THURSDAY, MARCH 17, 1887

THE STATE AND HIGHER EDUCATION

IT is seldom that a Cabinet Minister receives so influential a deputation as that which on Friday last requested Mr. Goschen to supplement the revenues of the Victoria University from the National Exchequer. The gentlemen present represented the intelligence and industry of the North of England: they told a story of earnest and patriotic effort, and we sincerely trust that Mr. Goschen will feel able to afford them the moderate assistance they desire.

The ground on which the request was made, and on which Mr. Goschen promised to consider it with favourable attention, was designedly circumscribed by narrow limits. Neither the deputation nor the Chancellor wished to raise the wide question of the future relations between the State and the higher education. Both were anxious to regard the matter in hand from one point of view only. For good reasons the State has seen fit to confer the power of granting degrees upon the Victoria University, but it insists that external examiners shall take part with the Professors of the University in the conduct of the degree examinations. The cost thereby entailed on the Colleges, though not very great, is still an appreciable burden to institutions which can barely pay their way. It is therefore suggested that without committing itself to any far-reaching scheme of a general endowment of University Colleges, the State might properly defray the cost of the restrictions which it has itself imposed. Unlike the Universities of Oxford and Cambridge, the Victoria University has hitherto depended on funds which have been accumulated in a single generation. Unlike the University of London, it is a federation of Colleges engaged in educational work. These institutions want their class fees and their examination fees as well as all their slender resources from endowments, and could turn them to good account. Their case is, that to do so would be to the public advantage. They ask that 2000*l.* a year may be given towards the salaries of the examiners and other University officials, in order that the Colleges of the Victoria University may be able to devote the whole of their available funds to the work of teaching.

With this position we have no fault to find. The circumstances of the Victoria University are exceptional, and we think that the Chancellor of the Exchequer, if he grants the request of the deputation, may fairly contend that he has not committed himself on the wider issue that must before long be raised.

We cannot, however, refrain from pointing out that the question of State aid to higher education cannot remain in its present position. Whether such aid shall or shall not be given is no longer open to discussion. It is given already, but not, apparently, on any definite principle.

If it is right that 12,000*l.* a year should be supplied from the national funds for three new Colleges in Wales, which have still their reputations to make, it is surely wrong that England should have received no help till a school of science of European celebrity like the Owens College is forced to ask for a share in a grant of 2000*l.* a year. Scotland, Wales, and Ireland receive upwards of 40,000*l.* a year in aid of higher education. Why is England, who pays no small share of this, to have no equivalent aid herself? It has not been found that a liberal educational policy discourages the "pious founder." University College, Dundee, and Lord Gifford's recent bequest are proofs that he still flourishes in Scotland. Why should a contrary result be feared if England shared Scotland's advantages?

It may be said that the fact that the northern Colleges have reached their present degree of efficiency without State support is sufficient proof that it has not been needed. We doubt the validity of this argument. Time is an important element in the industrial warfare of the present day. If we are to wait till prosperity and high prices enable our provincial Colleges to struggle through the slough of financial difficulty in which many of them are involved, we may find too late that efficient educational institutions have helped to bring to others prosperity which has not come to us. The higher education of our industrial population is no mere luxury to be attended to at a more "convenient season," but a vital necessity, a fundamental condition of commercial success. The State should indeed do nothing to choke the fount of private generosity by which in the past that education has for the most part been provided. It should do all in its power to direct local effort towards those channels in which most good can be done. The promoters of the Yorkshire College were four years in collecting one-third of the sum which they originally regarded as necessary for their enterprise; and the undertaking might have languished for several years more had not the Clothworkers' Company come forward with an offer of timely and judicious help. Much good might be done if in like manner the State would assist and encourage the founders of a College in the earlier and more difficult stages of their work.

We are, however, clearly of opinion that if after fair trial it is evident that a "University College" cannot hope to attain efficient support, or to fill its class-rooms from the surrounding neighbourhood, the State would do well to transfer its patronage of higher education elsewhere. If an institution, whether called a "University College" or not, is really doing elementary work, it can, under our present system, obtain State aid. If its pupils are entered for the South Kensington and City and Guilds of London Examinations, it may, by the grants thus received, largely diminish the sum which would otherwise be required for the payment of its teachers. If, then, it is sufficiently proved that any institution belongs to this class, it is already provided for, and has no special claim for further and exceptional help.

On the other hand, it must be remembered that the higher education has never been self-supporting, and that the most successful College can only hope to make both ends meet by endowments or by a sufficient income obtained from some other source than fees. More good will be done by allotting any sum devoted to higher education to Colleges which may be in financial difficulties, but which have proved that they are situated where the want of such education is felt, than in affording exceptional support to institutions in thinly-populated districts, where the "raw material" for a successful experiment in teaching of the highest class cannot be

found. An able lad gains much valuable knowledge, and, most important of all, self-knowledge, by contact with those who are his equals not only in talent but in years. It would be better, by a system of scholarships, to give the youth of country districts an opportunity of learning what competition means in a flourishing College, than to foster a large number of half-equipped and struggling institutions, which cannot reasonably hope to attract students of more than average capacity in numbers sufficient to justify their claim to being centres of the higher learning.

To encourage in their initial stages promising educational enterprises; to determine, if need be after fair trial, whether any given institution can do most good as a centre of elementary, secondary, or higher instruction; to afford to institutions of each grade help, the amount and continuance of which depend upon the educational results they attain and upon the increase or withdrawal of local support,—these are the general lines on which the State may aid secondary and higher education. It would thus encourage the performance of good work in each educational stage at those points where in the nature of things good work of that kind could best be done. It would be led no doubt into expenditure, but in this, as in so many other cases, the old induction holds good. "There is that scattereth and yet increaseth," is true of nations as of individuals, and most true of national expenditure on education.

PRACTICAL ZOOLOGY

An Elementary Course in Practical Zoology. By B. P. Colton, Instructor in Natural Sciences, Ottawa High School, Illinois. (Boston: D. C. Heath and Co., 1886.)

THIS volume is one of the latest additions to the stock of laboratory hand-books based upon the well-known type-system. It is more comprehensive, but, in detail, much simpler and more elementary, than any of its predecessors, while it differs from them in its method of treatment. The objects and scope of the work are set forth in a short introduction, and the detailed matter is embodied in thirty-two fasciculi, each devoted mainly to a consideration of some one type of organisation. Of these, ten are devoted to Insects and three to Crustacea—this, however, for a special purpose to which we shall allude. Practical hints dealing with methods and the like are incorporated with the text.

Certain emendations will be necessary in a subsequent edition, and to these we shall refer duly. In not a few cases the descriptions of the structural features of a given animal have been prefaced by a brief account of its habits and movements. An arrangement, this, of which we heartily approve. It must not be imagined, however, that the book stops short here. The author sets himself "to aid the student in getting a clear idea of the animal kingdom, as a whole, by the careful study of a few typical animals," and he reminds us that "a definition thought out by the student himself, imperfect though it be, is of more value to him than a perfect definition learned from a book, which often appeals to mere memory. Definitions made in the way these pages require are good as far as they go: they should be corrected and supplemented by the instructor. It develops a boy more to earn a dime than to receive a dollar as a gift."

The contents of the work are well arranged, the style is clear and concise, and the facts are presented in logical sequence, nothing being anticipated; but despite the assertion quoted above, there are far too few facts recorded. Some of the descriptions are meagre in the extreme, while others are so brief as to be useless. For example: on p. 8 the nervous system is introduced to the beginner for the first time (and that in the grasshopper) as consisting "mainly of a white cord extending along the floor of the whole body-cavity. In most of the abdominal rings the nerve-cord has enlargements called ganglia, from which nerves branch to the surrounding parts." The like is to be said of the descriptions of the spider's organs of respiration (p. 22), of the clam's kidney (p. 52), and other organs which could be named; while those of the dorsal vessel and "liver" of the earthworm demand early rectification. On p. 30 the author says of the "line of division between the head and thorax" in the crayfish:—"Huxley places it between the second pair of maxillæ and the first pair of maxillipeds. Hyatt places the division between the first and second pairs of maxillæ, as the space between these is membranous entirely across the sternal region, while back of this line the parts are hard and firmly soldered together." One primary object of a book of this kind should be that of imparting a sound training in methods by way of systematising the work of the student, and every conscientious teacher of zoology knows that by no means the least formidable difficulty to be encountered is that of teaching his pupils how much, and what, they shall leave aside. Bearing this in mind, we would fain see all matters which involve differences of opinion such as that alluded to above, eliminated from an elementary work.

The author has evidently been struck with the fact that there has manifested itself, under the growth of the type-system, a tendency to produce a lop-sidedness in the mind of the student. He is by no means alone here, but he sets himself to rectify the matter. This he does by extending and considerably modifying the said system; with what amount of success, has yet to be seen. He, and others who have since come into touch with him, must bear in mind that the type-book is, for the most part, but a tool in the hands of the student working (as does he for whom the author prescribes) under the guidance of a teacher, whose bounden duty it is personally to direct the work in all its details. He, and he alone, is to blame for this apparent defect.

One charge frequently brought against the type-system is that of apparent neglect of classification. The author meets this difficulty in a praiseworthy manner, by first describing a given animal as fully as his case demands, and then dealing with certain allied forms sufficiently to bring out the nature of those comparisons upon which our existing classifications are based. He introduces the subject of classification (p. 12) in an absolutely dogmatic and empirical manner, which, while it does not do justice to his intentions, exposes at the same time the dangers of the method adopted. He supplements the afore-mentioned chapter for chapter. Writing on p. 44, he says:—"Animals are ranked according to the number of things they can do, and do well. The earthworm has many parts, but they are nearly all alike, and do not enable it to do many different things. A part of an animal having a specia

work to do is called an organ, and its work is its function. The earthworm has many organs, but few functions. Apply this principle to man and an ape. Each has four limbs. The ape is called four-handed, but has no good hands; he cannot handle things well. He has not good feet; he cannot walk well. What is the one thing he can do well with his four foot-hands? How many distinct functions has man with his hands and feet? Multiplication of parts without corresponding variety of structure and function mark an animal as low in rank." In striving for originality, the author has here gone astray; and with regard to the study of classification in all its branches, we are of opinion that it ought not to form a primary object in a work of purely educational value. For the advanced student, consideration of it must come as a matter of course sooner or later: for the beginner it is better that it be dealt with at the hands of the teacher, and that with the utmost caution.

On p. vi. of the introduction we read: "If the main object of this study is the mere acquisition of facts, full descriptions of most animals can be elsewhere obtained; but if the more important part in education is to lead the pupil to see and think for himself, then some such method as this" (above cited) "should be used." It is under the influence of this desire to "educate" the mind of the student that the author's plan is most novel and his labour most successful. One example will illustrate. On p. 124 the student is directed, when examining the lungs of the mammal, as follows: "Keeping the eyes fixed on the lung, prick a hole through one side of the diaphragm, and note the collapse of the lung." Then follows the question, "Is the lung on the other side affected by this operation?" A forcible means, this, of bringing home a fundamental fact of lung-structure, which, though so simple, is, as any teacher of experience knows to his sorrow, so generally overlooked by the beginner. It is here introduced in a manner which cannot fail to bring home conviction or to create a lasting impression; and the student who shall have thus learned it will some day wake up to the fact that he has made an important discovery. Many other charmingly simple examples of the kind might be cited. In one or two cases the idea is overdone. In others the student is misled for want of a technical term; and speculating upon the probable nature of the retort which might be in such a case elicited, the writer is reminded of a reply obtained from a beginner who had worked out most satisfactorily the mammalian portal vein, in ignorance of the conventional nomenclature. The question, "What do you call this vein?" was met by the rejoinder, "Stomacho-liver." More technical terms might, with advantage, be introduced into this book. The acquisition of a technical nomenclature must go hand in hand with that of the fundamentals of a science, and we are of opinion that, until such are rightly and fully mastered, the student must be, as a tool in the hands of his teacher, guided with an unfailing precision.

In consideration of the pernicious rubbish which, even yet, occasionally finds its way into our own elementary schools under the guise of the elementary text-book of science, it is pleasant to reflect upon the merits of this work. The author is fortunate in being unhampered with the everlasting syllabus; he performs his experiment in his own manner, and it is worthy of a fair trial. We question, however, the advisability of making the study of insects the focal point. The author asserts that his work "has usually begun with the fall term. At this time insects are abundant, and many kinds may be easily collected; they therefore serve well to show how animals are classified." We presume, therefore, that he adopts the inevitable. He further claims that "insects are attractive: from insects the student passes on to forms which, if taken up at first, would perhaps be distasteful to him." This may be, but we doubt it. For the analogous use of flowers as a means of introduction to the study of botany much more is to be said. This book is written for special use upon special ground and under special circumstances; it forms part of a system, and its success can only be rightly judged by someone cognisant of the whole. The task which the author has in hand is one, of its kind, the most difficult, and at the same time the most pleasing, of which we can conceive. In it he is honoured, and his plan of work must, like all which have preceded it, have its shortcomings. That these will be made good with a ripening experience we doubt not.

It remains to call attention to one or two matters standing in need of immediate reconsideration. On p. 169 we find the heresy of the evaginated hydra revived, with much emphasis. P. 71 bears the extraordinary statement that "a fish whose body is flattened from side to side is said to be 'compressed'; the word 'flat,' when used in describing a fish, means flattened from above downwards, and is applied to such a fish as the flounder." Directions are given (p. 120) for injecting the blood-vessels of the mammal, but they are wholly superfluous, as more than that which is required for the purpose in hand can be made out without it, while the process is involved in difficulties which are beyond the pale of such elementary students.

The author's directions for killing most of the animals are surprisingly novel; those for despatching the turtle and pigeon being worthy of the modern executioner. P. 102 reads: "with a strong pair of pinchers seize the head" (of the turtle), "pull it well out, and chop it off; examine the mouth; are there teeth present?" No experienced zoologist needs to be reminded of the effects which this repulsive piece of butchering would produce; but even that pales beside the injunction (p. 105) to "open the pigeon's mouth, and insert a pipette containing about a teaspoonful of chloroform into the opening of the glottis, at the base of the tongue" (this has to be found by the student), "blow the chloroform into the lungs, being careful that the point of the pipette does not slip out of the glottis." Never was insult worse than this added to injury. These things must be speedily altered if intended for the juvenile who is "to see and think for himself."

G. B. H.

THE DUTCH COLONIES IN SOUTH AMERICA AND THE WEST INDIES

Westindische Skizzen: Reise-Erinnerungen. Von K. Martin, Professor für Geologie an der Universität zu Leiden. vii.-186 pp. 8vo, with 22 Plates and 1 Map. (Leiden: E. J. Brill, 1887.)

TOWARDS the close of 1884 several learned Societies in Holland granted collectively the means for a scientific mission to the Dutch colonies in South America

and the West Indies. Prof. Suringar, with an assistant, took charge of the botanical work, whilst Prof. Martin was to carry on mineralogical and geological investigations, and Mr. Neervoort van de Poll volunteered as zoological collector. The party visited Dutch Guiana, Curaçao, Oruba, and Buen Ayre, and made also a short trip to Venezuela.[1]

Prof. Martin's preliminary report on Curaçao and adjacent islands appeared in the Journal of the Dutch Geographical Society (1885) soon after his return to Holland; and the part referring to Guiana was printed in the "Contributions towards the Linguistics, Geography, and Ethnography of Dutch India" (1886). Of two short notices on the geology of the countries visited, one was inserted in the *Revue Coloniale Internationale* (1885), and the other in the Proceedings of the Royal Academy of Sciences, Amsterdam (March 1886).

The present work is the first part of the author's final report. The narrative of the expedition is cast in the general shape of a diary, but the author usually brings together all the information bearing on the same topic. Strictly scientific matters are excluded, and will be given in a second volume. There is, however, no deficiency of interesting facts referring to the geography and natural history of those out-of-the-way places. The ethnographical chapters on the ancient Indian population of Oruba (with a plate giving samples of old rock-paintings found in certain caves of the island) and on the Bush-Negroes of Surinam are especially valuable. Perhaps Prof. Martin might with advantage have given a little more general geological information, which certainly would have been not less acceptable to the readers of this volume than his notes on the botanical and zoological character of the ground covered by his explorations.

In Guiana the author went up the River Surinam as far as the Negro settlement of Toledo (4° 33′ N. lat., and 55° 18′ W. of Greenwich), a place not formerly visited by any scientific explorer, and indeed not even by any white man. The further ascent of the river would have given no geological results, as the waters began to rise with the beginning of the rainy season, making it impossible to collect specimens from the rocks in the middle of the stream.

The general situation of Dutch Guiana unfortunately is far from being prosperous. The development of the colony has not kept pace with that of its English neighbour. Agriculture, which ought to be its main strength, is going down-hill, and we believe Prof. Martin is quite right when he expects very little aid from the increasing produce of the gold-washings in the interior. The cause of the evil appears to be rather complicated, as may be seen from a very clever article published by B. E. Colaço Belmonte in *Timehri* (December 1885 and June 1886).

The Dutch islands off the northern coast of Venezuela are so very little known outside the narrow circle of people connected with the interests of those colonies that any information about them must be as welcome as if it came from Corea or Madagascar. The islands are very small, measuring only about 1000 square kilometres, and are inhabited by 36,000 people, most of them being descendants of Negroes, who speak the *Papiamento*, a jargon which is a curious mixture of Spanish, English, Dutch, Portuguese, and Carib words. The climate is excessively dry, and the vegetation is therefore very poor. For the same reason Curaçao is an important sanitary station; and as the port of Willemstad is one of the safest in existence, it is to be expected that the island will gain in importance by the opening of the canal through the Isthmus of Panama. The principal article of export is phosphate of lime, which is found there in large quantities and of considerable richness. Here as well as on the Venezuelan islands of Los Roques, Orchila, Las Aves, Los Testigos, &c., the phosphates owe their origin to an epigenetic change of the coralline limestone, which became infiltrated with phosphate of lime from overlying deposits of guano, exposed to the action of the periodical rains. All these islands have a nucleus of eruptive rocks (diorite, diabase, gabbro, eclogite): the same geological constitution exists in the central hill of the peninsula of Paraguaná and in the mountain-ridges of La Guajara. We have thus a line of volcanic out-flows corresponding to a long fissure running from east to west.

