hope shortly to present to our readers an account of the system by which about 2500 of the elder boys and girls in the Birmingham Board Schools are now receiving lessons in elementary science, at, practically, little or no extra cost to the town of Birmingham.

It is proposed to establish the new Professorship of Physiology at Cambridge in the ensuing Easter term. The appointment of a Professor of Pathology is also declared by the General Board of Studies to be urgent. The Medical Board has recently unanimously reported that the appointment of a Professor of Surgery is urgently necessary; and Prof. Humphrey has offered to resign the Professorship of Anatomy and accept the Professorship of Surgery for the present, without stipend.

The death is announced of William Desborough Cooley, the author of a History of Geographical Discovery, a Physical Geography, and other geographical works, and who at one time wrote largely on theoretical African geography.

The half-yearly General Meeting of the Scottish Meteorological Society will be held to-day. The business before the meeting is: (1) Report from the Council of the Society; (2) Address by Prof. Piazzi Smyth, at request of the Council, on Rainband Spectroscopy; (3) the Meteorology of Ben Nevis in 1882, by Clement L. Wragge.

The *Réforme*, the new Paris paper, which has established telegraphic communication with London, publishes daily a translation of the previsions issued by the Meteorological Board of London, which is read by the French public at the same time as in England.

M. Lalanne, Member of the Academy of Sciences, has been elected a Life Senator in the Liberal interest. It seems to be becoming almost a constant practice of the French Senate to select its "Irremovables" from among the several classes of the Institute.

An Electrotechnical Society has been formed at Vienna, similar to the one existing and flourishing at Berlin.

The German astronomers who had proceeded to Punta Arenas in Magellan's Straits in order to observe the last transit of Venus have at last returned to Germany.

A meteoric stone weighing a hundredweight fell near Alfianello, near Brescia, on February 16 last. It entered the ground to a depth of two metres, and caused a shock like that of a slight earthquake.

A memoir, for which a gold medal (600 francs) has been awarded by the Belgian Academy, is by Prof. Fredericq, of Liege; it is on the influence of the nervous system on the regulation of temperature in warm-blooded animals. After many experiments, the author affirms that cold acts on the sensitive nerves of the skin, and through them on centres of thermogenesis in the *medulla oblongata*. These centres react, and through centrifugal nerves cause an increase of the phenomena of interstitial combustion, especially in the muscles; but we also fight with cold by a diminution of the losses of heat, the vessels of the skin being constricted, owing to an excitation of the vaso-constrictor centres, through impression of the sensitive nerves of the skin by cold. M. Fredericq considers that the system does not (as most physiologists say) contend against heat by diminishing the production of heat. The regulation of temperature is simply based on increase of the losses of heat, by dilatation of the cutaneous vessels, by acceleration of the outer circulation, increased secretion and evaporation of sweat, and greater admission of air to the lungs. The vaso-dilator nerve centres (sudorific and respiratory) are excited directly by superheated blood.

An interesting trial of an electrically-moved tramcar took place on Monday at Kew, and, notwithstanding some inevitable hitches, may be regarded as fairly successful. The peculiarity of the application of electricity in the present case lies in the use made of accumulators. The car was constructed at the Electrical Power Storage Company's works at Millwall, and is of the usual dimensions for carrying forty-six inside and outside passengers. It weighs, with its accumulators and machinery, but without any passengers, four and a half tons. Under the inside seats of this tramcar is placed the accumulator, consisting of fifty Faure-Sellon-Volckmar cells, each measuring 13 inches by 11 inches by 7 inches, and each weighing about 80 lbs. This accumulator, when fully charged, is capable of working the tramcar with its maximum load for seven hours, which means half a day of tramway service. From the accumulators the current is communicated by insulated wire to a Siemens' dynamo placed underneath the car, which acts as a motor, the motion being transmitted to the axle of the wheels through a driving-belt. To start the car the current is switched on from the accumulator to the dynamo, the armature of which being set in motion, the power is communicated to the driving wheels. The car can be driven from either end, and the power required can be exactly apportioned to the work to be done by using a greater or lesser number of cells. On a level road, for instance, with a light load, only a comparatively small number of cells will be necessary, but with a heavy load or on a rising gradient greater power will be required, and additional cells must be switched in. The action of the motor, and consequently the direction of the car, can be readily reversed by reversing the current, and the car can also be as readily stopped by shutting off the current entirely and applying the handbrake with which the car is fitted. At night the car is lighted by means of four Swan incandescent lamps, two of which are placed under the roof and one at each end of the car. All the lamps derive their current from the accumulator. The car is also fitted with electric bells, worked from the same source, and is to be run regularly on the Acton tramway line. The Storage Company also had a successful trial on Monday at Kew of a launch fitted with a battery of forty cells and a Siemens' dynamo.

We learn from the last number of the *Journal* of the Russian Chemical and Physical Society (1883, fascicule 1) that, at a recent meeting of the Society, Prof. Mendeléeff made a communication on the applicability of the third law of Newton to the mechanical explanation of chemical substitutions, and especially to the expression of the structure of hydrocarbons. If we admit not only the substitution of hydrogen by methyl, but also the substitution of CH_2 by H_2, and of CH by H_3—as must be according to the law of substitutions as deduced from the third law of Newton—we can not only explain, but also predict, all cases of isomerism, without recurring to the usual conceptions as to the connections and atomicities of elements. Thus, benzene can be understood as a normal butane, $CH_3CH_2CH_2CH_3$, or $(CH_3CH_2)_2$, where a double symmetrical substitution of H_3 by CH has taken place, the H_2 having been taken from CH_3 and the third H from CH_2, so that only the CH groups are left; benzene being thus $= \left(\frac{CHCH}{CH}\right)^2$. It would explain the isomer of benzene, dipropargyl the formation from acetylene, and the substitution and addition products from benzene.

The additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus erythræus* ♂) from India, presented by Mr. C. F. Henshaw; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Mr. F. C. H. Dadswell; a Herring Gull (*Larus argentatus*), British, presented by Miss Ella Vicars; three Common Swans (*Cygnus olor*), British, presented by Mr. J. Hargreaves; four Prairie Grouse (*Tetrao cupido*) from Iowa, North America, presented by Mr. Henry Nash; a Daubenton's Curassow (*Crax daubentoni* ♀) from Venezuela, presented by Mr. Rowland Ward, F.Z.S.; a North American Turkey (*Meleagris gallo-pavo* ♂) from North America, presented by His Grace the Duke of Argyll, K.T., F.R.S.; a Malbrouck Monkey (*Cercopithecus cynosurus*) from West Africa, deposited; a Gaimard's Rat Kangaroo (*Hypsiprymnus gaimardi* ♀), three Coypu Rats (*Myopotamus coypus*), born in the Gardens.

GEOGRAPHY OF THE CAUCASUS

Of the several branches of the Russian Geographical Society, the Caucasian and the East Siberian are well known for the amount of valuable geographical work they have done during the thirty years or so of their existence. The high scientific interest connected with the exploration of the Caucasus is obvious. The scientific exploration of the Alps has revealed to us a new world; but the highlands of the Caucasus, with the high plateaux of Trauscaucasia, afford a still greater variety of geological and physico-geographical features than the Alps; besides, situated as they are on the boundary between the moist climate of the west and the dry one of the east, between the deeply-indented coasts of Europe and the deserts and plateaux of Asia, between the young civilisations of the west and the old civilisations of the east, the Caucasian highlands afford such a variety of climatic, botanical, zoological, and ethnological features as hardly can be met with in any other country of the world. Very much remains to be done to bring these highlands within the domain of scientific knowledge. In what has been done up to the present, the Caucasian branch of the Russian Geographical Society has always had a good share, either by direct exploration, or by bringing to the knowledge of the scientific world such explorations as otherwise would have remained unknown in the archives of different Government offices, or by giving a scientific character to such explorations as were made for military or diplomatic purposes. Besides, the activity of the Caucasian Geographical Society is not limited to the Caucasus. Closely connected with the General Staff of Tiflis, it extends its explorations to the Trans-Caspian region, to Asia Minor, and to Persia; and closely follows the Russian military expeditions, surveyors, and diplomatists who eagerly visit these countries.

Unfortunately the publications of the Caucasian branch—the *Zapiski* or *Memoirs*, and the *Izvestia* or *Bulletin*—are but very insufficiently known abroad, *Petermann's Mittheilungen* being nearly the sole channel through which they are brought to the notice of the scientific world. The following summary, therefore, of the last publications of the Society will be of some use to scientific geographers. Without attempting to review all the volumes of the *Memoirs* and *Izvestia* which have appeared, we shall limit this paper to a review of the two last of each, the chief results of the papers contained in former volumes being already embodied in Elisée Reclus's "Géographie Universelle."

Several papers of the sixth volume of the *Izvestia* are devoted to the geodesy of the Caucasus and adjacent countries. During the war of 1878 a considerable amount of geodetical work was done in the province of Kars and in Asia Minor, and M. Kulberg gives the latitudes and longitudes determined. The longitudes of Kars, Erzerum, and Mysun were determined by means of telegraphic signals (the accuracy of this method being such as to reduce the probable error between Pulkova and Vladivostok, on the Pacific, to 0″·14, that is, to 50 yards on a distance of 7000 miles). Other longitudes were determined by chronometer. A trigonometrical network was extended to Erzerum, and numerous surveys were made. The longitudes of several points at Constantinople were determined with great accuracy by General Stebnitzky, as well as that of Batum by M. Kulberg.

The same volume contains also a list of latitudes and longitudes determined on the banks of the Emba and on the Mangishlak peninsula.—M. Kulberg contributes also an interesting paper on the results of determinations of lengths of the pendulum on the Caucusus, in order to determine the increase of gravity caused by the Caucasian chain. The observations were made at

Tiflis, Elizabethpol, Dushet, Gudaur, and Vladikavkaz with the same pendulums that were used for a similar purpose in Russia and afterwards in India. It results from the observations that in all the above-named localities, the lengths of the seconds pendulum are less than the calculated ones, namely, by 0·0037 Paris lines at Batum, 0·0455 at Elizabethpol, 0·0445 at Tiflis, 0·0476 at Vladikavkaz, 0·1171 at Dushet, and 0·1226 at Gudaur. Thus, the geoid (or the true figure of the earth's surface, as determined by the directions of the pendulum) nearly corresponds with the spheroid on the shores of the Black Sea; it rises above it by 1587 feet at Tiflis, and by 1622 feet at Elizabethpol. It rises further north, reaching 4175 feet at Dushet, and 4371 at Gudaur, but soon falls, and has at Vladikavkaz, on the northern slope of the main chain, nearly the same height as at Tiflis, that is, 1697 feet above the spheroid.

The purely geographical papers are numerous:—M. Bakradze contributes a paper on the Batum province,—the Saatabago of antiquity,—and the basin of the Chorokh River, inclosed by mountains 10,000 feet high, and often of volcanic origin. The vegetation of the province is perhaps still more luxuriant than in other parts on the coasts of the Black Sea, where it altogether develops with a prodigious strength, owing to the great amount of rain; vines cover the trees in the coast district. But the country is thinly peopled. The old Georgian population is forgetting its language, and is disappearing from the upper parts of the basin of the Chorokh; the Lazes occupy only nineteen hamlets; the Armenians number no more than 570 houses; the Abhazes and Circassians, who have immigrated from the Caucasus, and Kurds are also scarce. —Another paper, by M. Levashoff, gives a detailed description of the mountains on the left bank of the Chorokh, between Batum and Artvin; these mountains are spurs of the Anti-Taurus chain which terminates close by the Chorokh in the peak Kvahid, 10,390 feet high. The left affluents of the Chorokh flow in narrow gorges, the bottom of which, and sometimes the slopes, are occupied by hamlets of Mussulman Gurians. Each of these gorges has its own individuality, and communication between them is very difficult. The small villages of each gorge are quite isolated from those of a neighbouring gorge. The fields of Indian corn and rice are often scratched on the small terraces on the slopes of mountains, often at a height of 3000 feet above the sea-level, and close by ruins of old small fortresses, each of which has its own legend. The tributaries of the Chorokh become wild streams after each rain, and the avalanches are dangerous enemies. The forests, which cover the mountains from top to bottom, are peopled with bears, wolves, and foxes. Further down, towards the sea-coast, the gorges become wider, and their bottom is covered with gardens. The Chorokh itself has a breadth of twenty-five to fifty yards, and runs with such rapidity that the *kayouks*, or local boats, managed with great skill through the rapids, pass the distance from Artvin to Batum (more than fifty miles) in four or five hours.—We notice also in the same volume a paper on the villayet of Trebizond, translated from the German; the letter of Mr. Gifford Palgrave on vestiges of glacial action in North-eastern Anatolia, translated from a former volume of NATURE; the account of a party who undertook to climb the Elbrouz, but stopped 3500 feet short of its summit; and a notice on Western Daghestan.—M. Chernyavsky gives a detailed description of periodical phenomena in the life of plants at Sukhum-kaleh, during the autumn, winter, and spring of the years 1871 to 1875.

M. Seidlitz contributes a note on goitre and cretinism on the Caucasus. It is spread in several valleys of the main chain, especially in the Upper Svanetia; in the valley of the Tzhenis-tzhali many cases of cretinism were noticed. Altogether the small people of Svanets, which numbers only 12,000 souls, seem to be in a state of degeneracy, and ought to have an infusion of fresh blood from without. The goitre was noticed also in adjacent parts of the upper basin of the Rion river, among the Osets. On the northern slope of the Caucasus, west of the Kazbek peak, as well as in the basin of the Kuban, the goitre was not noticed; but it is known in Western Daghestan and in the valleys of the Andian Koysou ridge. It is cured by the waters of springs containing carbonic acid. Women are more subject to this disease than men. Another disease, of hysterical character, endemic to the same locality, is worthy of notice. The men and women affected bark like dogs, and the aborigines consider it as the result of bewitching, in which the "barking grass," as the Avars say (a kind of *Orchis*), is used by the bewitchers. In the Anti-Caucasus goitre was noticed in the Nakhichevan district and in the Batum province. It is always endemic, and never takes an epidemic character, as was the case in 1877 at Kokan, in Turkestan, where 9 per cent. of the soldiers and officers were seized with this disease after a year's stay at Kokan.