The chapter referring to Prof. Martin's visit to Venezuela is short, as was his stay in that country. It does not pretend to give anything new, but it is a very proper conclusion to the author's "Recollections of Travel."

When speaking of the so-called flight of flying-fishes, Prof. Martin says it appeared to him that the animals now and then, by a jerk of their tails, gave a new impulse to their ascending movement, in addition to the work done by their fins ("als ob die Thiere sich mit Hülfe des Schwanzes manchmal von neuem emporschnellten und so die Arbeit der Flossen unterstützten"). Our own observations of several species of flying-fishes lead us to adopt entirely Prof. K. Möbius's conclusions, viz. that the pectoral fins do no propelling work at all, but only keep the body of the animal resting on the air, and that the occasional rise in the line of movement, when the latter goes against the wind and the direction of the waves, is due to the lifting pressure of the wind, which ascends the opposite slope of the wave (K. Möbius, "Die Bewegungen der fliegenden Fische durch die Luft," Leipzig, 1878).

Prof. Martin's style is very clear and fresh. The plates which accompany the book, mostly engraved from his own drawings, are excellent illustrations of scenery and ethnographical objects, and the whole volume is got up in a manner which is highly creditable to the publisher. We expect with great interest the concluding part of this valuable report, which, no doubt, will be an important contribution to South American natural history.

A. ERNST

[1] Prof. Suringar, on his way home, spent some days on the Dutch Leeward Islands St. Eustatius and Saba. He has published as yet only a small part of his very interesting report in the Journal of the Dutch Geographical Society (unfortunately in the Dutch language, so that few botanists abroad will be able to read it), besides a paper on a new Melocacti from Curaçao, in the Proceedings of the Royal Academy of Sciences, Amsterdam.

HYDRAULIC POWER AND HYDRAULIC MACHINERY

Hydraulic Power and Hydraulic Machinery. By H. Robinson, M.I.C.E., &c. Pp. xiv. + 190, and 42 plates. (London: Charles Griffin, 1887.)

THIS work purports to "record existing experience in this branch of engineering." It is divided into thirty-five short chapters (not numbered, and therefore

not quite easy of reference). Five of these treat of general subjects, and the rest of particular machines or details.

The work opens with a well-written summary (16 pp.) of what is known of the flow of water under pressure, including a statement of the formulæ from Torricelli down to our own day, with a short account of some o the more recent experiments. Then follow some "General Observations," in which it is explained that the fears entertained on the first introduction of high-pressure water-power that accidents would be frequent from the bursting of pipes, especially in frosty weather, have proved groundless. The "relief-valves" necessary to avoid the shock from suddenly stopping or changing the motion of a non-elastic fluid like water are described and drawn. In another chapter the author describes the mode of "packing" so as to produce joints tight under high water-pressure, explains the use of "cupped leathers" to form a self-tightening joint, and shows the necessity of clear water, since dirty or gritty water causes rapid wear of the leathers.

The advantages of "power co-operation" all over large towns are considered in a short chapter (6 pp.), and illustrated by its successful application at Kingston-upon-Hull. Much more space might have been given to this now very important branch of the subject. A short chapter (6 pp.) details the cost of water-power in various places: it seems to vary from $\frac{1}{10}$ of a penny, to nearly 2*d.* per 100 foot-tons.

There are three chapters (covering only 7 pp. in all) on water-wheels, turbines, and centrifugal pumps. These chapters are too short to be of any practical use. The remaining 27 chapters are almost entirely devoted to the description of the appliances necessary for the use of high-pressure water-power, and to the very varied machines which may be thereby worked: many of these—especially the larger and more recent machines—are very fully illustrated. All this part of the work is of great interest. The pressure required for various purposes is stated to be 700 lbs. per square inch for ordinary hydraulic machines, 1500 to 2000 lbs. for shop-tools, and up to 20,000 lbs. for compressing iron and steel; and the advantages in the use of high-pressure are explained. The conditions to which this hydraulic power is suitable are shown to be those in which great power is to be exerted at scattered points for a short time only, and at irregular intervals. The machines and appliances described and illustrated are very numerous and diversified—far too many to enumerate here. Among the more interesting may be mentioned cranes, riveters, dock-gear, swing-bridge-gear, steering- and ship-gear, gun-lifts, and hoists of all sorts.

The practical part of this work is excellent: it is, in fact, a short monograph on the use of high-pressure water-power. But the theoretical part sadly needs revision. The term "power" is loosely used, sometimes meaning "force" (say in pounds), sometimes "work" (say in foot-pounds), sometimes "horse-power" (of 33,000 foot-pounds per minute). It is not surprising, therefore, to find the following mistakes: (1) a factor, 60 (*i.e.* 60 seconds in a minute), omitted in computing "horse-power" on p. 24; (2) a factor, 33,000, omitted in computing "horse-power" on p. 27, also the units (feet and pounds) not mentioned in same place; (3) a result on p. 35, which seems to be inch-pounds ÷ 33,000 (*i.e.* ÷ by foot-pounds per minute) marked as H.P.; (4) the following on p. 98, "the power (or foot-pounds) transmitted through a high-pressure water-main is determined by multiplying the fnumber of pounds of water flowing per second by the pressure." From a numerical example lower down it may be seen that the "power" referred to in this sentence is to be estimated (not in foot-pounds, but) in foot-pounds per second, and that by "pressure" is meant head of pressure, in feet.

ALLAN CUNNINGHAM, Major, R.E.

OUR BOOK SHELF

The Statesman's Year-Book for 1887. Edited by J. Scott Keltie. (London: Macmillan and Co., 1887.)

THIS work is so well known and so generally appreciated that it is necessary merely to note the appearance of the volume for 1887. The editor has made every effort to bring the statistics up to the latest date, and those who have been in the habit of referring to the book will find that its value has been considerably increased by important additions and modifications. An adequate account of the smaller British colonies has been introduced, and much new information is given with regard to the various systems of land-tenure in India. The leading facts brought out by the new censuses in Germany and France are embodied, and Mr. Keltie has been careful to show the precise results of the recent colonial enterprises of these two countries.

Joint Scientific Papers of James Prescott Joule, F.R.S. Published by the Physical Society of London. (London: Taylor and Francis, 1887.)

AMONG the contents of this volume are some elaborate papers on "Atomic Volume and Specific Gravity," prepared by Mr. Joule in association with Sir Lyon Playfair. Mr. Joule took the principal part in the experiments on the expansion of salts, the maximum density of water, &c.; but the important theoretical results arrived at with regard to atomic volume he attributes almost entirely to his colleague. Another valuable series of papers were the joint work of Mr. Joule and Sir William Thomson. The subjects are: "The Thermal Effects experienced by Air in rushing through Small Apertures," and "The Thermal Effects of Fluids in Motion." In the year 1843, Mr. Joule read a paper on "The Caloric Effects of Magneto-Electricity and the Mechanical Value of Heat," to the Chemical Section of the British Association assembled at Cork. The subject did not excite much general attention, so that, when he brought it forward again at the meeting in 1847, the Chairman suggested that he should not read his paper, but confine himself to a short verbal description of his experiments. "This," says Mr. Joule, "I endeavoured to do, and, discussion not being invited, the communication would have passed without comment if a young man had not risen in the Section, and, by his intelligent observations, created a lively interest in the new theory. The young man was William Thomson, who had, two years previously, passed the University of Cambridge with the highest honours, and is now probably the foremost scientific authority of the age." The work they afterwards did together, the results of which are here recorded, was chiefly experimental, performed in Manchester and the neighbourhood.

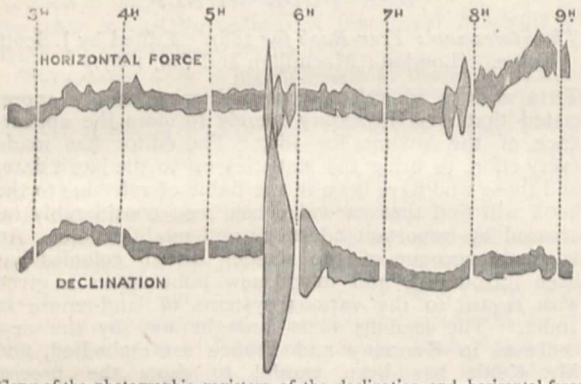
LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

The Earthquake

WITH reference to the earthquake which occurred on the morning of February 23 last, it may be of interest to inform you that two of the magnetic registers of the Royal Observatory, Greenwich, entirely confirm the fact shown by the Kew horizontal-force register (NATURE, March 3, p. 421), of the shock having been sensible in England. The particulars are as follows:—

At 5h. 38m., Greenwich civil time, the declination and horizontal-force magnets were suddenly thrown into vibration by some cause not magnetic, the extent of vibration being in the case of declination 20′ of arc, and in the case of horizontal force ·004 of the whole horizontal force. Other smaller vibrations will be observed, on the annexed copy of the Royal Observatory photo-



Copy of the photographic registers of the declination and horizontal-force magnets, as recorded at the Royal Observatory, Greenwich, 1887, February 23.

graph, as occurring in declination at about 6h. 0m., and in horizontal force at about 5h. 45m., 7h. 40m., and 7h. 50m. respectively. No motions of this character were shown in the vertical-force magnetic register, the two earth-current registers, or in any of the meteorological registers.

It may be mentioned that the declination magnet is a bar 2 feet long, suspended by a single thread about 6 feet long, and stands in the magnetic meridian, and that the horizontal-force magnet, also 2 feet long, has a bifilar suspension, the threads, about 7½ feet long, being twisted horizontally to cause the magnet to stand at right angles to the magnetic meridian. The time of vibration of the declination magnet is 24 seconds, and that of the horizontal-force magnet 21 seconds. The magnetic declination at Greenwich at the present time is about 17° 53′ west.

W. H. M. CHRISTIE

Royal Observatory, Greenwich, March 10

The *Engineer* on the Dimensions of Physical Quantities

IN a brief book-notice (*ante*, p. 387) I commented on the grave error of measuring potential energy in terms of horse-power, comparing it with the allied absurdity of measuring distance in terms of speed. I also cited the following passage:—

"dividing 3,942,400 foot-pounds per minute by 33,000 foot-pounds, we get 119·4 horse-power";

and I put beside it the allied absurdity:—

"dividing 500*l.* a year by 50*l.*, we get 10*l.* a year."

I thought it superfluous to point out the nature of the mistake, but I judged rashly. For the *Engineer* (in a leader, of March 4, 1887) has made a somewhat excited attack on this and other of my statements:—remarking

"we are in doubt whether 'P. G. T.' really has any idea what (*sic*) the expression means."

To this charge I plead guilty. For if I were myself to divide 3,942,400 foot-pounds per minute by 33,000 foot-pounds, the result would contain the unit of *time* alone; and could certainly not express horse-power. It might be angular velocity perhaps. It is true that if I were to divide 3,942,400 foot-pounds per minute by the mere *number* 33,000, I should probably obtain the result 119·4 horse power. But the *Engineer* will ascribe all this to the pedantry of the "professor," for its article goes even farther in absurdity than does the passage quoted above. It leaves out the "per minute" and says the author "is strictly correct (*sic*) when he says that 3,942,400 foot-pounds are to be divided by 33,000 foot-pounds to get the horse-power"! Alas for Fourier, and *Dimensions* of physical quantities!!

I wonder what the *Engineer* would assign as the result of dividing 10 eggs per minute by 2 eggs. Would it, or would it not, be 5 eggs per minute?

P. G. T.

Tabasheer

MR. W. T. THISELTON DYER'S ingenious contribution on Tabasheer in NATURE (p. 396) will doubtless be interesting in connection with the subject of the nature and mode of distribution of silica in vegetable bodies, in which it is so often contained.

Brewster, in 1819, says (*Edinburgh Philosophical Journal*, n. 1, p. 147):—"It is found in the joints of the female (?) bamboo, sometimes in a fluid state like milk, sometimes with the consistency of honey, but generally in the form of a hard concretion. Some specimens of it are transparent, and resemble very much small fragments of the artificial pastes made in imitation of opal; others are exactly like chalk, while a third kind is of an intermediate character, and has a slight degree of translucency.

"In the year 1804, Messrs. Humboldt and Blonpland brought with them from America some specimens of tabasheer, called *guaduas butter* by the Creoles, taken from the bamboos which grow to the west of Pinchincha in the Cordilleras of the Andes (Humboldt's 'Personal Narrative,' vol. i. Introd. p. xii. note). These specimens were analysed in 1805, by Messrs. Fourcroy and Vauquelin (*Mémoires de l'Institut*, tom. vi. p. 382), who found them to be different from the tabasheers of Asia. Instead of being wholly composed of silex, they contained only 70 per cent. of this earth, and 30 per cent. of potash, lime, and water."

Cohn speaks of two kinds of tabasheer, viz. crude and calicified. The former consists of roundly-angular pieces of unequal sizes, possessing all degrees between transparency and opaqueness, and passing from brownish, reddish, yellowish, or dark gray to black in colour; the latter is opal-like, milky, or pale in colour, not unlike a lump of sugar. Tabasheer can be cut into pieces very easily, and shows, in polarised light, only extremely feeble double reflection.

Brewster, moreover, by studying the optical properties of tabasheer, formed one of the semi-transparent specimens, which he obtained from Nagpore and Hyderabad, into a prism, and found to his "great surprise that the refractive power of tabasheer was not only lower than water, but so much lower, as to be almost intermediate between water and gases." The results he obtained are as follows:—

		Index of refraction
Air		1·0000+
Tabasheer from Hyderabad, yellowish by reflected light		1·1115
Tabasheer from Nagpore ...	bluish by reflected light	1·1454
,, ,, harder		1·1503
,, ,, ...		1·1535
,, ,, very hard		1·1825
Water		1·3358

As to the chemical constituents of this substance, Poleck's recent analysis (*Bot. Centralbl.* Band xxix., 1887, p. 95) shows that it contains 99·6 per cent. of pure silicic acid and only 0·4 per cent. of other mineral matters, as natrium, sulphuric acid, &c., but neither potash nor phosphoric acid has been detected. The crude specimens contain 58 per cent. of water; the calicified specimens, on the other hand, are free from water.

We may perhaps dwell shortly upon the *habitat* of tabasheer. Mr. Dyer has fully shown its occurrence in India; now let us consider whether it occurs further in the eastern parts of Asia, as in China and Japan, where the growth of bamboos is still in full vigour. In China, tabasheer is known as Tien-chü-hwang or Chü-hwang, that is, the "yellow (substance) of bamboo"; or sometimes called Chü-kaou, or the "cerate of bamboo." "Pun-tsaou-kang-mûh" says: "They are produced inside the stem of bamboos, and look somewhat like yellow earth; they may be often found attached in masses to the inside of the bamboo cane."

From the well-known old Japanese encyclopædia, "Wakan Sansai Dsuyé," the following descriptions may be quoted: "After bamboos have been cut down in March or April, and

left for some time, tabasbeer is sometimes found inside the stem when broken." In Japan it is called *Take Miso*, and I have only heard that some portion of fluid, or some solid particles, occur inside the stem of bamboo, but not to such a remarkable extent as we meet with in India. In the Island of Kiusiu, the stem of bamboos is found sometimes filled with fluid, and especially in the province of Satsuma, particles like grains of sand are often detected. In a new Japanese work about bamboos, entitled "Nihon Chikufu," or "A Collection of Japanese Bamboos," by Nawoto Katayama, published in three volumes in Tokio in 1885, it is stated that in Tokio, if bamboos from the neighbouring provinces of Shimotsuké and Hitachi are kept till July or August and then broken, some watery juice or particles like sand may frequently be found. These particles are pale yellow in colour, but the quantity is only sufficient to fill a very small shell. "Sōmoku Seifu," and other Japanese botanical books, also mention tabasheer.

TOKUTARO ITO

Cambridge

"The Origin of Mountain Ranges"

THE reviewer of "The Origin of Mountain Ranges in NATURE (Feb. 17, p. 361) says, in reference to my views on the contraction hypothesis:—"He seems to hold that, according to the contractionists, crumpling is produced by unequal contraction in the solid shell itself, which certainly is not their view. And he entirely omits all reference to the one fact which is the life and soul of the hypothesis, that the earth's crust is not strong enough to stand by itself without support, a fact which admits of rigid mathematical demonstration."

Will you kindly permit me to state that this is an entire misapprehension; that I hold neither view; and I have a difficulty in understanding how such inferences can be drawn from anything contained in the work.

T. MELLARD READE

Liverpool, February 18

I AM very sorry if I have represented Mr. Reade as saying what he did not intend to say, but the construction I put upon his words seemed, and still seems, to me to be that which they naturally bear. Mr. Reade's notion of what it is that the contraction hypothesis maintains, and his reasons for differing from its conclusions, are apparently summarised in Chapter XI. on pp. 121–25. He there tries to form an estimate of the ratio between the radial and circumferential contractions *within a shell of* 30 *miles* in thickness which he assumes to be solid. It seemed to me accordingly that he was contemplating only contraction within a thin shell which he himself starts with assuming to be solid, and that he deals only with "unequal contraction in the solid shell itself."

If Mr. Reade meant something quite different from this, I failed to grasp his meaning; that this was so may or may not be my fault, but in either case I am much obliged to Mr. Reade for putting me right, and very sorry that I should have laid upon him the troublesome necessity of pointing out my mistake.

What the other view is which Mr. Reade disavows, and what other inferences are contained in the passage he has quoted, I confess that I am unable to discover.