The ethnography of the Caucasus occupies a large place in this volume of the *Izvestia*. M. Zagursky contributes a note on the supposed kinship of the Osets with the Etruscans, and shows that it would be rather difficult to establish this kinship on account of a want of likeness between the Osetian language and the little we know about the language of the Etruscans.—Prof. Patkanoff contributes a valuable paper on the place occupied by the Armenian language among other Indo-European languages. He concludes that, and shows why, the question still remains open. Several linguists consider the Armenian language as decidedly belonging to the Iranian group, whilst others classify it with the European group. Lagarde distinguishes in it three elements: the Haikan, the Arkasid, and the Sassanid elements; the two latter are Iranian, but the Haikan element belongs to a family of languages the oldest of which is the Zend. Hübschmann concludes that it occupies an intermediate place between the Iranian languages and the Slavo-Lithuanians; and Fr. Müller, a partisan of its Iranian origin, admits that it has some kinship with the Slavo-Lithuanian languages. Prof. Patkanoff concludes that it occupies an intermediate place between these two, and is a representative of an extinct group of Indo-European languages, which formerly was spread perhaps in Asia Minor.—We notice also several notes: on the dolmens of the Maykop district; on the descriptions of the first physical training given to children by different Caucasian peoples (these interesting descriptions, comprising nearly all Caucasian peoples, were sent to Moscow to Dr. Pokrovsky); on archæological discoveries in the province of Kuban, &c.

The *Izvestia* contain also many interesting short notices on the scientific work done on the Caucasus by other Societies and private persons; and bibliographical notices on different works dealing with the Caucasus. Elisée Reclus's description of the Caucasus in the "Géographie Universelle" is considered as the best that has yet appeared, and it is proposed to translate it into Russian, with notes and additions.

The Appendix contains several valuable papers, namely: a note on the Bosphorus and Constantinople, by M. Stebnitzky (with a map), containing some new information on currents in the Bosphorus and on the mean temperature at Pera, according to new observations of M. Kumbari (14°·3 Cels.); a note on the Aysors of the province of Erivan; a note on the population of Turkish Armenia, by M. Eritsoff (1,162,957, out of which 214,350 are Turks, 357,577 Kurds, 498,007 Armenians, 41,682 Kizilbashes, 25,516 Greeks, and 17,400 Aysors); and several translations.

The geodetical part is represented in the seventh volume of the *Izvestia* by a paper by M. Kulberg, on the influence of the oscillations of the supporting disc of the pendulum of the Russian Academy on the measured length of the seconds pendulum. The correction due to this cause was found to be equal to +0·0650 Paris lines, which correction closely corresponds to the difference between the Russian pendulum and that of Cater, which was found at Kew to be equal to 0·0056 inches, or 0·0631 Paris lines. The corrected lengths of the seconds pendulum at the above-named localities (at 13° Réaumur, and reduced to the sea-level) would be thus: 440·2734 Paris lines at the Tiflis Observatory, 440·3279 at Vladikavkaz, 440·2126 at Gudaur, 440·2018 at Dushet, 440·3172 at Batum, and 440·2364 at Elizabethpol.—A biographical notice of the late Gen. Khodzko gives an account of the immense work he performed for the triangulation of the Caucasus. He began this work in 1847 with the Anti-Caucasus, always taking for himself the most difficult parts of the work, such as the measurements on the summit of Alaghöz (13,436 feet high), or of Ararat (16,916 feet), 6000 feet above the snow-line, and of other high summits. On June 28, 1851, he observed an eclipse of the sun on the summit of Galavdur, at a height of 10,380 feet, and noticed the protuberances which were doubted at that time as belonging to the atmosphere of the sun. The geodetical determination of 1386 points in Trans-Caucasia was terminated in 1854, but that of Northern Caucasus was begun only in 1860, and was connected with those of Russia in 1864. The accuracy of this immense work and its importance for geodesy and physical geography are well known.

The same volume contains several valuable geographical papers and maps. Among the latter the first place belongs to those of the frontier between Russia and Persia, from the Caspian to Babadurmaz, and of the frontier between Russia and Turkey, from the Black Sea to Ararat; both are accompanied with maps.—General Stebnitzky contributes a most valuable sketch of all that is known about the Pontian range, which follows the southern coast of the Black Sea from the Yeshil-irmak to the Chorokh.—M. Stepanoff contributes an interesting paper on the province of Kars, recently annexed to Russia; and M. Bakradze one on the ethnography of the same province. The province consists of three different parts: the lowlands of the basin of the Olti River, covered with clay hills intersected with irrigation canals, and offering great advantages for gardening; the 5000 to 6000 feet high plateau of Kars, 50 miles long and 35 miles wide, bordered with mountains the highest of which reaches 9700 feet. It is covered with lavas and basalts, deeply cut by rivers; the mountains are devoid of wood; agriculture is carried on on this plateau, notwithstanding its great height. The third part of the province is again a plateau, 6000 to 7000 feet high, where agriculture becomes impossible, but covered with good pasture-land, and dotted with lakes. The population of the province has suffered much from wars. In the basin of the Olti and in the north-east it was formerly Georgian, who have become Mussulmans; the Kurds make one-sixth of the population. The basins of the Araxes and Kars rivers were formerly occupied by Armenians. The capital of Armenia, Ani, now in ruins, was situated here. After 1830, no less than 90,000 Armenians emigrated into Russian dominions, whilst Turks, Turcomans, Karapakhs, and Caucasian emigrants (Kabards and Osets) occupied their place, forming thus a most mixed population. Presently the Mussulmans emigrated back from the province (no less than 65,447 souls during two years), and 7100 Russian Nonconformists have occupied their place, as well as 10,000 Greeks and about 4100 Armenians. The migration of whole populations is thus still going on in our times, as it was going on formerly after the great wars of the past. It is easy to foresee that the country contains most remarkable Armenian antiquities, such as churches built in the ninth and tenth centuries.

Since the year 1880 the director of the Tiflis Observatory, M. Milberg, has undertaken a series of measurements of the temperature of the ground, together with measurements of temperature by a black-bulb thermometer suspended 1·5 metres above the ground, and M. Smirnoff analyses the results of these measurements. The blackened thermometer has given a somewhat higher average temperature for the year than the usual thermometer suspended in shade (12°·7 Celsius, instead of 11°·6); the same was observed, as is known, in England. At the same time its maxima are obviously higher and its minima are lower than those of the usual thermometer in shade, its range being from −14°·5 to +42°·9, instead of −12°·0 to +37°·6; whilst the range of average temperatures of different months was 28°·6 instead of 27°·5 in the shade. The underground thermometers were placed at depths of 1, 2, 5, 12, 20, 41, and 79 centimetres, and were observed, the six former every hour, and the last each three hours. Two other thermometers, placed at depths of 1·6 and 3·5 metres, were observed once a day. The whole series of observations is published in the *Memoirs* of the Caucasian Agricultural Society, and the *Izvestia* give the monthly averages, as well as a *résumé* of the results. We shall add to this *résumé* that the observations at Tiflis show well the retardation of seasons at a depth of 79 centimetres, the coldest and warmest months being February and August, instead of January and July. The frosts at the spot where the observations were made do not penetrate deeper than 40 centimetres.—M. Maslovsky gives some observations of temperature at Askhabad, in the Akhaltekke oasis, during the summer months; the moisture in May was but 31 to 33 per cent., falling as low as 17 per cent., and reaching sometimes 59 per cent.—M. Chernyavsky gives the Abkhaze, Mingrelian, and Georgian names of different plants.

Several papers deal with the population of the Caucasus: M. Zagursky has contributed a paper on the ethnographical maps of the Caucasus, and, after having sharply criticised the works of M. Rittich, recommends as the best ethnographical map of the Caucasus, that which was published by M. Seidlitz in *Petermann's Mittheilungen*, and in which M. Zagursky has embodied the results of the little-known but remarkable linguistic works of the late General Uslar. Still this map leaves much to desire and ought to be accompanied by an explanatory memoir.—The much-debated question as to the number of Armenians in the Russian dominions is discussed by M. Eritsoff, who comes to the conclusion that it must be (taking into account the increase of population until 1881) 860,456 on the Caucasus, and 56,536 in European Russia.—M. von Eckert gives the results of anthropological measurements he has made, according to the instructions of Virchow, on 30 Adighes, 7 Ingushes, 11 Georgians, 14 Osets, 14 Armenians, 9 Aderbijan Tartars, and 80 Little-Russians from the Government of Kharkoff. They proved to be all brachycephalic, the average indexes being 80·7 for the Osets, 80·9 for the Tartars, 81·9 for the Ingushes, 82·0 for the Adighes, 82·2 for the Little-Russians, 83·3 for the Georgians, and 86·5 for the Armenians. The percentage of broad faces (*chamäprosop* faces, that is, those where the breadth between the cheek-bones is less than 89·9 per cent. of the length of the face, measured from the upper part of the nose to the lowest part of the chin) is 44 for Tartars, 64 for Armenians, 71 to 77 for Osets, Georgians, and Adighes, 86 for Ingushes, and 90 for Little-Russians.

The same volume contains several notes: on the Charjui; a list of heights in the Aderbijan; on the Scotch colony at Kuras and many others; and a bibliographical notice, by M. Stebnitzky, of Elisée Reclus's description of the Caucasus, which is spoken of in high terms.—The Appendix contains the translation, with notes, of the memoir, by Major Trotter, on the Kurds in Asia Minor, and of the Consular Report of W. Gifford Palgrave on the provinces of Trebizond, Sivas, and Kastamuni.

The eleventh volume of the *Memoirs* of the Caucasian Geographical Society contains three papers by M. Petrusevitch: on the Turcomans between the Uzboy and the northern borders of Persia; on the north-eastern provinces of Khorassan; and on the south-eastern coast of the Caspian and the routes to Merv. Some of these papers are already known to English geographers; and the others probably will be translated in full. They are accompanied by a map of the Russian Trans-Caspian dominions and of Northern Persia.

The twelfth volume of the *Memoirs* contains the first part of a large work, by the late General Uslar, on the ancient history of the Caucasus. It deals with the oldest traditions about the Caucasus, and is a most remarkable attempt at a *scientific* inquiry into the remotest history of this country. It is accompanied by a biographical notice of General Uslar, by M. Zagursky, his collaborator and follower. It is certain that M. Uslar, who pursued for many years the truly scientific exploration of Caucasian languages (undertaken first by Sjögren), has done in this branch far more than anybody else. But his works—which were only lithographed in a few copies, and each of which is not only a serious study of separate languages, but also a thorough description of the nation it deals with—are very little known, and this only from the short reports that were made on them by the late Member of the Russian Academy of Sciences, M. Schiefner. The few pages in which M. Zagursky gives an account of the work of Uslar, of the methods he followed, and of the results he arrived at, ought to be translated in full, as surely they would be most welcome to all those in England who are interested in the study of ethnology. They deserve much more than a short notice. P. K.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—Prof. Moseley and Prof. Burdon Sanderson have been appointed *ex officio* Members of the Board of the Faculty of Natural Science.

Prof. Clifton has been elected a Member of the Hebdomadal Council in place of the late Prof. Smith.

The Professorship of Archæology and Art, founded by the late Commissioners out of the revenues of Lincoln College, has been in abeyance owing to the proposed statute not having received the Queen's assent. The College now proposes to endow the professorship, and a statute will be promulgated at the beginning of next term, providing for a Professor of Classical Archæology and Art, "who shall lecture on the arts and manufactures, monuments, coins, and inscriptions of classical antiquity, and on Asiatic and Egyptian antiquities, or on some of those subjects."

Mr. G. A. Buckmaster, B.A., and late Natural Science Demy of Magdalen College, has, after examination, been elected to the Radcliffe Travelling Fellowship. Mr. Buckmaster also obtained the Burdett Coutts Scholarship for proficiency in geology in 1882. The Fellowship is of the annual value of 200*l.*, tenable for three years. The candidate must declare that he intends to graduate in medicine in the University of Oxford, and to travel abroad with a view to his improvement in that study. A Fellow forfeits his Fellowship by spending more than eighteen months within the United Kingdom.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, February.—An account of certain tests of the transverse strength and stiffness of large spruce beams, by G. Lanza.—The abstraction of heat by mechanical energy, by J. Rowbotham.—On the application of the principle of virtual velocities to the determination of the deflection and stresses of frames, by G. F. Swain.—Cone pulleys, by H. W. Spangler.—Dust explosions in breweries, by C. J. Hexamer.—A summary of progress in science and industry, 1882.

THE January number of the *Revue d'Anthropologie* (Premier Fasc., 1883), contains the first part of a valuable memoir—unfortunately left incomplete by Paul Broca at the time of his death—on the cerebral convolutions of the human brain, as shown by casts. Broca, having found from long experience that it is almost impossible to obtain specimens of a normal cerebrum in which both hemispheres are symmetrical, devoted his attention to the preparation, for the special use of students, of exact models of the convolutions divested of the secondary folds, whose extreme variability makes it difficult to determine their true character. The memoir now first printed supplies an exhaustive description of the brain at every stage from fœtal to senile life, with explanations of the significance of the different colours used in the preparation of the models, which have been completed under the superintendence of M. S. Pozzi.—"Buffon Anthropologiste" is the title of a paper by M. P. Topinard, in which he has reprinted the main part of a lecture previously addressed to his class in the École d'Anthropologie. The object of the address is to show that Buffon was the precursor of Darwin and Lamark, both as to the theory of development from one, or at most a few original types, and in his belief in the survival of the fittest. His undoubted contradictions M. Topinard ascribes to the necessity of the times, which compelled him to respect the opinions of the clergy so far as to address to the Faculty of Theology a written retractation of fourteen propositions contained in his "Histoire Naturelle," which that body had condemned. This curious document is here given *in extenso*.—M. C. Sabatier, a former *juge de paix* in Kabylia, in an article on "La femme kabyle," explains the nature of the enactments by which the French Government is endeavouring to ameliorate the condition of women among the Kabyles, who till the present time have virtually been slaves, being treated alike by their fathers and husbands as the least valued of chattels. As the result of long discussions with the heads of the tribes, two new "kanouns," or laws, have been agreed to and put into force, which M. Sabatier believes to be decisive steps towards the social regeneration of the men as much as of the women, one of these enactments restricting the rights of the father to give his daughter in marriage before she has reached a fixed age, and the other freeing a wife from the control of her husband under certain conditions of desertion and neglect.—MM. Corre and Roussel's report of their observations of 200 crania of criminals preserved in the Anatomical Museum of Brest is supplied with various tables exemplifying their precise cranial characteristics, the nature of the crimes committed, the birth-place of the criminals, &c. The general conclusions are in complete accord with those of Bordier, Broca, &c.