A. H. GREEN

Leeds, March 13

The Vitality of Seeds

IN a letter in your last issue (p. 414) upon the vitality of seeds, "N. E. P." states that Prof. Judd in his address to the Geological Association (I presume he means the Geological Society) was reported to have said: "The botanist cites the germination of seeds, taken from ancient Egyptian tombs, as a striking illustration of how long life may remain dormant in the vegetable world." This appears to be a remarkable assertion to emanate from such an eminent scientific man as Prof. Judd, for if he really did make this statement one would think he must have some good proof quite incontrovertible. I must admit I am sceptical, and do not place credence in the statements that have been made by certain people, that wheat or barley, which is frequently found in the ancient tombs of Egypt, could possibly germinate after the lapse, say, of 3000 years.

We have often heard of people having had tricks played upon them by crafty Arabs, who, when discovering grain, knowing, perhaps, that the purchaser wished to test it, substituted for it some of modern date, which was said to be of the same species. When this was sown, it germinated, and probably yielded a fine crop; but the real grain found in the tomb was to all purposes dead. Mummy-wheat is, I presume, simply a commercial name for a certain species, which has no sort of connection with the tombs of ancient Egypt. Sir Gardner Wilkinson, in his book "The Ancient Egyptians," vol. i. p. 471, refers to experiments having been successfully made with some grains of corn discovered in the tombs. Dr. Birch added the following footnote:—"The experiments are said to have been made in France. (The possibility of corn germinating after so many years is strongly denied by some botanists on account of the impossibility of the delicate and minute embryo, placed immediately below the surface, being preserved so long in life, close to the surface.)"

As the late Dr. Birch in the above made reference to experiments having been made in France, I beg to quote the opinion of M. Paul Pierret, a very eminent Egyptologist, Conservateur du Musée Égyptien du Louvre, in his "Dictionnaire d'Archéologie Égyptienne," under the head of "Blé":—

"Tout ce qui a été dit sur la germination des grains recueillis dans les hypogées est absolument faux; tous les essais tentés dans les conditions voulues de sincérité scientifique ont avorté. Ce blé, semé dans la terre humide, s'amollit, s'enfle, se décompose, et, au bout de neuf jours, est entièrement détruit."

F. G. HILTON PRICE

29 Weymouth Street, W., March 7

I BEG to refer your correspondent "N. E. P.," on this subject, to my "Memoir of the Late Professor Henslow," p. 207, where I have given the results of copious experiments made by him in reference to the vitality of seeds, as well as the results of a close investigation of the whole subject by himself, Dr. Daubeny, and others—being a Committee appointed for the purpose in 1840 by the British Association; all tending to show that no seeds retain their vitality for much more than forty years, and very few for anything like so long, and throwing utter discredit upon often-received statements as to the long-retained vitality of the so-called mummy-wheat found in the catacombs of Egypt.

Bath, March 7

L. BLOMEFIELD

THE question put by your correspondent with reference to the germination of seeds taken from ancient Egyptian tombs appears to be directly answered by M. A. de Candolle in his work on "The Origin of Cultivated Plants." His words are:—"I think it pertinent to say that no grain taken from an ancient Egyptian sarcophagus and sown by agriculturists has ever been known to germinate. It is not that the thing is impossible, for grains are all the better preserved that they are protected from the air and from variations of temperature or humidity, and certainly these conditions are fulfilled by Egyptian monuments; but as a matter of fact, the attempts at raising wheat from these ancient seeds have not been successful."

However, if the germination of mummy-wheat is not sufficiently authenticated, Prof. Judd might perhaps point to other cases which, although of less value on account of their antiquity, would nevertheless go far enough to prove his point. There is, I believe, the case recorded by Dr. Lindley of some raspberries "raised in the garden of the Horticultural Society from seeds taken from the stomach of a man whose skeleton was found thirty feet below the surface of the earth, at the bottom of a barrow which was opened near Dorchester. He had been buried with some coins of the Emperor Hadrian, and it is therefore probable that the seeds were sixteen or seventeen hundred years old."

The following well-ascertained fact, recorded by Prof. Duchartre and others, may prove of interest. Some years ago in Paris, when a number of very old houses were being pulled down in the "Cité" to make room for Haussmannian improvements, Dr. Boisduval examined some dark-looking earth taken from the very foundations of one of those houses. The earth was found to contain seeds, which, being planted carefully under a glass bell, germinated in due time, and proved to be seeds of *Juncus bufonius*, L. This plant, as is well known, affects damp, marshy places such as the island was on which Lutetia Parisiorum grew up. It was therefore admitted as very probable that those seeds of *Juncus bufonius* must have been dormant in the ground ever since the time when the "Cité" marshes became dried up, and the ground began to be occupied by houses.

L. MARTIAL KLEIN

University College, Dublin

CEREBRAL LOCALISATION[1]

II.

WE have considered the main positions first taken up by Dr. Ferrier with regard to functional localisations, and it will be convenient to examine in the same order the criticisms and statements of other observers regarding those positions.

(1) *The Rolandic region.*—The effects of excitation and ablation in this region, so far as relates to the production, or the paralysis, of the movements of voluntary muscles, are almost universally admitted, and to this extent the researches of Dr. Ferrier have received brilliant corroboration. But the inference that this region is therefore of necessity motor has not been so generally acceded to. The attacks to which it has been subjected are based, almost without exception, upon a denial of the statement that lesions of this region do not involve the loss or impairment of sensation in the paralysed parts. It is alleged that, on the contrary, the motor paralyses are invariably accompanied by loss or impairment of sensation, either of the so-called muscular sense (Hitzig, Nothnagel; "sense of movement," Bastian), or of tactile sensibility (Schiff, Tripier), or of sensibility in general, muscular and cutaneous (H. Munk); and it has been supposed that the paralyses of motion which result from these cortical lesions are not true motor paralyses, such as would be caused by destruction of a motor centre, but are rather due to the loss of the sensations which guide the volitional movements, or the ideas of such sensations, of which the part of the cerebral cortex removed is assumed to be the seat.

The question seems, on the face of it, one which is easily determinable. Do animals, and especially monkeys, in which a lesion in the Rolandic region has been established, exhibit loss of tactile (or any other form of) sensibility? Are cases of motor hemiplegia in man which are produced by injury or disease of this region accompanied by loss of cutaneous or muscular sensibility, or are they not? As regards animals, many, indeed most, observers answer this question emphatically in the positive sense. As regards man, the evidence is more conflicting. We have, it is true, the advantage of being able to obtain a direct answer regarding the existence, or absence, of sensibility in any particular case; but on the other hand there is not necessarily the same restriction of the lesion to the cortical gray matter, and the exact localisation is much more difficult of determination. Accordingly we find that cases of motor paralysis from cortical lesions in man have been put in as evidence upon both sides, according as they have been accompanied or not by impairment of sensibility. Dr. Ferrier is, however, very positive upon this point, relying upon the accuracy of his own observations in animals, as well as upon evidence derived from pathological observations in man, and the allegations to the contrary are disposed of by him in the following manner:—

"The conclusion that tactile sensibility is lost or diminished after destruction of the cortical motor area is based on defective methods of investigation and erroneous interpretation of the reactions of the lower animals to sensory stimulation. Though an animal does not react so readily to sensory stimulation of the paralysed side, it does not follow that this is due to diminished or absent perception of the stimulus. An animal may not react, or react less energetically, to a sensory stimulus, not because it does not feel it the less, but because it is unable, or less able, to do so from motor defect. . . . All that the experiments of Schiff and Tripier demonstrate is that motor reactions are less readily evoked on the side opposite the cortical lesion. But the same thing occurs in cases of purely motor hemiplegia in man" (pp. 374-75).

"Strictly cortical lesions of the motor area do not cause anæsthesia in any form, and it may be laid down as a rule to which there are no exceptions that if anæsthesia is found along with motor paralysis the lesion is not limited to the motor zone" (p. 378).

"The total abolition of the muscular sense (as in locomotor ataxy) does not paralyse the power of effecting movements. Even though the impressions ordinarily generated by muscular contraction are not perceived, yet the person can walk or move his limbs with perfect freedom under the guiding sense of vision. Even with the eyes shut the patient can intend his movements with correctness" (p. 380).

"Loss of the muscular sense never occurs without general anæsthesia of the limb. . . . The statements to the contrary, sometimes met with, rest only on the foundation of a demonstrably false hypothesis as to the nature of the ataxy which it is invoked to explain" (p. 380).

"The idea of a movement may be perfect when the motor centres are entirely destroyed. A dog with his motor centres destroyed has a clear idea of the movement required when asked to give a paw, and exhibits its grief at being unable to do so in an unmistakable manner; and the patient suffering from cortical motor lesion, after making futile efforts to carry out his ideally realised movement, not uncommonly bursts into tears at his failure. There is no defect in the ideation, but only in the realisation, of the movement" (p. 383).

"The cortical centres are motor in precisely the same sense as other motor centres, and are differentiated anatomically from the centres of sensation, general as well as special" (p. 393).

Certainly, if it can be shown that a distinct part of the cortex is concerned with the perception of impressions of general sensibility, this would afford strong *primâ facie* evidence against the Rolandic region being endowed with sensory functions. And we shall presently see that such evidence is forthcoming.

(2) The evidence for the second proposition (that the visual centre is situated *exclusively* in the angular gyrus) has not found confirmation, and is virtually surrendered by the author. That the angular gyrus is at all concerned in the visual process is entirely denied by H. Munk, who has shown that complete blindness is produced by removal of the *occipital lobes* alone, without the implication of the angular gyri, and that removal of one occipital lobe produces blindness of the corresponding half of both retinæ (hemianopsia). According to Munk, this blindness is permanent; but Luciani and Tamburini, who have obtained the same immediate result, affirm that it may after a time disappear. Dr. Ferrier, however, denies that the mere removal of the occipital lobes is followed by any perceptible deficiency of vision; and in support of this statement, which was already made in the former edition, he quotes the results of his own more recent experiments, which were performed in conjunction with Prof. Yeo, and also certain unpublished results which have been obtained by Mr. Horsley and myself. Dr. Ferrier has, however, been mistaken in supposing that our observations bear out his statement, for we invariably found, when an extensive removal was effected in the occipital region, that hemianopsia resulted therefrom, as described by Munk. But in the few experiments which we performed the blindness was not permanent, only persisting, so far as we could judge, for some days, or, at the utmost, weeks; and in one of these cases, in which we *afterwards* destroyed the angular gyrus, hemianopsia which appeared to be permanent was produced. This is confirmatory of the statements of Drs. Ferrier and Yeo. I am myself, however, not at all sure that the permanence of the result was due to the destruction of the angular gyrus, and may not rather have been produced by the more complete removal of the occipital lobe which that destruction

[1] "The Functions of the Brain." By David Ferrier, M.D., LL.D., F.R.S. Second Edition, re-written and enlarged. (London: Smith, Elder, and Co., 1886.) Continued from p. 441.

involved. As for the angular gyrus, the author seems now to admit that the blindness of the opposite eye which he has obtained on destroying that convolution is quite temporary, not, indeed, persisting for more than an hour or two after the operation. Nevertheless, he infers that this loss of vision which he describes is due to the fact that the angular gyrus is concerned with the appreciation of *direct* or *central* visual impressions. I have myself failed to obtain evidence either of permanent or temporary visual disturbances as the result of destruction of the gray matter only of one or both angular gyri; and I confess it is to me somewhat surprising that an experimentalist so experienced, and a reasoner so clear-sighted, as Dr. Ferrier, should have attempted to erect a theory of such importance upon a foundation so insecure!

(3) A similar idea arises in one's mind when one considers the evidence which the author has to bring forward of the localisation of the auditory centre in the superior temporo-sphenoidal convolution. Of course, if this be the case, it must follow that bilateral removal of this gyrus will produce complete and permanent deafness. According to Dr. Ferrier, this is actually what happens; but there is only one case followed by complete recovery from the immediate effects of the operation which he is able to quote in support of that statement. This case is that of a monkey which was exhibited to the International Medical Congress in London in 1881, and the animal certainly appeared to be deaf, for it in no way reacted to a loud noise, such as the report of a pistol fired near its head. But, convincing as this test seemed at the time to most of those present, I may here remark that a test of this character is of little or no value when applied to monkeys. For a perfectly normal monkey, if its attention or curiosity is excited in any way, and especially if it is brought into a strange room and surrounded by strange faces, will often give not the slightest sign of perceiving even a loud sound, such as the report of a pistol, when such sound is suggestive of no ideas. On the other hand, a sound which is habitually associated with an emotional idea, *e.g.* the noise made by the approach of a hostile companion, or a footstep which is associated with the expectancy of food, will generally be instantly reacted to. It is true that Dr. Ferrier, in the case mentioned, has not relied entirely upon the negative result obtained from the pistol-report, but expressly mentions other tests as having been applied by him. One remark which he makes is, however, very significant: "Occasionally a doubt was raised as to whether the absence of reaction to sounds was absolute."

I have always been inclined to think that Dr. Ferrier, in localising the auditory centre exclusively in this convolution, has relied too much upon this single case—especially since his deductions therefrom have not been supported by the results of other experimentalists. Luciani, in particular, insists upon the fact that extensive destruction of the temporo-sphenoidal lobe is necessary in order to produce deafness, and that even then the loss of hearing is not permanent. This statement I can myself fully corroborate. I have recently, in conjunction with Dr. Sanger Brown, entirely destroyed the superior temporo-sphenoidal gyrus on both sides in several monkeys, and in not one of them has there been any appreciable loss or impairment of hearing. On the other hand, when the lesion has involved not only the superior gyrus but also the greater part of the lobe there has in one or two instances seemed to be at first, not an entire loss, but a diminution of the power of appreciating auditory sensations—this condition, however, being recovered from after a few days.

I am aware that in locating the auditory centre in the superior temporo-sphenoidal gyrus Dr. Ferrier does not rely alone upon the result of extirpation, but adduces also the movements of the ear and eyes which follow electrical excitation as evidence that a subjective auditory sensation is thereby evoked. Taken by itself this is no evidence at all, for similar movements may be obtained from excitation of totally different portions of the cerebrum, to say nothing of the cerebellum and of the lower nerve-centres. It only becomes evidence as corroborating the effect of extirpation. But a single "negative instance" is sufficient to overthrow the hypothesis that the auditory centre is situated in the superior temporo-sphenoidal convolution alone, and would outweigh many "positive instances." We have, however, only the one well-recorded "positive instance" of Dr. Ferrier (and this was not altogether free from doubt) as against several "negative instances" (those of Munk, Luciani, and ourselves; which last have not yet been published, and could not, therefore, be taken into account by Dr. Ferrier). It is probable, therefore, that Dr. Ferrier's inference is too exclusive, and that other parts of the temporo-sphenoidal lobe must be included in the auditory centre.[1]

(4) The view that tactile sensibility is localised in the hippocampal region has naturally been attacked by those who hold that it is to the Rolandic region that the perception of this and other forms of sensibility are to be referred. It would not appear, however, that they have taken the trouble to repeat Prof. Ferrier's experiments upon this region, so that his position can hardly be said to have been seriously assailed. On the other hand, it has received both corroboration and extension from the experiments of Mr. Horsley and myself, the results of which were shown to Dr. Ferrier, and the conclusions arrived at fully concurred in by him (pp. 340-45). These experiments showed in the first place that extensive destruction in the hippocampal region, especially of the posterior part of the hippocampal gyrus, is followed by hemianæsthesia, which is not, however, of a permanent character, but disappears after a few days; and further, that destruction or injury of the gyrus fornicatus (which, as Broca showed, is to be regarded as a direct extension around the corpus callosum of the hippocampal gyrus (see Fig. 2), produces still more marked and far more permanent symptoms of a like kind.

(5) and (6) With regard to the cerebral localisation of the functions of taste and smell, the author in this edition brings forward no new proofs of an experimental nature. But he adduces and quotes evidence from comparative anatomy to show, not only that in animals in which the sense of smell is largely developed (the "osmotics" of Broca) the hippocampal lobule is greatly developed, but also that the development of the anterior commissure, especially of its posterior division, goes hand in hand with that of the hippocampal lobule, and its internal extension, the nucleus amygdalæ, and is therefore to be regarded as a commissure of the olfactory centres. The evidence in the first edition regarding the localisation of taste-perceptions was of the scantiest description, and has been in no way subsequently strengthened, and it is necessary that further experiments should be made upon the subject with the view of testing the opinion which the author has with all caution put forward on the subject.

(7) Upon the special functions of the pre-frontal lobes, or whether any function is in fact specially concentrated in this part of the brain, very little light has been thrown by the researches of the past fifteen years. There is a very prevalent idea that intellectual capacity goes hand in hand with the development of this region, an idea which has existed from the time of the old Greeks, although it was not apparently shared by peoples of yet more ancient civilisation. The idea does not, however, appear to receive any confirmation from the experimental method.

[1] Dr. Ferrier is mistaken in supposing (*vide* p. 310) that the results of the experiments of Mr. Horsley and myself confirm his conclusions regarding the localisation of the auditory centre in the superior temporo-sphenoidal gyrus. The error seems to have arisen from the misunderstanding of a verbal communication. What we did find in one or two cases was that the whole of the temporo-spheno.dal lobe exclusive of the superior gyrus might be removed on both sides without loss of hearing—not the converse, that hearing was abolished on destroying only the superior gyri on both sides. Indeed, we did not in any single instance perform this last experiment.