Archives des Sciences Physiques et Naturelles, January 15.—On a refractometer for measuring the indices of refraction and the dispersion of solid bodies, by M. Soret.—Theoretical and experimental study of a rapid vessel, by M. Pictet.—On the apparent forces arising from the terrestrial motion, by M. Cellérier.

Bulletin de l'Académie Royale des Sciences de Belgique, No. 12, 1882.—Considerations on the stratigraphic relations of the psammites of Condroz and the schists of the Famenne properly so-called; also on the classification of these Devonian deposits, by M. Mourlon.—Second note on the dynamo-electric machine with solenoid inductor, by M. Plücker.—Determination of the general law ruling the dilatability of any liquid chemically defined, by M. de Heen.—On the aurora borealis of November 17, 1882, by M. Terby.—Reports on prize competitions, &c.—The great discoveries made in physics since the end of last century (lecture at public *séance*), by M. Montigny.—Dwarfs and giants (lecture), by M. Delbœuf.

The Proceedings of the Linnean Society of New South Wales, vol. vii. Part 2 (April–June, 1882); Part 3 (July–September, 1882). The chief contents are, *Botanical:* Botanical notes on Queensland. No. 2, the tropics; No. 3, the Mulgrave River; No. 4, Myrtaceæ.—On a coal-plant from Queensland, by Rev. J. E. Tenison-Woods.—Half-century of plants new to South Queensland, by the Rev. B. Scortechini.—Forage-plants indigenous to New South Wales, by Dr. Woolls.—On *Myoporum platycarpum*, a resin-producing tree of the interior of New South Wales, by K. H. Bennett.—Botanical notes in the neighbourhood of Sydney, by E. Haviland.—*Zoological:* On a new Gobiesox from Tasmania; on two new birds from the Solomons; on a new Coris from Lord Howe's Island, by E. P. Ramsay.—Australian Micro-lepidoptera, No. 7, by E. Meyrick.—On a reported poisonous fly from New Caledonia; new species of fish from New Guinea and Port Jackson; on an insect injurious to the vine, by Wm. Macleay.—On a new species of Allopora, by Rev. J. E. Tenison-Woods.—On Australian fresh-water sponges; on the brain of *Galeocerdo rayneri;* monograph of Australian Aphroditea (Plates 6 to 11); notes on anatomy of pigeons, by W. A. Haswell.—Some new Queensland fishes; on a new species of squill from Moreton Bay, by W. de Vis, B.A.—Habitat of *Cypræa citrina*, of Gray, by J. Brazier.—New variety of *Ovulum depressum*, found at Lifou, by R. C. Rossiter.—On a breeding place of *Platalea flavipes* and *Ardea pacifica*, by K. H. Bennett.—*Geological:* Physical structure and geology of Australia, by Rev. J. E. Tenison-Woods.

Journal of the Asiatic Society of Bengal, vol. li. Part 2, Nos. 2 and 3, 1882 (December 30, 1882) contains:—Some new or rare species of Rhopalocerous Lepidoptera from the Indian region, by Major G. F. L. Marshall, R.E. (Pl. 4).—On an abnormality in the horns of the Hog-deer (*Axis porcinus*), with an amplification of the theory of the evolution of the antlers in ruminants, by John Cockburn.—On the habits of a little-known lizard (*Brachysaura ornata*), by John Cockburn.—Second list of butterflies taken in Sikkim in October, 1882, by L. de Nicéville.

Morphologisches Jahrbuch, eine Zeitschrift für Anatomie und Entwickelungsgeschichte, Bd. 8, Heft 3, contains:—The nasal cavities and lachrymo-nasal canals in amniotic vertebrata, by Dr. E. Legal.—The structure of the hydroid polyps, by Dr. Carl F. Jickeli (Plates 16-18).—The tarsus in the birds and Dinosaurs, by G. Baur (Plates 19 and 20).—Contribution to a knowledge of the development of the vertebral column in Teleostians, by Dr. B. Grassi.—On an hypothesis concerning the phylogenitic derivativion of the blood system of a portion of the Metazoa, by Dr. O. Bütschli.

Reale Istituto Lombardo di Scienze e Lettere Rendiconti, vol. xv. fasc. xx.—Reports on prize-awards; announcements of prize-subjects, &c.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, February 15.—"Description of an Apparatus employed at the Kew Observatory, Richmond, for the Examination of the Dark Glasses and Mirrors of Sextants." By G. M. Whipple, B.Sc., Superintendent.

In the *Proc. Roy. Soc.* for 1867, Prof. Balfour Stewart described an apparatus designed and constructed by Mr. T. Cooke for the determination of the errors of graduation of sextants. This instrument has from that date been constantly in use at the Kew Observatory, and since the introduction of certain unimportant improvements has been found to work very well.

No provision was made, however, for its employment in the determination of the errors of the dark shades used to screen the observer's eyes when the sextant is directed to the sun or moon, and it has been found that errors may exist in the shape of want of parallelism in these glasses, sufficiently large to seriously affect an observation accurate in other respects.

It has also been found that sextant makers are desirous of having the shades examined before proceeding to fit them into their metal mountings, and also to have the surfaces of the mirrors tested for distortion before making the instruments up. With a view to the accomplishment of these ends, for some time past the Kew Committee have undertaken to examine both dark glasses and mirrors, and to mark them with a hall-mark when they are found to answer the requirements necessary for exactitude.

For these purposes the following apparatus has been devised by the author, and brought into use at the Observatory.

A telescope of 3¼ inches aperture and 48 inches focal length, a pair of collimators of 1¼ inch aperture and 10 inches focal length, and a heliostat, are firmly fixed to a stout plank, so that their axes may be in the same horizontal plane. The eyepiece of the telescope carries a parallel wire micrometer.

In order to adjust the instrument, the telescope is directed to the sun, a shade being fitted to the eyepiece and then placed in its Y's focused for parallel rays. The collimators are then fixed on their table with their object-glasses opposed to that of the telescope, the eyepieces and wires having first been removed, and a metal plate with a sharply-cut hole in its centre fitted to their diaphragms.

Light is next reflected down the collimator by the heliostat, and the aperture in the diaphragm being viewed through the telescope, is carefully focused by moving the object-glass of the collimator to and fro by means of its rack and pinion.

The diaphragm aperture is next collimated by rotating the collimator in its bearings.

Both collimators being thus adjusted, they are placed side by side, so that their illuminated sights can be viewed simultaneously in the telescope, appearing as superimposed bright disks 12′ in diameter. They are next separated so that the disks remain merely in contact at the extremity of their horizontal diameters.