Animals from whom these lobes have been removed exhibit "a total absence of symptoms" (p. 396). "In my first series of experiments (carried out without antiseptics), I noted, after removal of the prefrontal regions, a decided alteration in the animals' character and behaviour. . . . They had lost, to all appearance, the faculty of attentive and intelligent observation" (p. 401). But that this was due to an extension of the effects of the lesion consequent on the want of antiseptic precautions appears from what immediately follows :—"In some of my latest experiments, in which the lesions were strictly limited (under antiseptic precautions) to the pre-frontal regions, I could not satisfy myself of the existence of any appreciable mental deterioration. . . . A similar total absence of discernible symptoms has been observed also by Horsley and Schäfer" (p. 396).[1]

On the other hand, Dr. Ferrier believes that he has in one or two instances obtained unequivocal evidence that the whole of the pre-frontal lobe is concerned with the movements of the head and eyes, being an extension forwards of the centre for those movements which he had previously described. Nevertheless, he quotes approvingly certain observations of Hitzig and of Goltz upon dogs in which this region had been destroyed upon both sides, and which appeared in consequence to exhibit weakness of memory and lack of attention, without any paralysis of movement or sensation, as tending to confirm, what the comparative study of the relative development of the frontal lobes in different animals and individuals appears to show, "that the frontal lobes, the cortical centres for the head and ocular movements, *with their associated sensory centres*, form the substrata of those psychical processes which lie at the foundation of the higher intellectual operations" (p. 467). The qualification which I have italicised takes away the whole point of the statement so far as relates to the region under discussion. And a single well-recorded instance in man (such as the celebrated American crowbar case), in which there has been extensive destruction of this region without the occurrence of any appreciable symptoms during life, renders it manifest that there can be no restricted localisation of any special function in this part.

"Munk professes to have found that after destruction of the pre-frontal region in dogs and monkeys, paralysis occurs in the muscles of the trunk on the opposite side. . . . My own experiments, as well as those of Horsley and Schäfer, disprove Munk's assertions in the case of monkeys," and "in regard to dogs they are flatly contradicted by Hitzig, Kriworotow, and Goltz." Moreover, "Horsley and Schäfer have shown that the centres for the trunk-muscles" in the monkey "are in the marginal convolutions" (pp. 400-401). It is not a little curious to observe how in the desire to conform to the prevalent view regarding the frontal region being the special seat of intelligence, both Ferrier and Munk endeavour to prove that the different movements which they respectively asssociate with this region are particularly related to the development of the intellectual faculties. Munk even goes so far as to assert that the development of the *trunk-muscles* in mammals marches *pari passu* with the evolution of the intellectual capacity. One is surprised that he has not carried the comparison yet further, and drawn attention to the relation between the "wisdom of the serpent" and the complexity of the movements of the reptilian trunk!

The amount of space which it has been necessary to occupy in discussing the question of cerebral localisation may be justified, not only by its general interest and importance, but also by the fact that the author of this work is one of the most prominent exponents of a doctrine which, whether wholly or partially right, has revolutionised cerebral physiology and profoundly modified the department of medicine with which this branch of physiology is linked. We can consequently only refer very briefly to some of the principal alterations and additions which we find recorded regarding other subjects.

The structure of the nerve-centres is treated at much greater length than in the former edition, and is copiously illustrated with many original microscopic drawings by Mr. Bevan Lewis and others. The conducting functions of the spinal cord, which were somewhat cursorily dismissed in the former edition, are here considered at length. The view of Brown-Séquard that there is a differentiation within the cord of the paths for different forms of sensibility is subjected to a searching criticism, with the result that the existence of such tracts is entirely rejected by Dr. Ferrier. He, however, nowhere refers to the question of specific paths for temperature-sensations, a question which has become one of much importance in connection with the recent researches of Blix, Goldscheider, and others on the differentiation of specific cutaneous points for these and other forms of cutaneous sensibility. To the question of the existence of a "muscular sense," by which is meant that faculty by which we are aware of the position and movements of our limbs without calling in the aid of our visual perceptions, Dr. Ferrier brings forward a considerable weight of argument to prove that it is not to be regarded as in any way a specific form of sensation, and still less a sense of effort or innervation produced by the appreciation by the sensorium of centrifugal discharges which are emitted from motor centres (Bain, Wundt), but that it is merely the result of impressions of tactile sensibility conveyed by the ordinary sensory or afferent nerves both of the muscles and of the parts acted upon by them, and, as such, can have neither a specific path of conduction nor a central terminus apart from the paths and termini for tactile sensibility.

The functions of the spinal cord as a centre for co-ordinate movements are also treated more fully than before, and it is shown that even in the higher animals each segment of the cord may act as a co-ordinating centre for complex and apparently purposeful movements of the limbs. For it has been demonstrated in monkeys by the author, working conjointly with Prof. Yeo, and in dogs by Bert and by Marcacci, that such movements may be evoked by the excitation of single anterior roots in the cervical and sacral regions. And Dr. Ferrier describes one or two experiments, in which he succeeded in stimulating the anterior cornu of the gray matter alone, and which yielded similar results (*vide* note to p. 77). In relation to the functions of the cord, the tonus of the muscles and the so-called "tendon-reflexes" are carefully considered, and their importance as an expression of the condition of the reflex are pointed out. Many new facts are accumulated regarding the remaining parts of the central nervous system, and their bearing upon the functions of the several organs is gone into in several instances with great care and at considerable length. To most of these it is impossible to refer particularly. It may, however, be noted that the direct excitability of the corpus striatum, at least of its caudate nucleus, which has been denied by Franck and Pitres, is positively re-affirmed, and the motor functions of that organ maintained, by Dr. Ferrier, as the result of new experiments performed by him. But, whether or not it be the case that they are directly excitable, it would appear that the precise functions of the basal ganglia, and the relation which they bear to motion and sensation, are as much a matter of conjecture as ever.

To the chapter which deals with the cerebral hemispheres from the psychological aspect one or two important additions have been made, especially in the part

[1] Further on (p. 402) the author states that we have noted signs of stupidity in the monkeys in which we had removed the pre-frontal regions. I do not think, however, that such dullness as was exhibited in one or two of these cases was more marked or lasted longer than with equally extensive lesions of other parts of the brain.

devoted to the consideration of speech, in which the conditions of "word-deafness" and "word-blindness" are now discussed. The view which has been put forward, amongst others, by Dr. Hughlings Jackson, that there are other and higher centres, over and above those which have been demonstrated by physiological and clinical research, which form the substrata of the higher mental operations, does not receive support from Dr. Ferrier. "It seems more reasonable to believe that there may be higher and lower degrees of complexity in the same centres than to assume the separate existence of more highly evolved centres, for which no evidence is obtained by the results of experimental research" (p. 460).

It might have been expected that the remarkable conditions of the cerebral functions which are met with in both man and animals in an hypnotic state would at least have been alluded to in this edition, but they appear to have entirely failed to attract the author's interest, and the subject is passed over in silence.

In conclusion it may confidently be affirmed that, whatever exception may be taken to this or that statement or opinion, or to the mode in which this or that question is discussed, this new edition of Dr. Ferrier's work, from the care with which it has been revised, the extent of the information which it contains, and the clearness of style and lack of ambiguity which characterise its every page, must prove of the greatest value to the student of neurology, and cannot fail to enhance the high reputation of its author. E. A. SCHÄFER

THE VALUE OF THE NEW APOCHROMATIC LENSES

AT the annual meeting of the Royal Microscopical Society, the Rev. Dr. Dallinger, who was elected President for a fourth year, delivered his annual address, in the course of which he gave a judgment concerning the new object-glasses made with the new German glass, in the following terms:—

In proceeding to fulfil the honourable duty that, by your courtesy, devolves upon me, I purpose in the main to follow the line I have taken in preceding years. I congratulate the Society on its work, and on its steady influence in promoting progressive improvements in the optical and mechanical construction of the microscope, devoid of all prejudice as to how, or from whence, such improvements may come. And whilst, happily, it is not of necessity a President's duty to pass in cursory review the microscopical work of the year, there are times when it may be well for him to review the points of improvement that have been made in the instrument itself.

For the past twenty years I have had an increasing interest in the continuous improvement of the optical appliances of our instrument—an interest which, from the first, applied not only to objectives, but also to eye-pieces and condensers, which consecutive calculation, thought, and experience have shown to have a correlated importance.

Eighteen years ago I had, by practice, made myself fairly master of a 1/25-inch objective of that period made by Powell and Lealand. I still possess that lens, and it is as good a lens of its class as they ever constructed. Soon after, I became equally familiar with a 1/50-inch of the same class by the same makers.

By saying that I became master of these lenses, I mean that I discovered exhaustively what they would and what they would not do. By this, I learned definitely what I wanted in lenses, if I could get it; and to get that has been my unceasing endeavour until now. And certainly the quest has not been vain. And my method has been to examine impartially, and possess myself of, English, Continental, or American lenses, whenever they have shown any capacity for doing best what my work proved to me required to be done.

I know that, in estimating the quality of a lens by the class of image it affords of certain test-objects well known to us, a certain amount of empiricism must take place. We do not absolutely know the image it ought to present. But this only applies within very narrow limits. Take the Podura scale: I can give you an image of it with my 1/25-inch and 1/50-inch of twenty years ago. What I, in common with most microscopists, considered then the *best* result, the most sharp, clear, and delicately defined image, with those lenses I can get now; but, with those lenses, nothing better.

But the elements—the essential features that constituted the quality of beauty in that image—are the very elements, the actual features, that every admitted improvement in our object-glasses has brought out more perfectly. So that if I now put, say, the Podura scale under my old dry 1/25-inch objective, and, beside it, another precisely similar scale under a new homogeneous 1/20-inch objective of N.A. (numerical aperture) 1·5, the very qualities of the image which I, and experienced microscopists generally, thought the best twenty years ago are incomparably transcended in beauty and perfectness now.

But that is not, and has not been, my only or my chief test. It has been one more eminently practical, so far as my own work went; at least for some years.

Up to ten years ago, although I had spent weeks in patient effort, no lens that I possessed, or that was within my reach, could be made to reveal the flagella of *Bacterium termo*. The flagella of many minute monads and of such Bacterial forms as *Spirillum volutans*, and even *Bacterium lineola*, I could demonstrate, though some of them with difficulty; but not a trace of that of *B. termo*. But, near that time, Powell and Lealand produced a battery of immersion-lenses on a new formula and of much relative excellence; and with these lenses the flagella of *B. termo* were brought within the range of sight.

Since that time that has been a good lens, to me, in proportion to the greater or less ease and perfection with which it has revealed this delicate fibre. And let me say that such lenses as do this are those that always, without fail, give us the best ideal image of Podura scales and other tests. You will pardon me, I trust, for this amount of personal reference, since it will give a greater relevancy to what will follow.

Improvements of great optical importance have been made during the last few years. The manufacture of homogeneous lenses by Messrs. Powell and Lealand gave us the opportunity, which we could not have with foreign makers, of urging certain modifications. The addition of the correction collar was a minor, but still important, point. But the great point was the increase of the N.A. These makers have shown themselves most anxious, and have spared no efforts, to reach the highest aperture yet attained.

Advancing, say, from N.A. 1·25, they attained to 1·35 in such powers as the 1/25-inch and the 1/50-inch; subsequently to 1·47 in 1/8- and 1/12-inch objectives; and finding these, from my working point of view, of such supreme gain, I urged them still on, and was ultimately rewarded by the possession of a 1/6-inch N.A. 1·5., followed by a 1/12- and a 1/20-inch foci of the same great aperture. From each of these I obtained special advantages over all like powers, but with lower apertures, within my reach.

A question frequently asked may be asked again, In what way do these last increments of aperture aid us? The practical answer is not difficult. Speaking from observation, I may say that all the objectives I have employed for the most critical work fail to produce images by the extreme marginal zone of the aperture. It is the judgment of competent judges that it will be fair to roughly estimate this defective outermost zone at 10 per cent.; so that, from the total measurement of the aperture by Prof.

Abbe's method, I find that in practice this amount may be deducted as of very little service, in all apertures beyond about 1·3; hence, to be able to utilise fully any given aperture beyond 1·3, it is practically necessary that the measurement by means of Abbe's apertometer should be about 10 per cent. higher.

But a further advantage of great numerical aperture is that, other things being equal, we can utilise with excellent results deeper eye-pieces.

I have long realised the advantage, with finely corrected objectives, of a far larger series of eye-pieces than the catalogues provide. Messrs. Powell and Lealand several years ago made me one or more eye-pieces between each of their deeper eye-pieces of standard catalogued focus, and they certainly, within the limit of excellence beyond which greater eye-piece power cannot be employed, bring out to far greater perfection the qualities of any high-class object-glass.

But we have had announced to us an improvement in the optical arrangement of the microscope, based upon an important and fundamental change in the media employed in the construction of object-glasses and eye-pieces. It will be known that I refer to the system of apochromatic object-glasses and compensating eye-pieces devised by Prof. Abbe, and under his auspices carried out by Messrs. Zeiss, of Jena.

The aim of the construction of these new objectives and eye-pieces has been to provide a higher degree of achromatism than could be reached by the old media; the new kinds of glass produced at the Jena Optical Glass Works, under the superintendence of Dr. Schott and Prof. Abbe, can be so combined in the construction of an object-glass as to achromatise not only the essential portion of the primary spectrum, but also to a great extent the secondary spectrum, leaving only small residuals of the tertiary order still visible under certain test conditions. The final elements of correction are supplied by "compensating" eye-pieces of special construction designed to correct what Dr. Abbe refers to as "the differences in the amplification of the image for the various colours . . . formed by the objective outside the axis, which cannot be corrected by the objective itself."

The first trials of these new optical combinations made in Germany evoked unstinted praise, and those who, like myself, desired nothing so much as real improvement, awaited their arrival in England with eager and even anxious curiosity.

The first that came to this country came to Mr. Frank Crisp, and by his courtesy this lens, an apochromatic of 1/8-inch focus was placed in my hands. I subjected it to comparison, in succession, with my complete set of high powers, including those of N.A. 1·5, and upon tests, and by methods, which I have indicated.

It will be well understood that the high excellence and great aperture of my three latest object-glasses would have given a very elevated standard of comparison, a standard of comparison, so far as I know, never before reached, and the result was that with the potentiality of the system represented by the apochromatic lens I was most powerfully and hopefully impressed. I felt, in fact, that the lens itself was of great merit. But withal, by my standard of test I felt that its merits had been overestimated.

It is quite true that on some of my delicate test-objects the images shown by the apochromatic lens in combination with the "compensating" eye-pieces appeared to advantage when compared with my lenses combined with the ordinary eye-pieces; but when I tried my own various powers with the same compensating eye-pieces I am constrained to say that no real advantage over my latest lenses could be discovered. My judgment, therefore, was most favourable as to the immense advantage of the eye-pieces and of the possibilities that lay in the entire system rather than in the special apochromatic object-glass taken by itself; and although pressed again and again by the editors of journals to give a public expression of my judgment, I steadily declined, feeling that it was not, and could not at that time, be exhaustive.

Later, an opportunity was courteously afforded me by the makers to examine a complete series of these object-glasses, from 1-inch to 1/8-inch focus, and with eye-pieces fitted for English stands. In the examination of these objectives and their system of eye-pieces I spared no pains to be exhaustive and impartial. I desired to find the evidence of progression in optical excellence, for which I am always in search, and the excellence of the 1-inch greatly impressed me; but I failed to realise my high hopes in the behaviour of the higher powers. The result, however, of a most critical examination was to very greatly strengthen my conviction of the value of the optical system which these lenses represented, and above all of the excellence of the actually new resource provided for us by the compensating eye-pieces.

In what I have here said I must again remind you that the comparison of Zeiss's apochromatic object-glasses was with a group of object-glasses the most carefully made, most excellently corrected, and with the widest numerical apertures, of any object-glasses that had ever passed through my hands, based on the old system of correction. But with this understanding it appears to me a responsibility that I must not evade to state the facts at this crisis in the development of object-glasses. And I do this with the more confidence that, as I have already informed you, Mr. Mayall, wholly independent of me, examined this set of objectives and eye-pieces, and we each recorded separately, in writing, our judgments at the time of examination; and I subsequently found that our resulting judgments were almost identical.

Dur ng this time samples of the new optical glass had reached the English opticians, and Messrs. Powell and Lealand in relatively brief time, and on a formula of their own, made an apochromatic 1/12-inch object-glass, and eye pieces, constructed on the plan devised by Abbe. By the wise advice of Mr. Mayall this was exhibited at our November meeting. My high opinion of that lens and its compensating system of eye-pieces I at that meeting expressed, and need only add that since I have become the possessor of a second object-glass of precisely similar construction and power made by the firm, I am much strengthened in the opinion I gave.

We all appreciate the splendid services rendered to microscopy by Prof. Abbe, and it was a happy expression of that appreciation that led Mr. Mayall to propose a visit to Jena, with his microscope and such object-glasses as he thought would worthily represent the standpoint we had now reached in England.

I understand that Prof. Abbe greatly desired this, wishing to possess the fullest information as to our methods of testing object-glasses, and to be permitted to examine our best optical work.

I need hardly say that it was a source of great pleasure to me to place at Mr. Mayall's disposal all the lenses and apparatus I possessed that would serve him; for it was in the highest interests of the microscopy of the world that so great a leader in recent progress should see the effects of his teaching and practice as evidenced by our latest object-glasses, and especially by the new apochromatic 1/12th by Powell and Lealand, with its system of compensating eye-pieces.

Mr. Mayall has told us the story of his visit: of his kindly reception; of the earnest and repeated trials of the object-glasses he was able to submit to Prof. Abbe; and of the frank appreciation expressed by Prof. Abbe of the English object-glasses. This comparison will, in my judgment, "make history" for the future of our instrument. It will react here and in Germany. Prof. Abbe's splendid powers are more than ever concentred on the work of touching a higher perfection in object-glasses;

he knows that every improvement initiated in Jena will be watched by keen eyes in England; and he has evidence, which will be as welcome to him as his work is to us, that we are not likely to neglect any point of excellence, provided only we can be made to see it as such. I understand that Dr. Zeiss admits that the formulæ on which his apochromatic objectives are constructed involve far greater technical difficulties than were met with in the older formulæ; and this is evidenced by the great number of separate lenses combined in the construction.