The instrument is now ready for use, and the examination of the shades is performed in the following manner:—

The glass to be tested is fixed in a rotating frame in front of the object-glass of one collimator, a corresponding shade being placed between the heliostat and diaphragm of the other collimator. The sun is now directed on to the diaphragms. The coloured disks are viewed through the telescope, when, if the sides of the shade, placed between the collimator and the object-glass of the telescope, are perfectly parallel, the relative position of the disks is unchanged; if, however, the shade is not ground true, the disks will appear either separated or to overlap. In the first case the amount of separation is measured by the micrometer, and serves to indicate the quality of the glass. In the case of overlapping images the shade is rotated through 180°, and separation produced which can be measured. A second examination is then made, the shade having been turned through 90°.

If in no position a separation of images is found to exist to the extent of 20″, the glass is etched K.O. 1; if more than 20″ but less than 40″, the mark is K.O. 2; with greater distortion than this, the shade is rejected and not marked.

To examine the quality of the mirrors, a small table, on levelling screws, is put in front of the object-glass of the telescope. The mirror to be tested is placed on its edge on this table, and turned until a distant well-defined object is reflected down the tube of the telescope. The object-glass of the telescope having previously been stopped down to an aperture corresponding to the size of the mirror, the reflected image is contrasted with that seen directly, and if the definition is unchanged the mirror is marked K.O. with a writing diamond, and returned to the maker; if the object appears distorted, its unfitness for use is similarly notified. A small fee is charged for the examination.

Geological Society, February 7.—J. W. Hulke, F.R.S., president, in the chair.—G. D'Arcy Adams, Prof. Ferdinand Moritz Krausé, and the Rev. Alfred William Rowe were elected Fellows, and Dr. Karl A. Zittel, of Munich, a Foreign Correspondent of the Society.—The following communications were read:—On the metamorphic and overlying rocks in parts of Ross and Inverness shires, by Henry Hicks, F.G.S., with petrological notes by Prof. T. G. Bonney, F.R.S. In this paper the author described numerous sections which have been examined by him in three separate visits made to the north-west Highlands. In some previous papers, sections in the neighbourhood of Loch Maree had been chiefly referred to. Those now described are to the south and south-east of that area, and occur in the neighbourhoods of Achmashellach, Strathcarron, Loch Carron, Loch Kishorn, Attadale, Strome Ferry, Loch Alsh, and in the more central areas about Loch Shiel and Loch Eil to the Caledonian Canal. In these examinations the author paid special attention to the stratigraphical evidence, to see whether there were any indications which could in any way be relied upon to prove the theory propounded by Sir R. Murchison that in these areas fossiliferous Lower Silurian rocks dip under thousands of feet of the highly crystalline schists which form the mountains in the more central areas. On careful examination he found that in consequence of frequent dislocations in the strata the newer rocks were frequently made to appear to dip under the highly crystalline series to the east, though in reality the appearance in each case was easily seen to be due to accidental causes. Evidences of dislocation along this line were most marked; and the same rocks in consequence were seldom found brought together. He recognised in these eastern areas at least two great groups of crystalline schists metamorphosed throughout in all the districts examined, even when regularly bedded and not disturbed or contorted; and they have representatives in the western areas, among the Hebridean series, which cannot in any way be differentiated from them. These he called locally by the names, in descending order, of Ben-Fyn, and Loch-Shiel series. The former consist, in their upper part, of silvery mica-schists and gneisses, with white felspar and quartz; in their lower part, of hornblendic rocks, with bands of pink felspar and quartz, and of chloritic and epidotic rocks and schists. The Loch-Shiel series consists chiefly of massive granitoid gneisses and hornblendic and black mica-schists. Thirty-three microscopical sections of the crystalline schists and the overlying rocks are described by Prof. Bonney, and he recognises amongst them three well-marked types. In No. 1 he includes the Torridon Sandstone, the quartzites and the supposed overlying flaggy beds on the east side of Glen Laggan. These are partially metamorphosed, only distinct fragments are always easily recognisable in them in abundance. In No. 2, the Ben-Fyn type, the rocks are crystalline throughout, being typical gneisses and mica-schists. In No. 3, the Loch-Shiel series, he recognises highly typical granitic gneisses of the Lower Hebridean type. Dr. Hicks failed to find in these areas at any point the actual passage from group 1 to group 2; neither did the same rocks belonging to group 1 meet usually the same rocks belonging to group 2. The evidence everywhere showed clearly that the contacts between these two groups were either produced by faults or by overlapping. Group 3, placed by Murchison as the highest beds in a synclinal trough, supported by the fossiliferous rocks, the author regarded as composed of the oldest rocks in a broken anticlinal. They are the most highly crystalline rocks in these areas; and the beds of group 2 are thrown off on either side in broken folds. These, again, support the rocks belonging to group 1. The author therefore feels perfectly satisfied that the crystalline schists belonging to groups 2 and 3, which compose the mountains in the central areas, do not repose conformably upon the Lower Silurian rocks of the north-west areas with fossils, and that these highly-crystalline rocks cannot therefore be the metamorphosed equivalents of the comparatively unaltered, yet highly disturbed and crumpled, richly fossiliferous Silurian strata of the southern Highlands, but are, like other truly crystalline schists examined by him in the British Isles, evidently of pre-Cambrian age. In an Appendix by Prof. T. G. Bonney, F.R.S., on the lithological characters of a series of Scotch rocks collected by Dr. Hicks, the author stated that he observed in the above series, as he had done in other Scotch rocks lately examined by him, three rather well-marked types—one, where, though there is a certain amount of metamorphism among the finer constituents forming the matrix, all the larger grains, quartz, felspar, and perhaps mica, are of clastic origin; a second, while preserving a bedded structure and never likely to be mistaken for an igneous rock, being indubitably of clastic origin, retains no certain trace of original fragments; while the third, the typical "old gneiss" of the Hebridean region, seldom exhibits well-marked foliation. It is sometimes difficult to distinguish between the first and second of these; but this the author believed to be generally due to the extraordinary amount of pressure which some of these Scotch rocks have undergone, which makes it very hard to determine precisely what structures are original. Even the coarse gneiss is sometimes locally crushed into a schistose rock of comparatively modern aspect. The least altered of the above series the author considered to be the true "newer-gneiss" series of the Highlands, but both of the others to be much older than the Torridon Sandstone.—On the Lower Carboniferous rocks in the Forest of Dean, as represented in typical sections at Drybrook, by E. Wethered, F.G.S., with an appendix by Dr. Thomas Wright.