Now it has long been my judgment, and a judgment that has been confirmed by men of large practical experience, that errors of technical execution, when present, are shown at once by deep eye-pieces: with an object of regular structure, whose image fills the field of the eye-piece, the experienced eye readily detects a want of sharpness. I am bound to say that the apochromatics from Jena did not impress me by this test as having accuracy of technical execution equal to the object-glasses with which they were compared.

On the other hand, I find that with the new apochromatic made by Powell and Lealand I can employ advantageously deeper eye-pieces than I had ever used before.

Now there is a less number of separate lenses in the London objective, and whether this superiority is due to the lesser number of lenses or to other causes I may not determine. I refrain from details concerning the comparisons I, amongst others, made of the lower power apochromatic of Zeiss, further than to remark that in my judgment too much has been sacrificed to the object of enabling the observer to employ very thick cover-glasses. This is, no doubt, a convenience; but if, as in Zeiss's 1/4-inch and 1/6-inch, the choice lies between object-glasses that cannot be used for covered and uncovered objects and object-glasses that, with a moderate range of thickness for cover-glass, provide that facility, the latter appear to me from a practical point of view to be the better.

I note with interest that Powell and Lealand have made an achromatic oil-immersion condenser of N. A. 1·4, and will probably be able to increase the aperture to 1·5 in proportion as thinner glass is used to mount objects upon. The mechanical part of this instrument had, when it first reached me, a very neat form, but was difficult of manipulation; and this, involving as it did alteration, has prevented me from really testing its merits. But I have just received it, with a mechanical modification I suggested well carried out, and I have little doubt but I shall realise now its optical excellence. On the whole, then, we may rejoice in the fact that a distinct advance has been made in the optics of the microscope, and the more so from a conviction that there lies considerable potentiality still in the sources from which the amount of progress made has resulted.

ATLANTIC WEATHER CHARTS

THE Meteorological Council has just issued a folio of synchronous weather charts for the North Atlantic Ocean and the adjacent continents, those now published forming the first part of a series which embraces the thirteen months from August 1, 1882, to August 31, 1883. The whole series is to be issued in four parts, Part 1 containing the charts from August 1, 1882, to November 7, 1882. Two charts are given for each day—one shows the barometer, wind, and weather, whilst the other gives the air- and sea-temperature, and weather, the weather being given on both charts for the purpose of easy comparison with other elements. The isobars, or lines of equal barometric pressure, are drawn for each tenth of an inch, and figures are given in the central areas of the several depressions to show the lowest reading of the barometer recorded by vessels passing through these disturbances. The direction and force of wind are shown by a system of arrows which fly with the wind, and the different forms of arrow exhibit very readily where the wind reaches the force of a gale, whilst the winds at high-level stations, where the elevation is 4000 feet or upwards, are indicated by red arrows. The air- and sea-temperatures are shown by different coloured isotherms, or lines of equal temperature, which are drawn for each 5° F. The weather, such as rain, fog, or mist, is shown by different methods of shading, and, as mentioned above, is given with each style of chart. The synchronous hour for which the observations are charted is noon Greenwich time, except in the case of air- and sea-temperature, where local noon has been taken in preference. No letterpress has been published with the charts except a few explanatory notes, in which it is stated that the study of the weather of Western Europe for many years has established in a manner that is beyond question that the atmospheric disturbances, on which the changes of weather are in a great measure, if not mainly, dependent, reach our western coasts after having passed for a longer or shorter distance over the Atlantic. The Meteorological Council undertook the investigation with a view to ascertaining as far as possible the conditions under which such disturbances either originate in or traverse the Atlantic, and the extent to which the direction of their course, their magnitude, and persistence, may be influenced by the general meteorological conditions of the area within which they are generated, or of the regions which surround that area.

The period embraced by the charts is that during which the international system of circumpolar observations was being carried out, and data have thus been obtained from very high northern latitudes, which could not otherwise have been procurable, and by these means the results embodied in the charts have not only been rendered far more complete, but are of an exceptional value, not likely to be soon equalled. Among the circumpolar observations regularly used for the charts are those made at Spitzbergen and Jan Mayen, two stations which add materially to the value of the information on the eastern side of the Atlantic, as they enable many very important barometric changes to be traced which would otherwise be lost, and they help much in fixing the position of disturbances which have skirted the British coasts, and at the time when our weather is improving as these bad-weather systems are passing away.

There are, on an average, observations from rather more than 400 ships for each day, in addition to which there are daily observations from about 300 land stations. In all 11,236 returns, each containing the records of many days, have been received from about 3000 vessels. So large a number of observations have never before been used in the drawing of synchronous charts, and this of itself renders the work quite unique in its character. The area embraced, which extends from the Pacific Coast of America to the east of Moscow, in the heart of Russia, and from the Arctic to the Equator, enables the numerous weather changes to be watched day by day for days together, and allows of a very extensive and comprehensive view of the influence of the several varying conditions of the weather.

The charts show many very interesting features of weather changes, and they exhibit very clearly the general way in which the weather systems move from west to east in the middle latitudes. They show very frequent tracks of low-pressure areas to the north of the parallel of 40°, such areas being frequently observed over the United States; and after traversing North America, they intensify and develop energy on reaching the Atlantic, apparently gaining much of their strength from the supply of vapour over the ocean. Many such storms can be traced across the Atlantic, while some die out

after traversing only a part of that ocean. On the other hand, others are formed over the Atlantic, and especially in the vicinity of Newfoundland, where there is the mingling of hot and cold water, and where, as shown by both air- and sea-isotherms, there is a very great difference of temperature in a very small area. There are numerous instances both of the formation of storms and also of their sudden breaking up. It is also seen how at one time a storm will divide into two parts, and each will follow its independent course, while at another time two well-developed storms will merge and become one. The charts show how, as one of these travelling disturbances is approaching the British Islands, the weather becomes unsettled, and how, as the outer edge of the front segment strikes our coasts, the wind backs to the southward, and in a short time rain begins to fall and the wind freshens. If the disturbance passes over the British Islands, the changes are generally both important and rapid, whilst, if the storm area merely skirts our western coasts, as is the more common experience, the changes are less marked, and influence in the main only our western and northern coasts. The first issue of these charts deals only with the autumn, but they show very different conditions of weather at the early part of this season from those at its close, the whole system of weather being more disturbed as the season advances. There is, however, throughout the period a permanent area of high barometric pressure situated in mid-Atlantic, on the northern side of which the travelling disturbances move. This area of high barometer oscillates from day to day within fairly well-defined limits, and is very seldom altogether broken up; and doubtless a close study of the behaviour of this high-pressure area will tend to materially advance our knowledge of the now almost hopelessly puzzling weather changes with which in weather-forecasting we have to combat.

Among other points of interest exhibited by the charts may be mentioned the graphic manner in which the earlier charts show the meeting of the north-east and south-east trade-winds and the seasonal march of the limits of these winds with the sun. They also show that at the end of the summer the temperature of the air is warmer than the sea to the extent of 2° or 3°, while, as winter is approached, the sea is slightly the warmer. In September there is a good instance of the formation of a West Indian hurricane which eventually crosses the Atlantic and passes to the north of Scotland, and the chart of November 1 shows the vast extent of some of these Atlantic storms, one gale blowing over the whole ocean from the coast of America to that of Europe.

It is scarcely possible to over-estimate the high value of this series of charts. The most practical outcome of their publication, it is hoped, will be an improvement of our weather forecasts and storm warnings and a general extension of our knowledge of the laws which regulate the weather changes in our own islands; whilst from a nautical point of view they are of the utmost value to the seaman in enabling him to follow in detail the many changes he experiences, and they may assist him at times in making a better passage.

GILDED CHRYSALIDES[1]

PREVIOUS WORK.—Mr. T. W. Wood in 1867 published the observation that certain pupæ (*Pieris brassicæ*, *P. rapæ*, &c.) resemble in colour the surface on which they are found. Although this was disputed by some naturalists, it was confirmed by Mr. A. G. Butler and Prof. Meldola. In 1874 Mrs. M. E. Barber published some very striking observations on the colours of the pupa of *Papilio nireus* (South Africa), confirmation being afterwards afforded by Mr. Trimen, from the case of *Papilio demoleus*. Dr. Fritz Müller, however, shows that *Papilio polydamus* is not sensitive to surrounding colours. The observations were explained by supposing the moist skin of the freshly-formed pupa to be "photographically sensitive" to the colour of surrounding surfaces; but Prof. Meldola pointed out that there can be no real analogy with photography. Furthermore, many pupæ are formed at night, when the surrounding surfaces are dark. The present investigation was undertaken with the belief that the influence would be found to work upon the larva as it rests upon some coloured surface before pupation.

I. *Experiments upon Vanessa Io.*—This pupa appears in two varieties, being commonly dark gray and much more rarely yellowish-green. Six larvæ placed in a glass cylinder covered with green tissue-paper, produced six green pupæ; one of these, transferred to a black surface while still moist and fresh, became a green pupa precisely like the others.

II. *Experiments upon Vanessa urticæ.*—The pupæ have no green form, but appear in many shades of dark gray, the lighter ones having golden spots on them, while the extreme forms are almost covered with the golden appearance. These latter are very rarely seen in nature, except when the pupa is diseased. Over 700 pupæ were obtained in the following experiments:—

1. *Effects of Colours.*—*Green* and *orange* surroundings caused no effect on the pupal colours; *black* produced, as a rule, dark pupæ; *white* produced light pupæ, many of them being brilliantly golden. This last result suggested the use of *gilt* surroundings, which were found to be more efficient than white, and produced pupæ with a colour which even more resembled gold.

2. *Mutual Proximity.*—The larvæ being dark, it was found that when many of them became pupæ on a limited (white or gilt) area, the pupæ were darker than when they had been more isolated. The colours of each were in fact affected by that part of the surroundings made up by the black skins of its neighbours.

3. *Illumination.*—Black surroundings produced rather stronger effects in darkness than in light, but the pupæ were dark in both cases.

4. *Time of Susceptibility.*—The mature larvæ, after ceasing to feed, wander (stage i.) until they find a surface on which to pupate; they then rest upon it (stage ii.), and finally hang, head downwards, suspended by their last pair of claspers (stage iii.), in which position pupation takes place. Stage i. is variable in length, stage ii. may be estimated at 15 hours (but it is also variable), while stage iii. is fairly constant, and lasts about 18 hours; while the whole period is commonly about 36 hours in length. The larvæ are probably affected by surrounding colours for about 20 hours before the last 12 hours of the whole period, and in this time the pupal colours are determined. These facts were discovered by a very large number of experiments, in which larvæ were placed in surroundings of one colour, and then after a variable time were transferred to another colour producing an opposite effect. It was thus found that stage ii. is more sensitive than stage iii., although there is some susceptibility during the latter stage.

5. *The Part of the Larvæ which is Sensitive to Colour.*

(α) *The Ocelli.*—The most obvious suggestion was that the larval eyes (or ocelli, six on each side of the head) saw the colours, and, being influenced, transmitted an impulse to the nervous centres which regulate the formation of the pupal colours. When, however, these organs were covered with black varnish, the pupæ resembled surrounding surfaces to the same extent as when they were produced from normal larvæ.

(β) *The Complex Branching Spines.*—It seemed possible that these structures might contain some organ which was influenced by the colour, but after cutting them off the larvæ remained normally sensitive.

[1] Abstract of Lecture delivered by Mr. Edward B. Poulton at the Royal Institution, on Friday, February 11.

(γ) *The General Surface of the Skin.*—This was tested by *conflicting colour experiments*. It had been previously shown that the larvæ were sensitive during stage iii., and therefore they were covered in this stage with compartmented tubes, so constructed that the head and anterior part of the body hung in the lower chamber of one colour, while the posterior part of the body was in the upper chamber in another colour. In another method the larvæ were hung upon a vertical surface, while the head and front part of the body passed through a hole in a shelf, the vertical surface above the shelf, and the upper side of the shelf itself being one colour, while the vertical surface below the shelf and the lower side of the shelf were of the colour tending to produce the most opposite effects. The result of all these experiments was to show that the colour influence does act on some element of the larval skin, and that the larger the area of skin exposed to any one colour the more does the pupa follow its influence. Parti-coloured pupæ were not obtained, thus perhaps pointing towards the action of the nervous system rather than towards the direct action of light on or through the skin itself.

6. *The Nature of the Effects Produced.*—The colouring-matter of the dark pupæ is contained in a thin superficial layer of the cuticle; below this is a thicker layer divided into exceedingly delicate lamellæ, between which fluids are present, and the latter form the thin plates which, by causing interference of light, produce the brilliant metallic appearance. The thinner upper layer, being dark, acts as a screen in the dark pupæ. Precisely the same metallic appearances are caused by the films of air between the thin plates of glass which are formed on the surface of bottles long exposed to earth and moisture. Both have the same spectroscopic characters and the same transmitted colours (complementary to those seen by reflection). The brilliancy of the cuticle can be preserved in spirit for any length of time; it disappears on drying, but can be renewed on wetting (this had been previously known), and the colours are seen to change during the process of drying, and when the cuticle is pressed, for the films are thus made thinner. The same lamellated layer exists in non-metallic pupæ of other species, and is used as a reflector for transparent colouring-matter contained in its outer lamellæ. Thus the structure which rendered possible the brilliant effects due to interference probably existed long before these special effects were obtained, and was used for a different purpose.

7. *The Biological Value of the Gilded Appearance.*—It is probable that the gilded pupæ of Vanessidæ resemble glittering minerals such as mica (which is very common in many places); their shape is very angular, and like that of minerals: conversely the gray pupæ resemble gray and weathered rock-surfaces, and the two conditions of rock would themselves act as a stimulus for the production of pupæ of corresponding colour. The power was probably gained in some dry hot country, where mineral surfaces do not weather quickly. Once formed, it may be used for other purposes, and in certain species is probably a warning to the enemies that the insect is inedible. It is interesting to note how the Vanessidæ, primarily coloured so as to resemble mineral surroundings, are modified for pupation on plants. Thus *Vanessa Io* has a green form which is produced among leaves; *V. atalanta* has no green form, and spins together the leaves for concealment, but both these species commonly pupate freely exposed on mineral surfaces; *V. urticæ* has neither the green form nor the habit of concealment, and it has a strong disinclination to pupate on its food-plant, as many observations concurred in proving.

III. *Experiments upon Vanessa atalanta.*—This species was also made brilliantly golden or dark-coloured by the use of appropriate surroundings in the larval condition.

IV. *Experiments upon Papilio machaon.*—This species, like *P. polydamus* (Fritz Müller), has no power of being influenced by surrounding colours. A brown pupa was obtained on the food-plant, and many green ones upon brown twigs, &c. It is possible that the amount of shade may determine the formation of the dark pupa irrespective of colour, or that less healthy and smaller larvæ may produce the brown form, just as diseased Vanessa larvæ produce gilded pupæ.

V. *Experiments upon Pieris brassicæ and P. rapæ.*

1. *Effects of Colours.—Black* produced dark pupæ, and the greater the illumination the darker the pupæ (*P. rapæ*), this result being the reverse of that obtained with *V. urticæ; white* produced light pupæ, and the greater the illumination the lighter the pupæ (*P. rapæ*); *dark red* (*P. brassicæ*) produced dark pupæ; *deep orange*, in both species, produced very light pupæ of a green colour; *pale yellow* and *yellowish green* produced rather darker pupæ than the orange; *bluish-green* produced much darker pupæ; while *dark blue* produced still darker pupæ (*P. rapæ* only). Hence there is a remarkable and sudden fall, followed by a slow and gradual rise in the amount of pigment formed as the light from various parts of the spectrum from red to blue predominates in the reflected rays which fall on the larval surface. But their effects on the formation of superficially placed dark pigment are accompanied by changes affecting the formation of greens and yellows, &c., in the deeper sub-cuticular tissues. Hence the results of any given stimulus are exceedingly complicated.

2. *Other Experiments.*—It was shown by the method described above that the ocelli are not sensitive in this species, and by similar transference experiments it was proved that the influence acts on the larva and not on the pupa itself.

VI. *Experiments upon Ephyra pendularia.*—In this genus of moths the exposed pupæ are often green and brown in different individuals, but these colours follow the corresponding tints of the larvæ, and therefore cannot be influenced unless the latter themselves were changed, and such susceptibility in the larval state has not been proved for this genus. This is the only known instance of a constant relation between the larval and pupal colours.

VII. *Experiments upon the Cocoon of Saturnia carpini.*—It was found that the larvæ spin dark cocoons in black surroundings, but white ones in lighter surroundings.

NOTES

THE principal officers for the Manchester meeting of the British Association, to begin on August 31, under the presidency of Sir Henry Roscoe, have now been selected. The following will be the Presidents of the various Sections:—Section A, Mathematics and Physics, Sir Robert S. Ball, Astronomer Royal for Ireland; B, Chemistry, Dr. Edward Schunck, F.R.S.; C, Geology, Dr. Henry Woodward, F.R.S.; D, Biology, Prof. A. Newton, F.R.S.; E, Geography, General Sir Charles Warren, R.E., G.C.M.G.; F, Economic Science, Dr. Robert Giffen; G, Mechanical Science, Prof. Osborne Reynolds, F.R.S. For Section H, Anthropology, a President has not yet been chosen. One of the public lectures will be given by Prof. H. B. Dixon, who has taken as his subject "The Rate of Explosions in Gases." The lecture to the working classes will be given by Prof. George Forbes. It is expected that, socially, the Manchester meeting will be one of the most brilliant ever held. A very large sum has already been subscribed, and liberal arrangements are being made for excursions and other entertainments.

THE trustees of the fund established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, "for the advancement and prosecution of scientific research in its broadest

sense," having accumulated income available for grants, desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge, or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Applications for assistance from this fund should be addressed to the Secretary of the Board of Trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U.S.A., and should be accompanied by a full statement of the nature of the investigation, of the conditions under which it is to be prosecuted, and of the manner in which the appropriation asked for is to be expended. The new grants will probably be made in May next.

In consequence of the date fixed for the celebration of the Queen's Jubilee, the Senate of the University of London have deemed it necessary to change the time of holding the ensuing Matriculation Examination from the week beginning Monday, June 20, to the preceding week beginning Monday, June 13.

In his annual Report for the year 1886, Mr. H. B. Medlicott, Director of the Geological Survey of India, explains how it happens that Bengalis have not hitherto been employed in connection with his department. The Survey, he points out, has no duties of a mechanical nature to which, and through which, it would be possible to break in the uninitiated. Its work is strictly scientific, and requires the constant exercise, upon scanty data, of an independent, conscientious, and sober judgment. Now, Mr. Medlicott holds that Bengalis have not yet shown that they are fit for such work as this. "In Bengal," he says, "the word of knowledge has been preached for the last two generations, but in no single case has it found the needful germ in which it might come to maturity and bear fruit in original scientific work; it seems only to develop a more obnoxious kind of weed—words of science without substance. In the medical and engineering services they have for long had like teaching and opportunities to those from which Darwin, Huxley, Tyndall, and a host of others have arisen, but of like result in Bengal there is no symptom even. For a still longer period the practical results of the new knowledge in the shape of material progress have been displayed with ever-increasing energy from the West, but neither has this awakened in the Oriental mind a a power to do likewise. Of imitation there is no lack, but of creative power there is no sign. If this is not a demonstration on the part of the Bengali of his ineptitude for science, evidence counts for nothing. He would do well to take it to heart, if by any means he may correct his failing. Meanwhile, even if there were not particular evidence to confirm it, I hold this as sufficient warrant for objecting to the appointment of natives to the slender staff of the Geological Survey."

Mr. A. Lawrence Rotch, the proprietor of the Blue Hill Meteorological Observatory in the United States, has recently issued a pamphlet giving an account of the foundation and work of the observatory. According to the *American Meteorological Journal*, the station on Pike's Peak, 14,000 feet above the sea, is of problematic value to meteorology, whereas "the Blue Hill Observatory, only 635 feet above the sea, and much younger, has already been of considerable meteorological service."

Some time ago we referred to the fact that experiments were being made at Fort Scott in connection with the manufacture of sugar from Sorghum. A report on these experiments was lately presented to the U.S. Department of Agriculture by Mr. H. W. Wiley, to whom the conduct of the work was intrusted. The results were very discouraging, and the failure is attributed by Mr. Wiley to the following causes:—(1) Defective machinery for cutting the canes and for elevating and cleaning the chips and for removing the exhausted chips. (2) The deterioration of the cane due to much of it becoming over-ripe, but chiefly to the fact that much time would generally elapse after the canes were cut before they reached the diffusion battery. The heavy frost which came on October 1, 1886, injured the cane somewhat, but not until ten days or two weeks after it occurred. (3) The deteriorated cane caused a considerable inversion of the sucrose in the battery, an inversion which was increased by the delay in furnishing chips, thus causing the chips in the battery to remain exposed under pressure for a much longer time than was necessary. The mean time required for diffusing one cell was twenty-one minutes, three times as long as it should have been. (4) The process of carbonatation, as employed, secured a maximum yield of sugar, but failed to make a molasses which was marketable. This trouble arose from the small quantity of lime remaining in the filtered juices, causing a blackening of the syrup on concentration, and the failure of the cleaning apparatus to properly prepare the chips for diffusion. With regard to the future, Mr. Wiley is of opinion that the chief thing to be accomplished is the production of a Sorghum plant containing a reasonably constant percentage of crystallisable sugar.

Mr. Hennessy, of the Indian Survey, to whom, as we have already announced, the Government of the Straits Settlements applied to aid in a survey of the latter territory, has declined the appointment offered him. *Indian Engineering* observes that as the size and population of the Straits do not come up to those of an Indian district, and as the colony has already a Surveyor-General, a Deputy Surveyor-General, several Assistant Surveyors-General, with a full complement of subordinates, as well as a Special Commissioner of Lands, there must be something wrong when another surveyor from India is required in order to carry out a satisfactory survey. The circumstance appears to require some explanation.

On December 10, a volcanic eruption of great violence took place in Mount Tarumai in Yezo. Ashes continued to fall for several hours in the vicinity of the foot of the mountain, and on the neighbouring coasts, and even after this had ceased the underground disturbances continued. On December 13 the eruption recommenced, and lasted for four days. A large slip occurred on the side of the volcano, an area of about 10,000 feet square being affected, and stones and other debris fell so thickly as to change the configuration of the sea-shore to some extent. Previous eruptions, according to Prof. Milne's work on the volcanoes of Japan, occurred on February 8, 1874; October 7, 1883; January 4, 1885; and April 21, 1886.

On March 15 a strong shock of earthquake passed through Mandalay, perceptibly moving buildings and trees. No damage occurred.

On the 9th inst. Mr. W. A. Carter lectured to the Croydon Natural History Society on "Marine and Fresh-water Fishes." Mr. Carter stated that fish have the power of influencing each other by sounds and action, and in support of this assertion he described the movements of a shoal of carp in a pond. He had observed them following the lead of a single congener, which conducted them to a quantity of food a considerable distance off. Referring to fish monarchs, the lecturer said he had noticed that certain freshwater fish, such as the trout, were subservient to a ruler, which might be seen swimming at the head of his tribe, as might also certain marine forms, such as herring and bass.

The new gun-powder melinite has already begun its work of destruction. Some days ago a bomb filled with this explosive agent exploded by accident in Belfort arsenal, killing six persons, and severely wounding eleven.

A DINNER was lately given to Prof. de Lacaze-Duthiers by some forty or fifty of his pupils, who also presented him with a magnificent engraving of his own likeness. This was a well-deserved tribute of admiration for the good and useful work done in the department of zoology by Prof. de Lacaze-Duthiers. He has done great service to students of natural science by his personal labours, by the establishment of the two marine zoological stations of Roscoff and Banyuls-sur-Mer, and by the founding of the *Archives de Zoologie Expérimentale*.

THE zoological station of Cette, on the Mediterranean coast, founded by Prof. Sabatier, of Montpellier, has been recently attached to the École Pratique des Hautes Études. Cette is a very interesting place for zoologists, owing to the abundance of the fauna and its variety.

THE laboratories of the Paris Medical School will soon—that is, in the course of the spring or summer—be transferred to new buildings in front of the Medical School. The present laboratories are ugly and unhealthy.

SOUTHAMPTON, we are glad to see, is anxious to possess a University College of its own. On Wednesday, the 9th inst., a public meeting, over which the Mayor presided, was held to express the general opinion on the subject, and resolutions were unanimously carried in favour of the scheme. In one of these resolutions it was stated that, in the opinion of the meeting, "The Hartley Institution is admirably fitted, and has high claims, to form the nucleus of a University College for Southampton and the surrounding district."

SIR JOSEPH WHITWORTH'S will, dated December 1884, has now been proved. He leaves two hundred shares in Sir Joseph Whitworth and Company (Limited) to the Owens College, Manchester; eighty shares to the Institution of Civil Engineers, London; and forty to the Institution of Mechanical Engineers. By his will, after making certain bequests, he left the residue of his estate to the School Boards of Manchester, Salford, and Stockport, and to the Science and Department, South Kensington; but by codicils added last year he revokes his bequests to the School Boards and South Kensington, and leaves all his real estate and the residue of his personal estate to his executors and trustees absolutely for their own use and benefit, but in confidence that they will make such dispositions of his property for educational purposes as they know that he would have wished made.

WE regret to announce the death of M. Alexander Borodin, Professor of Chemistry at the Medico-Surgical Academy at St. Petersburg, and one of the most eminent Russian musical composers. He died on February 27.

THE death is announced of Dr. Gustav Heinrich Kirchenpauer, first Burgomaster of Hamburg, and a well-known naturalist. He died on March 4.

A DECREE has been signed by the King of Italy by virtue of which a new and complete edition of the works of Galileo will be published at the cost of the State. The Minister of Education, with the assistance of some eminent professors, will superintend the publication, which will fill twenty quarto volumes of 500 pages each.

BY the investigation of forty-two large North German lakes, the well-known zoologist Dr. Otto Zacharias has proved that the lower fauna occupies an intermediate position between that of the Scandinavian and that of the Swiss and Italian freshwater basins. Since it is supposed that during the Ice epoch gigantic glaciers stretched from the north of Europe to the foot of the Riesengebirge, it is interesting to learn that the North German lakes contain a number of lower Crustaceans that, till now, have only been found in Scandinavia.

THE Academy of Sciences at Berlin has granted the following sums for the furtherance of zoological research:—75*l.* to Dr. Karl Brandt (Königsberg) for investigations on Radiolaria; 50*l.* to Prof. Ludwig (Giessen) for the continuation of his work on Echinoderms; 100*l.* to Dr. Heinicke (Oldenburg) to continue his researches on the varieties of the herring. Besides these sums, 1950*l.* has been given for the printing of some important zoological works, viz. Prof. Dohrn's "Jahresbericht," Dr. Taschenberg's "Bibliothek," and Prof. Fritsch's work on "Electric Fishes."

THE total value of fish landed on the coasts of Scotland for the two months ending February 1887 was 190,068*l.*, being an increase over the corresponding period of last year of 8434*l.*

THE twenty-second volume of the Transactions and Proceedings of the Royal Society of Victoria has been sent to us. It contains the address of Prof. Kernot, the President, delivered on March 11, 1886; and among the papers are "The Atmosphere a Source of Nitrogen in Plant Economy," by Mr. E. Lloyd Marks; "Notes on some Evidences of Glaciation in the Australian Alps," and "The Cryptogamia of the Australian Alps," by Mr. James Stirling; "On an Apparatus for Utilising the Force of the Tides," by Mr. Lockhart Morton; and "On an Apparatus for Determining the Stability of Ships," by Mr. C. W. McLean.

WE have received Parts 21-25 of "Länderkunde des Erdteils Europa." The editor of this admirably illustrated work is Prof. Alfred Kirchhoff, and among the contributors are Profs. Penck, Egli, and Heim. The aim of the writers is not merely to describe the countries with which they deal, but to bring out the influence of geographical conditions upon material, political, and social progress.

IN reference to the acclimatisation of flat-fish in American waters, the latest Bulletin of the United States Fish Commission states that in April 1880 five soles sent from England reached New York, and were deposited outside Sandy Hook. In October 1881, out of a consignment of turbot and soles sent from England, three soles and six turbots survived. These were transferred to the Sheep's Head Bay. In order to ascertain whether any trace of these fish could be found, the Fish Commission in October last trawled in the vicinity of the spots mentioned, but did not succeed in capturing any flat-fish.

THE Botanical Museum of Hamburg will be rendered more generally serviceable to German commerce and industry by the addition of a commercial laboratory. For analyses and investigations a most moderate tariff has been set up.

IN an article in the *Entomologist's Monthly Magazine* for March, Mr. Herbert Goss raises the question whether *Aporia crataegi* is dying out in this country. At one time this butterfly was common in Kent, Sussex, Hampshire, Huntingdonshire, Northamptonshire, Herefordshire, Monmouthshire, and Glamorganshire. Now it has disappeared, apparently, from all these counties. Mr. Goss does not think that this can be attributed to the rapacity of collectors, and he holds that it can be accounted for only in some localities by cultivation and drainage. It seems to him more probable that the extreme scarcity or total extinction of the Black-veined White may be due to a succession of wet ungenial summers and mild winters.

THE investigations into the causes and nature of the species of elephantiasis known in Java as *beri-béri*, and in Japan as *kakké*, which have been conducted at Acheen, in Sumatra, by a medical officer delegated by the Japanese Government, and Dr. Cornelissen, Inspector of the Medical Service of the Netherlands India, have led to the following results: (1) *beri-beri* must be regarded as a disease produced by minute organisms; (2) these

organisms are Bacilli, which bear most resemblance to the *anthrax* Bacilli, but not smaller; (3) they are found in the blood, lungs, heart, and nervous tissue of persons dying of the disease; (4) they can be reared independently; (5) the Bacilli, which can live as parasites in the human organism, can also live and multiply out of it. These facts, which are said to be established by the investigations, explain how *beri-beri* patients can infect particular places, and how healthy individuals coming from uninfected places contract the disease in infected ones.

Mr. W. H. Beeby has reprinted from the *Scottish Naturalist* some interesting notes on the flora of Shetland. They are the result of a visit of about eight days to the Shetland Islands at the latter end of July last. Four distinct districts were visited, the greater amount of time being spent in Unst. Mr. Beeby is of opinion that the flora of the Shetland Islands is well worthy of further attention. An explorer would, he thinks, be rewarded by finding plants which are at present known only in the Faroes and in Scandinavia.

The contents of Part 2, No. 3, of vol. lv. of the Journal of the Asiatic Society of Bengal include a short paper by Dr. King, on two new species of holly from the Eastern Himalayas, but are otherwise purely entomological. Prof. Forel continues his critical examination of Indian ants in the Calcutta Museum. Mr. de Nicéville describes nine new species of Indian butterflies, chiefly from Sikkim (which are to be figured in a succeeding number). Mr. Doherty, of Cincinnati, U.S.A., communicates a paper on new or rare Indian butterflies, many of which are from the Nicobar Islands; and Mr. E. T. Atkinson, President of the Society, gives a compilation of what has been written concerning Indian Coccidæ, which may be taken as an introduction to the study of this obscure and injurious family of insects in India. The author has chiefly followed Signoret in the systematic arrangement. The collected information will prove useful in India, for some of these scale-insects have been most destructive to coffee and other plantations. Having a clue as to how and what to observe, Indian entomologists will, no doubt, soon show that legions of Coccidæ exist in India, as elsewhere, and many strange forms will be detected.

The additions to the Zoological Society's Gardens during the past week include a Gray Ichneumon (*Herpestes griseus*) from India, presented by Mr. C. F. Hird; a Golden Eagle (*Aquila chrysaëtus*) from Scotland; a Chilian Sea-Eagle (*Geranoaëtus melanoleucus*) from South America; a Brazilian Caracara (*Polyborus brasiliensis*) from Brazil, presented by Mr. C. Czarnikow; a Bronze-winged Pigeon (*Phaps chalcoptera*) from Australia, presented by Mr. Malcolm Nicholson; two Red-crested Cardinals (*Paroaria cucullata*) from Brazil; two Cockateels (*Calopsitta novæ-hollandiæ*) from Australia, presented by Colonel F. D. Walters; two Crested Newts (*Molge cristata*), presented by Mr. Alban Doran; a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa; two Blue-fronted Amazons (*Chrysotis æstiva*) from South America, deposited; a Hog Deer (*Cervus porcinus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

Telegraphic Determination of Australian Longitudes.—A "Report on the Telegraphic Determination of Australian Longitudes," signed by Messrs. Ellery, Todd, and Russell, has recently been published by the Government of South Australia. This Report contains the final results of the operations connecting Singapore and Port Darwin, carried out in 1883 by Capt. Darwin, R.E., in concert with the Australian astronomers above mentioned. The Observatories of Melbourne, Sydney, and Adelaide were subsequently connected with Port Darwin. The preliminary results of these telegraphic longitude determinations were communicated by Mr. Todd in 1883 to Sir G. B. Airy, and published in the *Observatory* for October of that year. The longitude of Singapore adopted in forming the results given in the Report before us is that determined by Commander Green, U.S.A., in 1882, viz. 6h. 55m. 25·01s. East of Greenwich (for Capt. Darwin's station), assuming that of the Madras Observatory to be 5h. 20m. 59·42s. Hence the resulting longitudes are:—

	h.	m.	s.
Observatory, Port Darwin	8	43	22·49
,, Adelaide	9	14	20·30
,, Melbourne	9	39	54·14
,, Sydney	10	4	49·54
,, Wellington, N.Z.	11	39	6·52
,, Hobart	9	49	19·80

The observations for the purpose of connecting Singapore with the various points in Australia are given in sufficient detail in the Report to enable us to see that the determinations have been made with care and attention to detail, and appear to be deserving of every confidence. The New Zealand and Tasmanian results may perhaps require further correction.

Comets and Asteroids.—Prof. Daniel Kirkwood has a brief note in the *American Journal* for January 1887, on the origin of comets, in which he points out the probability that two, at least, of recent short-period comets have had an origin in the zone of asteroids. Tempel's comet (1867 II.) has a period, inclination, and longitude of node approximately the same with those of Sylvia (Minor Planet No. 87), whilst its eccentricity is but little greater than that of Æthra (No. 132). Wolf's comet (1884 III.), before its last close approach to Jupiter, had an eccentricity which was exceeded by twelve known minor planets; its period was about 3619 days, and its mean distance 4·611, so that it would appear to have been simply a very remote asteroid. Its period was very nearly commensurable with that of Jupiter.

The Tails of the Comets of 1886.—Prof. Th. Bredichin has recently examined the curves of the tails of the three principal comets of last year in connection with his well-known theory as to the laws of formation of the tails of comets. The two first comets, those of Fahry and Barnard (1886 I. and II.), proved difficult to observe, the earth being nearly in the plane of the orbit of the former comet, so that the foreshortening greatly increased the errors of observations, whilst the tail of the latter was very short, and was diffused on one side. Both, however, were of the same type, the second, $1-\mu$ being found to be equal to 1·3 for the first, and 1·9 for the second. The third comet referred to, that discovered almost simultaneously by Mr. Barnard and Prof. Hartwig, proved much more important for the purposes of Prof. Bredichin's theory, since it showed three tails. Of these the principal one plainly belonged to the first type, a value of 17·5 for $1-\mu$ satisfying the observations very fairly. The shorter tail seen by a number of observers plainly belonged to the third type, $1-\mu$ being very small, whilst a third tail, seen by Mr. Backhouse (Nature, January 6, p. 224), and lying between the other two, evidently belonged to the second type.