Chemical Society, March 1.—Dr. Gilbert, president, in the chair.—The following gentlemen were elected Fellows:—A. C. Abraham, G. Board, C. N. Betts, E. Bevan, F. J. Cox, A. Collenette, S. Dyson, W. T. Elliott, H. B. Fulton, C. G. Grenfell, B. F. Halford, W. D. Hogg, D. Hooper, J. J. Knight, H. F. Lowe, T. H. Leeming, J. E. Marsh, W. Newton, C. Rumble, F. Scudder, J. O'Sullivan, S. A. Vasey, T. D. Watson, R. M. Walmsley, C. S. S. Webster, F. Watts.—The following papers were read:—On some derivatives of the isomeric $C_{10}H_{14}O$ phenols, by H. E. Armstrong and E. H. Rennie. Lallemand stated that a trinitro-thymol was produced by the action of a mixture of nitric and sulphuric acids on dinitrothymol. The authors find that a trinitro body is formed, but that it has the constitution and properties of trinitrometacresol. The authors could not obtain a trinitro body from carvacrol. When thymolsulphonic acid is treated with nitric acid, paranitrothymol is formed, the sulpho group being displaced. When bromothymolsulphonic acid is treated with chromic acid, an amorphous quinone is formed, but when permanganate is used, no quinone is produced. The authors have also studied the action of nitric acid on bromisobutylsulphonic acid.—Chemico-microscopical researches on the cell-contents of certain plants, by A. B. Griffiths. The author has grown cabbage plants on soils containing ferrous salts: the plants are larger, and their ash contains a considerable quantity of oxide of iron. In sections under the microscope crystals are visible which belong to the monoclinic system and give a blue colour with potassium ferricyanide and an opacity with barium chloride. The author concludes that they consist of ferrous sulphate.—The phenates of amido bases, by R. S. Dale and C. Schorlemmer. The authors have satisfied themselves that, when aurin is heated with ammonia, pararosanilin is at once formed. When aurin is heated with common rosanilin and alcohol, a solution is produced which on concentration yields a crystalline powder of rosanilin aurate; similarly by heating anilin and phenol in molecular proportions, anilin phenate is obtained in glistening plates melting at 29°·5, boiling 184°·5.

Anthropological Institute, February 27.—Prof. W. H. Flower, F.R.S., president, in the chair.—The election of Mr. C. Fountaine Walker was announced.—Dr. Garson exhibited and described a series of photographs of cases of hypertrichosis.—Mr. A. Tylor read a paper on the homological nature of the human skeleton. He finds that in the skull of all vertebrate animals, including man, a general resemblance to the trunk and limbs is carried out—for instance, variations in the limbs are accompanied by variations in the jaws, and the occiput varies with the pelvis, the sternum with the palate, and so on throughout the skull and body. This is due to mechanical causes. Bones, like the parts of plants, consist of stalks and leaves; the stalk-element is shown in the vertebræ and the long bones, and the leaf-element in the apophyses, the plate-bones of the skull, such as the parietals, &c. The elemental shaft-bones always bulge at the extremities where pressure is exerted, hence the peculiar form of all such bones. This form is a mechanical necessity, and, in accordance with the known laws of correlation and repetition of parts, helps us to understand the singular relations subsisting between the skull and the rest of the skeleton.

Institution of Civil Engineers, March 6.—Mr. Brunlees, president, in the chair.—The first paper read was on the productive power and efficiency of machine tools, and of other labour-saving appliances, worked by hydraulic pressure, by Mr. Ralph Hart Tweddell, M.Inst.C.E.—The second paper read was on stamping and welding under the steam-hammer, by Mr. Alexander McDonnell, M.Inst.C.E.

SYDNEY

Linnean Society of New South Wales, December 27, 1882.—Dr. James C. Cox, F.L.S., president, in the chair.—The following papers were read:—Occasional notes on plants indigenous in the neighbourhood of Sydney, No. 2, by Edwin Haviland. This paper treats chiefly of the construction and habits of *Utricularia dichotoma*.—Description of a new *Belideus* from Northern Queensland, by Charles W. De Vis, B.A.—A paper by the same author describing two new Queensland fishes (*Callionymus achates* and *Mugil nasutus*).—By the Rev. Dr. Woolls, on the species of Eucalyptus first known in Europe. Of the twelve species described by Willdenow, eleven are from the immediate neighbourhood of Sydney, and one only from Tasmania. This tree, the Tasmanian Stringy Bark (*E. obliqua*), was the first Eucalypt known in Europe, the specimen having been collected during Furneaux's voyage. On it L'Héritier founded the genus, 1788. The early descriptions are, as it may be supposed, very vague and imperfect, and their identification has been a matter of much difficulty and hesitation, now happily removed.—On some new species of tubicolous annelides, by William A. Haswell, M.A., B.Sc.—On new species of *Agaricus* discovered in Western Australia, by the Rev. C. Kalchbrenner.—On some points in the anatomy of the urogenital organs in females of certain species of kangaroos, Part 1, by J. J. Fletcher, M.A., B.Sc.—The Rev. J. E. Tenison-Woods read a paper on a species of *Brachyphyllum*, which was found in the Tivoli coal mine. In many respects this species resembled the well-known *B. mamillare* of the British and Continental Oolite, but lest any confusion should arise from a doubtful identification, and as the stems and leaves of this specimen were much thicker, and the leaves more fleshy than in *B. mamillare*, the author distinguished it as *B. crassum*. He considered that the discovery of this specimen served to place the Jurassic age of the Ipswich (Queensland) coal beds beyond much doubt.—A note was read by Dr. H. B. Guppy, of H.M.S. *Lark*, on the cocoa-nut eating habit of the *Birgus* of the Solomon Islands. Dr. Guppy had no doubt from what he had observed that the Robber-Crab is in the habit of breaking open the shells of the cocoa-nuts with its powerful chelæ.—Mr. Haswell stated that he had much pleasure in announcing to the Society that, thanks to the intelligent inquiries made by Mr. Morton of the Museum, while recently in Queensland, he had hopes that they were on the way towards learning something of the embryology of the *Ceratodus*. Mr. Morton had ascertained that the *Ceratodus* spawns in the Burnett River during the months of June, July, or August, the spawn being deposited in a slight excavation formed in the bed of the river at a depth of eight or ten feet, the male and female remaining in close attendance on it until hatched. Arrangements had been made by which it was hoped that a supply of the spawn might be obtained for observation next season.

PARIS

Academy of Sciences, February 26.—M. Blanchard in the chair.—The death of Baron Cloquet, Member in Medicine and Surgery, was announced.—The following papers were read:—Note on various points of celestial physics, by M. Janssen. At Meudon Observatory they are studying movements of photospheric matter with the aid of series of images obtained with the "photographic revolver"; they are also working at photographic photometry, the principle being that the intensities of two light-sources are in the inverse ratio of the time they take for the same photographic work (*e.g.* producing the same tint on two quite similar plates). The method will be applied to data of the comet of 1881, the full moon, &c. M. Janssen further hopes to present soon a complete study of the spectrum of aqueous vapour.—Results of a new series of experiments on the apparatus for transport of mechanical work installed on the Chemin de fer du Nord, by M. Deprez: note by M. Tresca (see p. 422).—On the heat of formation of chromic acid, by M. Berthelot.—Rain in the Isthmus of Panama, by M. de Lesseps. A table of observations of rainfall by Mr. John Stiven, for 1879–1882, shows that 1879 was an extraordinarily rainy year (2·152 m.), a large excess occurring in November. The rain-season lasts nearly six months, from May to November, excepting an interruption of a few weeks in June and July. This is explained by the behaviour of the ascending body of air which accompanies the curve of maxima in its annual oscillation on either side of the thermal equator, which movement is connected with the annual movement of the sun. The trade-winds north and south also affect the phenomena.—On the bronze tools used by miners in Peru, by M. Boussingault. A bronze chisel found in an old quarry of trachyte near Quito, evidently served in working the trachyte (softened by water); it contains copper 95, tin 4·5, with minute quantities of lead, iron, and silver.—Nebulæ discovered and observed at Marseilles Observatory, by M. Stephan.—Exhalation of nitrogen in a gaseous state during respiration of animals, by M. Reiset. MM. Petenkoffer and Voit negated such exhalation (affirmed by the author). Recent experiments by MM. Seegen and Nowak confirm M. Reiset's view.—Direct and rapid attenuation of virulent growths by the action of heat, by M. Chauveau. The method may be applied to liquids of artificial cultivation with much better success than to the natural humours of the system, and it may be graduated at will according to the degree of attenuation desired.—Contribution to the study of refrigeration of the human body in hyperthermic diseases, especially typhoid fever, by M. du Montpellier. He indicates the useful effects of his cooling apparatus.—Researches on the division of acids and bases in solution by the method of congelation of the solvents, by M. Raoult.—On the relations between covariants, &c. (continued), by M. Perrin.—On the theory of uniform functions, by M. Goursat.—Note on a point of the theory of continuous periodic fractions, by M. de Jonquières.—Remarks on a communication of M. de Chardonnet on the vision of ultra-violet radiations, by M. Mascart. He thinks the conclusions too absolute; he showed some years ago that ordinary sight habitually perceives the whole ultra-violet solar spectrum as lavender grey, and some eyes see even further.—On the increase of intensity of scintillation of stars during auroras, by M. Montigny. (Already noted elsewhere.)—On the production of apatites and of bromised Wagnerites with lime base, by M. Ditte.—Researches on the action of zinc-ethyl on amines and phosphines; new method of characterising the nature of these bodies, by M. Gal.—On the products of decomposition by water of fluoborised acetone α, by M. Landolf.—On neutralisation of glycolic acid by bases, by M. de Forcrand.—On a new base of the quinoleic series, phenol-quinoleine, by M. Grimaux.—Derivatives of strychnine, by M. Hanriot. He describes a new dinitro-strychnine, also diamido-strychnine.—On sulphocyanacetone, by MM. Tcherniac and Hellon.—Chloronitrated camphor, by M. Cazeneuve.—On the ice plant, by M. Heckel. His observations some years ago agree with those of M. Mangon.—Researches on the chromatophores of the *Sepiola Rondeletii*, by M. Girod. He regards the protoplasm of the pigmentary cell as the agent of extension; the basilar cell producing contraction.—On the disease of saffrons known as *Tacon*, by M. Prillieux.—On an inversion of temperature observed at a point of the Alps on December 27, 1882, by M. Henry. M. Broch noted a similar case near Christiania, where a rich banker has a châlet at a height of 408 m. In winter the temperature there is often about zero, while at Christiania it is 10 or 15 degrees below zero.—M. Daubrée indicated the contents of a new publication from Lima, *Anales de Construcciones civiles y de Minas del Perú*.

March 5.—M. Blanchard in the chair.—The following papers were read:—Observations of the satellites of Neptune, of Uranus, and of Saturn, with the equatorial of the eastern tower of Paris Observatory, by MM. Henry; Note by M. Mouchez. A new objective having been put in the instrument (acquired in 1849, under Arago) renders it the best instrument the Observatory has ever had.—Nebulæ discovered, &c. (continued), by M. Stephan.—The prolific power of virulent agents that are attenuated by heat, and the transmission by generation of the attenuating influence of a first heating, by M. Chauveau. The attenuation does not involve any alteration of the vitality or prolific power of the agents deprived, by heat, of their infectious properties. It is also shown that the influence is not merely individual, but may appear in the properties of new agents arising through proliferation of the protoplasm which has been directly subject to it.—M. de Lesseps stated that he was about to go to the region of the North African Chotts for a month, to consider the investigations of M. Roudaire.—A letter from M. Nordenskjöld referred to his intended departure for Greenland in August. He believes that vast regions covered with perpetual ice are a physical impossibility on our globe south of the 80th degree of N. lat., and goes to the interior of Greenland to test this view.—On the importance of the *rôle* of inhibition in therapeutics, by M. Brown-Séquard. A morbid activity will disappear suddenly, or nearly so, on irritation at some point (to be sought) more or less distant from that at which the activity prevails.—Practical use of sulpho-carbonate of potassium against Phylloxera in the south of France, by M. Culeron.—On the perturbations of Saturn due to the action of Jupiter, by M. Gaillot.—Observations of the great comet of September, 1882 (II. 1882), made at the Observatory of the Transit of Venus Mission at Martinique, by M. Bigourdan.—Observations of the new comet (Brooks and Swift) made at Paris Observatory (equatorial of the western tower), by the same.—Observations of the same comet at Lyons Observatory with the 6-inch Brunner equatorial, by M. Gonessiat. The comet appeared as a bright, nearly round nebulosity, with nucleus well condensed. In a clear sky, a straight tail of about 13′ long was observed. (M. Bigourdan estimates the brightness as about that of a star of 6th or 7th magnitude.)—On the approximation of sums of numerical functions, by M. Halphen.—On the series of polynomes, by M. Poincaré.—On the trajectories of different points of a connecting-rod in motion, by M. Léauté.—On the theory of electromagnetic machines, by M. Joubert. He calls attention to the loss of work in continuous-current machines through change of direction of the current in the coils of the ring.—On a new collimator, by M. Thollon. The slit is made to take any direction, while its image remains fixed. This is effected by means of a total-reflection prism placed behind the slit, with its hypothenuse face parallel both to the axis of the collimator and to the slit.—Dissociation of the bromhydrate of phosphuretted hydrogen, by M. Isambert.—On sulphuric chlorhydrate, by M. Ogier.—On chloride of pyrosulphuryl, by the same.—Heat of formation of solid glycolates, by M. de Forcrand.—On the hydrocarbons of peats, by M. Durin. From an examination of fresh mosses, he thinks it probable (with M. Dumas) that the hydrocarbons of peat are not formed during vegetal decomposition, but that they existed already in the mosses which formed the peat.—Experiments proving that sanguineous concretions, formed at the surface of an injured part of vessels, begin with a deposit of hematoblasts, by M. Hayen.—On the chromatophores of Cephalopoda, by M. Blanchard. He holds that they do not differ at all in general structure from those of fishes, batrachians, and especially saurians (chameleon). The chromatophore is a sort of amœba charged with pigment, living for itself and independent of the skin which imprisons it; it is, however, under the influence of the nervous system. The radiating fibres are mere fibres of connective tissue, and M. Blanchard has never (like M. Girod) found them to vary in form with the chromatophore.—On a flagellate Infusoria, ectoparasite of fishes, by M. Henneguy. This was observed on trout. The name *Bodo necator* is given provisionally.—On the *Gnetaceæ* of the coal formation of Rive-de-Gier, by M. Renault.—Selenetropism of plants, by M. Musset. Plants of phototropic sensibility were grown from seeds in pots in a very dark place; then, on three nights, exposed at a window to direct moonlight; the stems bent over towards the moon, and followed it in its course.

BERLIN

Physical Society, February 16.—Prof. Kirchhoff in the chair.—Prof. Krech described at length a spectrophotometer which he had made in 1872, and with which, in the years 1873, 1874, 1875, and 1876, he had made a large number of observations for verification of the theory of the apparatus and determination of its errors. The theory of the instrument and the improvements proposed were fully gone into; the experiments had been made before Herr Glau had described his spectrophotometer.

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