Minor Planet No. 265.—M. Bigourdan points out (*Comptes rendus*, vol. civ. No. 9) that the motion of R.A. of this body is unusually rapid, amounting to − 1m. 40s., or double the ordinary value for the other asteroids. As the planet is nearly exactly in opposition, it must be relatively near the earth, and may therefore be very advantageously employed in the future for the determination of the solar parallax.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 MARCH 20-26

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on March 20

Sun rises, 6h. 5m.; souths, 12h. 7m. 37·7s.; sets, 18h. 11m.; decl. on meridian, 0° 10′ S.: Sidereal Time at Sunset, 6h. 3m.

Moon (New on March 24) rises, 4h. 30m.; souths, 9h. 10m.; sets, 13h. 57m.; decl. on meridian, 15° 39′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury ...	5 48 ...	12 13 ...	18 38 ...	4 10 N.
Venus	6 51 ...	13 43 ...	20 35 ...	9 22 N.
Mars	6 22 ...	12 38 ...	18 54 ...	2 27 N.
Jupiter... ...	21 18* ...	2 22 ...	7 26 ...	11 42 S.
Saturn... ...	11 7 ...	19 16 ...	3 25* ...	22 30 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

March h.
20 ... 22 ... Sun in equator.
22 ... 3 ... Mercury in inferior conjunction with the Sun.

Variable Stars

Star	R.A. h. m.	Decl. ° ′			h. m.	
Algol	3 0·8 ...	40 31 N. ...	Mar. 20,		4 36	*m*
			,, 23,		1 25	*m*
			,, 25,		22 14	*m*
ζ Geminorum ...	6 57·4 ...	20 44 N. ...	,, 25,		19 0	*M*
U Monocerotis ...	7 25·4 ...	9 33 S. ...	,, 24,			*M*
S Cancri	8 37·5 ...	19 26 N. ...	,, 21,		22 42	*m*
U Hydræ	10 32·0 ...	12 48 S. ...	,, 22,			*m*
δ Libræ	14 54·9 ...	8 4 S. ...	,, 23,		22 47	*m*
U Coronæ	15 13·6 ...	32 4 N. ...	,, 24,		1 1	*m*
U Ophiuchi... ...	17 10·8 ...	1 20 N. ...	,, 23,		4 12	*m*
		and at intervals of		20	8	
W Sagittarii ...	17 57·8 ...	29 35 S. ...	Mar. 25,		23 0	*m*
β Lyræ...	18 45·9 ...	33 14 N. ...	,, 21,		23 0	*m*
			,, 25,		4 0	*M*
η Aquilæ	19 46·7 ...	0 43 N. ...	,, 25,		22 0	*M*
R Aquarii	23 38·0 ...	15 55 S. ...	,, 26,			*M*

M signifies maximum; *m* minimum.

Meteor-Showers

Near 55 Aurigæ, R.A. 98°, Decl. 45° N.; and on March 20, near θ Ursæ Majoris, R.A. 145°, Decl. 48° N.

GEOGRAPHICAL NOTES

OXFORD has decided to establish a Readership in Geography; candidates are invited to apply. Cambridge has postponed taking a similar step till 1888. While on this subject we may state that by a new Imperial ordinance geography has been raised to an equal footing with the most important subjects taught in German middle-class schools — *Realschulen* and *Gymnasien*. The programme for the examination of teachers desiring to make this one of their special subjects has been issued. There are three grades, and the standard in each is very high.

ACCORDING to advices received at Zanzibar from Uganda, Dr. Junker's caravan safely reached Emin Pasha, who was in good health. Intelligence has also been sent to Zanzibar that five months ago Emin Pasha visited Uganda, but that King M'wanga refused to allow him or his followers to pass through his territory. Emin Pasha then attempted to make arrangements for his passage through Karagwa, on the western shore of the Victoria Nyanza, but failed in this also, and afterwards returned to Wadelai, leaving a detachment of soldiers at Unyoro under the command of Capt. Casati, Emin Pasha's sole European companion.

WE learn on the best authority that Mr. Stanley, on his arrival at Stanley Falls with the first contingent of his Expedition, about 250, will proceed at once to Emin Pasha, without waiting for the rest of his party. No doubt he will be reinforced by some of Tippoo's men, and in this way there will not be a moment's delay. The main body will follow as soon as steamers are able to land them all at Stanley Falls, but first a camp will be established at some distance from the Falls as a base of operations. Dr. Junker gave an account of his seven years' exploring work, on February 26, to the Cairo Geographical Society. His magnificent maps were shown, one of them measuring 13 feet by 23 feet. Dr. Schweinfurth maintained the absolute accuracy of Junker's maps in all respects. Junker then gave a detailed account of his sojourn in the Niam-Niam country. Here he found extensive fertile plains, veritable savannahs, with grass over 3 feet high, and abundance of game. He then passed on to his exploration of the Wellé and the Mepoko, to within four days' journey of the Congo, concluding by giving some interesting details of the effect of the Mahdi revolt on these countries.

THE well-known African traveller, Dr. Zintgraff, who has been commissioned by the German Government to explore the Cameroon district, intends visiting the Cameroon Mountains. As large quantities of caoutchouc are said to be obtained there, Dr. Zintgraff will be accompanied by an expert in that material.

AN official publication of the Colonial Office (African, No. 332) contains a great deal of original information regarding the different districts and tribes of Sierra Leone and its vicinity.

ON Monday evening last a paper on "The Alpine Regions of Alaska" was read by Lieut. H. Seton-Karr at a meeting of the Royal Geographical Society. In the course of a description of a visit to this territory last year, the reader expressed the opinion that the St. Elias Alpine region offers one of the best places for the study of glacial phenomena under the most powerful conditions. According to Dall, the American surveyor, Mount St. Elias is 19,500 feet high. It is a mass of snow and ice from base to summit, and has always been marked in modern maps as exactly on the 141st meridian, which is the boundary line. If the shore line was correctly charted, he found that the summit was east of the meridian of longitude mentioned. It was therefore in the British Empire. Describing the ascent of the mountain, he stated that he proceeded to a point which the aneroid instruments gave as 7200 feet above the sea level. There remained in the Alpine regions of the North Pacific a wide field for explorers. Mounts Crillon, Fairweather, and La Pérouse, respectively 15,900, 15,500, and 11,300 feet high, were not quite so striking as the one he described, but were much nearer to civilised settlements. There is a large blank space upon the map of Alaska, lying between Cook's Inlet and the great Yukon River. It is as unknown as any of the unexplored regions on the globe.

A JOURNEY of considerable interest is now being carried out in Central Asia by Mr. A. D. Carey, of the Bombay Civil Service. Mr. Carey left India in May 1885, and marched through Ladak into Northern Tibet (Chángtán) as far as the Mangtsa Lake, and then struck northward, descending on the plain of Turkestan, near Kiria. He thus traversed over 300 miles of country which had never before been visited by a European. The altitudes on this section of the journey were always very great, the track running usually at about 16,000 feet above the sea, while one at least of the passes crossed was calculated to reach 19,000 feet. After a stay at Kiria and Khotan, the Khotan River was followed to its junction with the Tarim; the route then lay along the latter river to Sarik, and then across a stretch of desert to Sháh-Yarand Kuchár. From the latter place the Tarim was followed down to a point where it turns southward towards Lake Lob. From this point the towns of Kurla and Kárástaber were visited, and about the end of the year the Tarim was struck again and tracked down to Lake Lob. Thus the whole length of the Tarim has been explored. The country along its banks is described as flat and reedy, and the people extremely poor and miserable. Mr. Carey pitched his camp at the village of Cháklik, some distance south of the lake, and close to the foot of the great range of mountains which forms the northern scarp of the Tibetan highlands. On April 30, 1886, Mr. Carey started from this village on a journey southward into Tibet, over a pass in the Altyn Tagh Range, and onward by a track occasionally used by the Kalmucks. Since this start nothing has been heard of Mr. Carey, but it is presumed that after spending the summer and autumn in travelling over the elevated region he has returned to Turkestan to winter.

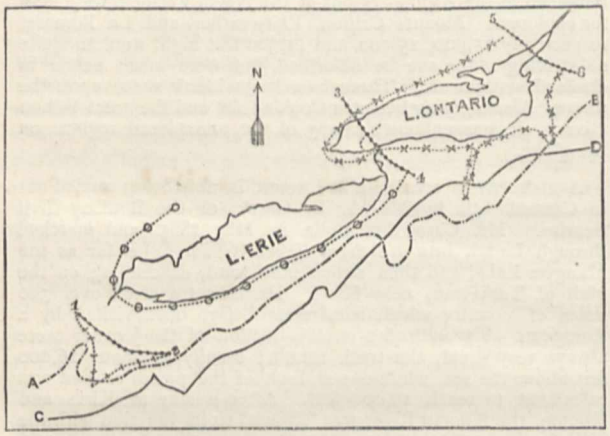
THE principal paper in the March number of *Petermann's Mitteilungen* is a special study of the basin of the Cachapool in the province of Santiago, Chili, by Dr. A. Plagemann. There is also a short paper on the hydrography of Batanga Land, by Herr P. Langhaus. From the notes we are glad to learn that the Roumanian Government has adopted a plan for the triangulation of that country, which will be the means of filling up an important gap in the cartography of Europe. Ergänzungsheft No. 85 of *Petermann's* contains a detailed account, with map and diagram, of Dr. Gustav Radde's journeys in the Alpine region of Daghestan in the summer of 1885.

PREHISTORIC REMAINS IN AMERICA

AT a recent meeting of the Washington Anthropological Society, Mr. G. K. Gilbert described a prehistoric hearth under the Quaternary deposits in Western New York. The speaker described the finding of the remains of a wood fire in the bottom of a well through the drift deposits near Gaines, a few miles south of Lake Ontario. The evidence in the matter rests almost entirely on the statements of a Mr. Tomlinson, a well-known and respected resident of the place, and who, personally, made the find upon his own farm. It was twenty years ago that the discovery was made, but Mr. Tomlinson has stated that his memory of all the essential details was very clear, and the speaker had every personal reason for believing the statements. The story is briefly that in sinking a well through 17 feet of gravel and clay, they found lying upon the rock at its bottom three large stones, partly inclosing a small space in which were about a dozen charred sticks, undoubtedly the remains of a fire started by human hands. Mr. Tomlinson gave some of these remains to neighbours, who still remember the matter, and the remainder he kept himself. In time, however, they have been lost, and the endeavour to find them did not meet with success.

The speaker then discussed at length the character of the beds under which the remains were found, and their geologic age, illustrating his statements by a map, of which a small copy is here reproduced.

The line A B shows the approximate southern limit of the lake drainage, and C D the approximate south-eastern extension of the second glacier, which, it will be noted, extends across the



Map of the Ontario-Erie Lake Basins, showing their Quaternary history. The prehistoric hearth was found at *x*.

drainage line for a considerable distance. When the front of the glacier began to retreat, successive lake basins were formed, extending toward the drainage line and discharging at the lowest point in the divide. When the front of the glacier had retreated to the line 1-2, a lake extended over the area shown by the fine dotted line bearing small cross lines, and discharged toward the Ohio, near what is now the city of Fort Wayne. When the ice front had retreated to the line 3-4, the lake covered the area in part inclosed by the fine dotted line bearing the small circles. It was on the eastern shore of this lake that this ancient fire was built, and by its shore wash that it was so gently covered as not to be disturbed during the process.

By further retreat of the glacier toward 5-6, a lower outlet was exposed in the valley of the Mohawk, and the surface of the glacial lake again fell—the Lake Erie portion to the level of the escarpment of Niagara limestone which still dams it back, and the Lake Ontario portion to a somewhat lower level. Further retreat of the icy dam to 5-6, and beyond, opened the St. Lawrence channel, and the present drainage was established.

From this explanation the comparative age of the hearth and its remains is indicated. It was near the end of the second glacial period, and at the time of separation of Lake Ontario from Lake Erie. At about this time, also, the Niagara River began its work of cutting through the escarpment of Niagara limestone, and at which it has been engaged ever since. Its rate of progress having recently been approximately determined, we are able to estimate the number of years as about 7000 since the lakes were separated and the gorge and falls begun. This estimate is based on comparisons of a recent survey by the U.S. Geological Survey with those made by the New York Survey forty years ago, and is open to some qualifications. In the first place, it is possible that some of the gorge was cut before the glacial period; then it has been found that the hardest stratum through which the river has to cut thins somewhat to the eastward, and thus offered less resistance to wear at an earlier date in the history of the gorge; and then, again, the possibility is presented of the volume of water having been vastly greater toward the close of the glacial period, and it is known that the erosive power of water increases very rapidly with increase of volume. These qualifications tend to reduce the time estimate; but on the other hand, evidence has been found that at one time the other lakes above Erie emptied by another means, and if this was so for any great length of time after the birth of the Niagara, it would tend to very greatly increase the time.

In the discussion following this paper, Mr. Murdock, of the Point Barrow Station, gave an account of the finding of a prehistoric relic under somewhat similar circumstances. Their station was near the extreme north-west corner of this continent, on a beach ridge a few yards from the Arctic Sea. This ridge was 9 or 10 yards in height, and extended along the coast for some distance. In making an excavation for an earth thermometer, they penetrated a 1-foot layer of turf which capped the ridge, and then frozen gravel and earth to a depth of 20 odd feet, where an Eskimo snow-goggle was found embedded in the frozen earth. The goggle was identical with those now in use, and consists of a piece of bone covering the eyes and bridging the nose, with small slits to admit a very limited amount of light and protect the eyes from snow-blindness. The specimen found had strings of braided sinew attached, but these were broken in removing them from the hard matrix. The speaker believed that the beds inclosing and covering this relic were the results of beach wash. The Eskimo of the region have a tradition that people used to live at the locality of the find, and a few remains of houses are found in the vicinity.

At the same meeting Mr. W. J. McGee read an informal paper on the finding of a spear-head in the Quaternary beds of Nevada.

The speaker described the geologic features of the Walker River cañon, in the lacustrine deposits in which the find was made. These deposits are those of the fossil Lake Lahontan, and were deposited in the old cañon during the Quaternary period. Since then the river has cut a new cañon through them, and they are now finely exposed. Beginning above, the beds consist of silt and loose materials for several feet, then comes a layer of calcareous tufa lying upon 20 to 30 feet of white marl, containing remains of extinct mammalia, and resting unconformably upon a somewhat similar series of beds of earlier date. It was in the white marl of the upper beds that the implement was found. The speaker described in detail the conditions under which the find was made. He was alone at the time, and far distant from camp or party; he had been carefully examining the face of the marl talus as he rode along, and was searching for occasional bone remains. At one point, 26 feet below the surface, he noticed a small projecting point which looked as if it was caused by a bone. Picking off some of the surface, he at once recognised the object to be a product of man's handicraft; and appreciating the importance of the find, and the necessity of a very thorough study of all the circumstances connected with it, framed some working hypotheses before removing the implement. At first it appeared probable that it was embedded in a superficial coating of the slime which is often washed over the surface of this loose marl. This was at once disproved by examination. Other possibilities were suggested, such as its having fallen into its position down a fissure or been shoved into the face of the cliff by man; but these were all found to be, if not impossible, extremely improbable, and the speaker had concluded that it was deposited with the marl. Extensive stratigraphic studies have been made of these lacustrine deposits by King, Russell, and Gilbert, and there can be no doubt but that these beds and the flint were deposited toward the close of the glacial period, and about at the same time as those covering the hearth described by Mr. Gilbert. The implement was a spear-head 3½ inches in length, finely made and well preserved.

In the discussion which followed this paper, several members called attention to the great value of the find from the fact that it was made by a well-trained observer, who appreciated the importance of his discovery before destroying the evidence, and then carefully studied every detail connected with it.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—Mr. S. H. Vines, M.A., D.Sc. Lond., F.R.S., and Prof. J. H. Poynting, M.A., have been approved for the degree of Doctor in Science.

Fortunately for research in pathology, the opposition to the acceptance of the John Lucas Walker Studentship proved abortive, and it was accepted by a majority of nearly five to one last Thursday.

Dr. Michael Foster, Sec.R.S., has been appointed the University representative on the Council of the Marine Biological Association till the next annual meeting of the Association.

The following Entrance Scholarships and Exhibitions in Natural Science will be open for competition in the coming summer:—Downing College: Natural Science, June 1, 50*l.* per annum; Peterhouse: Mathematics, Chemistry, and Physics, 40*l.* to 60*l.* per annum; date to be announced in June; non-Collegiate students: Physical Science, July, in connection with Oxford and Cambridge Schools Examination Board, 50 guineas per annum for three years, tenable at Oxford or Cambridge, open to non-Collegiate students of not more than one term standing, or to persons not yet in residence. Apply to the Rev. F. G. Howard, Cambridge.

SCIENTIFIC SERIALS

American Journal of Mathematics, vol. ix. No. 2, January.—The number opens with a continuation of Mr. Greenhill's memoir, wave-motion in hydrodynamics, in which is discussed wave-motion in the following cases: § 21, across a channel with sides sloping at any angle; § 22, against a uniformly-sloping shore; § 24, in a cone; § 25, in a cylinder; and § 23 contains an algebraical solution of waves against a shore.—Prof. Sylvester's lectures on the theory of reciprocants give notes of lectures xvii. to xxiv., with an extract from a letter of M. Halphen in which the existence of *invariants* in general is established *a priori*; this is given as introductory to the theory of differential invariants.—A memoir in the theory of numbers, by A. S. Hathaway, contains an historical introduction of interest. The second part considers fundamental principles and definitions, then a problem and the consequences of its solution, and then turns the question of ideal solution of the problem into the question of the establishment of a given theory of ideals; the demonstrations are left for the reader to supply. The third part is occupied with a rigorous establishment of the theory of ideals indicated in the second part.—The next paper, on a theorem respecting the singularities of curves of multiple curvature, by H. B. Fine, is a generalisation of a portion of a previous paper (vol. viii. No. 2) by the same writer.—The number closes with two short notes—one on pencils of conics, by H. D. Thompson (let the eight points in which a conic intersects a quartic be divided into two groups of four, and a conic be passed through each group: the two residual—four-point—groups lie on a conic; an exceptional case in Cayley's theorem, which had been overlooked by the author, is mentioned and references given to where it is discussed); the other consists of observations on the generating functions of the theory of invariants, by Capt. P. A. Macmahon.

Notes from the Leyden Museum, edited by Dr. F. A. Jentink, vol. ix. No. 1, January 1887, contains, among other memoirs, the following:—J. Buttikofer, on a collection of birds made in the highlands of Padang, in West Sumatra, by Dr. C. Klaesi. This paper gives details of 189 birds in this collection, and is prefaced by a short history of the various published accounts of the birds of Sumatra from the first memoir by Sir Stamford Raffles in 1822. The only new species described is a swift (*Hirundinapus klaesii*).—Dr. R. Horst, descriptions of earthworms. Describes as new a gigantic earthworm from a coffee-plantation in Sumatra, *Moniligaster houtenii*; and also from the same country, *Rhinodrilus tenkatei*, n.sp.—Dr. Th. W. van Lidth Jeude, on a collection of reptiles and fishes from the West Indies. Describes three new lizards and a new fish taken during the Dutch Expedition to the West Indies.—There are also ten papers on new or little-known insects.

Rendiconti del R. Istituto Lombardo.—Results of the observations made by Dr. M. Rajna at the Brera Observatory on the diurnal oscillations of magnetic declination during the year 1886, communicated by E. G. V. Schiaparelli. These observations were taken as in previous years at 8 a.m. and 2 p.m., the diurnal variation being obtained by determining the difference in time between the two periods. The monthly averages thus determined and tabulated show for the whole year a mean of 6′·72.

Bulletin de l'Académie Royale de Belgique, January.—On some curious effects of molecular forces in contact with a solid and a liquid, by G. Van der Mensbrugghe. Some experiments are described tending to illustrate the expansive force possessed by the contact layer between a solid and a liquid, and the existence of which the author claims to have been the first to demonstrate.—On Fermat's last theorem, by P. Mansion. It is shown that, if there exist integers x, y, z, verifying Fermat's relation $x^n + y^n = z^n$, where $x < y < z$, then not only the middle term, y, as shown by de Jonquières, but also the largest, z, and the smallest, x, are compound numbers.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 3.—"Preliminary Note on a Balanoglossus Larva from the Bahamas." By W. F. R. Weldon.

A preliminary account was given of the degradation of a Balanoglossus larva, found during the latter half of last year in the deep waters round the Bahamas. Up to the period of the development of a pair of gill-slits, this larva resembled, except in its pelagic habit, the larva found in Carolina by Bateson. After this stage, degradation set in, resulting in the atrophy of the two posterior pairs of body cavities, and the reduction of that in the præoral lobe: the gills and notochord, together with the greater part of the nervous system, disappeared, and the trunk diminished in size. The result was a bell-shaped creature, with a large præoral lobe, on the sides of which was developed a curious arrangement of tentaculiferous grooves. The alimentary canal remained functional, but the creature gradually shrivelled up, and (probably) died.

"Studies of some New Micro-Organisms obtained from Air." By G. C. Frankland and Dr. Percy F. Frankland.

In previous communications to the Royal Society by one of the authors,[1] details have been given of a number of experiments on the presence of micro-organisms in the atmosphere. In these investigations a solid culture medium was employed, which not only greatly facilitated their enumeration, but also presented them in an *isolated* condition. In this manner the authors have met with a number of different varieties of aërial micro-organisms, which have hitherto remained either unknown or undescribed. They have therefore undertaken the characterisation of a number of these organisms by growing them in various cultivating media and observing the different appearances which they subsequently exhibit, by studying them microscopically in stained and unstained preparations, and by cultivating them on gelatine-plates, and describing the colonies to which they give rise. They have likewise made a number of drawings to illustrate the appearances which they present under the various examinations to which they have submitted them. To further facilitate their identification the authors have provisionally given them names, by which they have endeavoured to represent some of their most striking individualities.

The authors venture to hope that by thus characterising some of the organisms most prevalent in the atmosphere, they may prove of assistance in those investigations which have for their object the study of the particular physiological changes which are brought about by specific micro-organisms.

The following is a list of the micro-organisms described:—

Micrococcus carnicolor	Bacillus plicatus
,, albus	,, chlorinus
,, gigas	,, polymorphus
,, chryseus	,, profusus
,, candicans	,, pestifer vermicularis
Streptococcus liquefaciens	,, subtilis minor
Sarcina liquefaciens	,, subtilis cereus
Bacillus aurescens siccus	Saccharomyces rosaceus
,, aureus	,, liquefaciens
,, citreus	Mycelium fuscum.

[1] (1) "The Distribution of Micro-Organisms in Air," Roy. Soc. Proc. vol. xl. p. 509; (2) "A New Method for the Quantitative Estimation of the Micro-Organisms present in the Atmosphere," *ibid.* vol. xli. p. 443; (3) "Further Experiments on the Distribution of Micro-Organisms in Air by Hesse's method," *ibid.* p. 446.

In addition to these varieties a description has been given for the sake of comparison of some aërial micro-organisms which were obtained by one of the authors from Dr. Koch's laboratory in Berlin. These are—

Micrococcus rosaceus	Bacillus subtilis
Sarcina lutea	,, (Micrococcus) prodigiosus.
,, aurantiaca	

Linnean Society, March 3.—Mr. W. Carruthers, F.R.S., President, in the chair.—The following gentlemen were elected Fellows of the Society:—B. S. Dyer, Right Hon. Sir E. Fry, S. T. Klein, C. Mariès, E. S. Marshall, R. Morgan, J. B. Stone, and A. W. Tait.—A paper was read by Mr. Alfred W. Bennett on the genetic affinities and classification of the Algæ. He referred to Prof. Sachs's scheme as based on the mode of reproduction and degree of complexity of the sexual process alone; this being the most important factor in the life-history of the plant. Supporting Sachs to a certain extent, he nevertheless differs from him, and rather agrees with Prof. Fischer's view of Algæ and Fungi running in distinct series, while he diverges from both writers as to the descent, relations, and grouping of the Algæ. He believes arrest of development has had an important influence in many presumed deviations among the groups in question. He avers that retrogression may take the form of the suppression of either the vegetative or the reproductive organs, and whichever predominates or progresses leaves the other feeble or degenerate. If the principle advocated by the author holds good, it leads towards the almost abandoned divisions of the Algæ into the green, the red, and the brown,—Chlorosporeæ, Rhodosporeæ, and Phæosporeæ. It would appear as if at an early period in the development of the simplest form of vegetative life, three kinds of cell-contents were represented, a colourless, a blue-green, and a pure green. Based thereon are the author's three great divisions:—I. *Schizomycetes*, forms entirely destitute of chlorophyll, and adapted to carry on only a parasitic existence; II. *Chroococcaceæ*, unicellular organisms, with cell-contents composed of watery blue-green endochrome diffused through the protoplasm, without distinct chlorophyll grains, starch grains, or nucleus; III. *Protococcaceæ*, characterised by cells possessing a nucleus, starch grains, pure chlorophyll identical with that of higher plants, and in certain states a true cell-wall of cellulose. The (I.) Schizomycetes lead to the Fungi, which are not discussed by the author. The (II.) Chroococcaceæ pass through the Oscillarieaceæ to Nostocaceæ. The (III.) Protococcaceæ are the great derivatives of the Algal group. Hence three great lines of descent are indicated. (1) The Diatoms are regarded as of remote origin, very low in the scale. (2) The Cœobiæ comprise a series through Sorastreæ to Volvox and Allies. (3) The Eremobiæ as a line of descent pass to the Multinucleatæ, *e.g.* Siphoneæ with gigantic cells. Thence cell-division originating, proceeded to the Confervoideæ-isogamæ, the Conferva group. From these in three different lines have sprung: (*a*) the Conjugatæ, including Zygnemids and Desmids, a retrogressive group; (*b*) the brown seaweeds adapted to deep sea life, Phæosporeæ, terminating in Fucaceæ; and (*c*) the Confervoideæ-heterogameæ, at the extreme of which the Coleochætæ are reached. The Coleochætæ lead direct to the red seaweeds, or Florideæ, a natural group with great variety in development of the sexual organs. By arrest of development branches proceed on the one hand through Nemalieæ to the Ulvaceæ, while on the other at a tangent from true Algæ were evolved the Characes, the Mosses, the Gymnosperms, and lastly the higher Angiosperms, or flowering plants.—A paper was read on the disease of Colocasia in Jamaica, by Mr. G. Massee and Mr. D. Morris. The negroes of the West Indies give the name "Cocoes" to the main stem and shoots of a species of Aroid. This forms a wholesome food, and is said to be preferable to yams and sweet potatoes. A blight arises in the tubers similar to the potato-disease; and as shown by the authors this is produced by a fungus belonging to the genus Peronospora, a new species named by them *P. trichotoma*. Instructions are given as to remedial measures, an important one being the absolute necessity of badly affected plants being wholly destroyed.

Physical Society, February 26.—Prof. W. G. Adams, Vice-President, in the chair.—The resolution passed at the meeting on February 12, providing greater facilities to persons being abroad for qualifying for membership of the Society, was unanimously confirmed.—Prof. W. Stroud and Mr. A. S. Gulbenkian were elected Members of the Society.—Mr. James Swinburne read a note on Prof. Carey Foster's method of measuring the mutual induction of two coils. The author described an apparatus devised last summer for measuring mutual induction by a null method, thus dispensing with a ballistic galvanometer. The induction in the secondary coil is balanced by an opposite effect produced by a variable known fraction of the primary current passing through one wire of a double-wound coil of known mutual induction, the other wire of which is joined in series with the secondary coil and galvanometer. In a preliminary trial, using an ordinary reflecting galvanometer, it was found that instead of no deflection being observed, two kicks in opposite directions occurred when there was iron in the circuit. A new galvanometer, with heavy needle, is now being constructed to overcome this difficulty. A null method of finding the ohm by means of a differentially-wound, heavy-needle galvanometer is suggested in the latter part of the note. Prof. Ayrton pointed out that Prof. Foster's method does not require readings on a ballistic galvanometer, and mentioned that in practice it is greatly superior to those given in Maxwell and the ordinary text-books. The chief drawback is the necessity of having large condensers of accurately known capacity where large coefficients are concerned. A large number of experiments have been carried out at the Central Institution by Mr. Sumpner with very satisfactory results. Prof. Adams concurred in Prof. Ayrton's statement regarding the difficulties in using Maxwell's methods in practice, and expressed his satisfaction with the great simplicity of Prof. Foster's method.—On the determination of coefficients of mutual induction by means of the ballistic galvanometer and earth inductor, by R. H. M. Bosanquet. The methods described depend on two measurements of the throws of a ballistic galvanometer: (1) that produced by the sudden rotation of a coil (the constants of which are accurately known) through 180° about a vertical axis; and (2) that produced by the mutual induction to be measured when a current of known strength is started in the primary circuit. The earth induction-coil is permanently joined in series with the ballistic galvanometer and secondary coil, and the primary current measured by an absolute tangent galvanometer of the Helmholtz pattern. If Q_0 and Q be the quantities of electricity which pass through the ballistic galvanometer in the two experiments, then

$$Q_0 = \frac{2NAH}{R},$$

where NA is the effective area of the inductor, and

$$Q = \frac{MC}{R},$$

where $C = GH \tan\theta$.

Hence

$$\frac{Q}{Q_0} = \frac{MG \tan\theta}{2NA} = \frac{\alpha}{\beta},$$

where α and β are the throws of the ballistic galvanometer. From the above we get

$$M = \frac{\alpha}{\beta}\frac{2NA}{G \tan\theta}.$$

A modification to be used when M or R are very large is also described. Numerical results obtained are given, from which it is inferred that Maxwell's formulæ for calculating the mutual induction of two circular coils cannot be applied where the distance between their central planes is at all comparable with their radii. Experiments on an A Gramme dynamo gave very irregular results when the currents were small, owing to the subpermanent magnetism of the machine. Further uses of the method are suggested, such as the absolute determination of capacity and resistance. Remarks on the subject were made by Prof. Carey Foster and Mr. Swinburne, and Prof. Ayrton replied to Mr. Swinburne's contention that Prof. Foster's method was not independent of observations of a ballistic galvanometer (since capacities are determined by their means) by pointing out that where accurate standards exist it is quite legitimate to base other absolute measurements on them.—Prof. Reinold then read an abstract of a paper on the continuous transition from the liquid to the gaseous state of matter at all temperatures, by Prof. W. Ramsay and Dr. Sydney Young. The authors find the relation between pressure and temperature of gases and liquids at constant volume expressible by $p = bt - a$ where b and a are constants, and therefore conclude that the *isochors* (*i.e.* curves connecting p and t for constant volume) are straight lines. At temperatures below the critical point, the isotherm, during passage from the gaseous to the liquid state, is a serpentine curve inter-

sected by the horizontal line of vapour-pressure corresponding with that temperature, the two areas between the curve and straight line being equal. By experiment and extrapolation the authors find the loci of the apices of the serpentine curves corresponding with different temperatures, to intersect at the critical point. The above results are proved for ether and carbon dioxide, and the authors believe them to be true for all stable substances. Prof. Rücker remarked that if similar relations hold for liquids and solids, the triple point of intersection would be of immense interest. Prof. Perry, whilst regarding the results as of vast importance, thought the curves and calculations should be very carefully discussed before being finally accepted.

Edinburgh

Royal Society, February 21.—Rev. Prof. Flint, Vice-President, in the chair.—In a paper on the effect of pressure on the maximum density point of water, Prof. Tait replied to criticisms made upon his results by Grimaldi.—Dr. J. Murray gave a re-determination of the mean height of the land of the globe above sea-level. He obtains a value higher than that obtained by previous observers.—Prof. Tait read a note on the effects of explosives. He pointed out that within a certain distance from the centre of explosion the speed of ejected matter (air, &c.,) is greater than that of sound. Hence within this distance there is great danger of damage to objects from impulsive pressure.—Dr. Traquair read a supplementary report on fossil Ganoidei collected in Eskdale and Tiddesdale.—Sir W. Thomson submitted a paper in continuation of his paper read before the last meeting on the equilibrium of a gas under its own gravitation alone.

Paris

Academy of Sciences, March 7.—M. Janssen in the chair.—Determination of the constant of aberration: first and second processes (concluded), by M. Lœwy. The relations being known between the ecliptical and equatoria lco-ordinates, the equation is here determined by means of which for a couple of stars without aberration the epoch may be calculated, when both are at the same altitude above the horizon.—On a theorem of M. Liapounoff respecting the equilibrium of a fluid mass, by M. H. Poincaré. By considerations borrowed from electrostatics, a simplification is here offered of the demonstration recently published by M. Liapounoff in the *Mémoires* of the University of Kharkoff.—On the direct fixation of the gaseous nitrogen of the atmosphere by vegetable soils with the aid of vegetation, by M. Berthelot. Having already described the results of the experiments made at Meudon on the fixation of atmospheric nitrogen by certain argillaceous and vegetable soils, apart from the action of vegetation, the author here gives the results of the experiments simultaneously carried on with the aid of vegetation, and under the ordinary conditions suitable for the natural development of plants. In this case the amount fixed was only 4·67 and 7·58 grms., as compared with 12·7 and 23·15 in the absence of plants. From these experiments important conclusions are drawn with regard to the rapid exhaustion of the soil under the prevalent systems of forced culture.—On the great movements of the atmosphere, and on M. Mascart's second note of February 28, by M. Faye. The author replies to the objections urged against, and repeats the arguments already advanced by him in support of, the theory he has formulated on this subject based on fifteen years' observations of atmospheric phenomena.—On the magnetic effects of the recent earthquakes, by M. Mascart. A more careful study of the curves recorded at the Observatory of Nantes shows that the magnetic effects observed at Paris, Lyons, and Perpignan, were also felt in the west of France, although here the oscillations were much feebler.—On the determination of the poles in magnets, by M. Mascart. For the method here described it is claimed that it involves no hypothesis on the magnetic state of the bars, and is free from the objections urged against the other methods now in use.—On the nutritive properties of latex, and on the aquiferous apparatus of *Calophyllum* as described by M. Vesque, by M. A. Trécul.—On the frequency and duration of showers, by M. Hervé Mangon. The results are here tabulated of the pluviometric observations taken at Paris during the years 1860–70 with the pluvioscope invented by the author. The rainfall here recorded is higher than that indicated by other instruments, which mostly neglect slight showers under 0·10 or 0·15 mm., which nevertheless represent from 1000 to 1500 kgrms. of water per hectare.—Letter on atmospheric eddies (M. Weyher's experiments, &c.), by M. D. Colladon.—Report on M. Léon Roque's note respecting a new metronome, based on the isochronism of the slight oscillations of the pendulum, by M. Fizeau. The Commission appointed to examine this instrument reports favourably on the principle of its construction as at once simple and practical, and considers that it is likely to be of service to the art of music.—Report on MM. Bérard and Léauté's memoir on the means of diminishing momentary increase of velocity in machinery furnished with governors acting indirectly, by the Commissioners, MM. Lévy, Marcel Deprez, Sarrau, and Phillips. The report considers that MM. Bérard and Léauté have arrived at a simple and complete solution of the problem how best to control the irregular action of machinery, and that, while specially useful for the manufacture of gunpowder, their apparatus will be found generally applicable to all mechanical work.—Note on the earthquake of February 23 in Italy, by M. F. Denza. General conclusions are given regarding the character, extent, duration, intensity, &c., of this disturbance, derived from reports received from all quarters at the Observatory of Moncalieri.—Propagation of the earthquake in one of the mines at Anzin (Nord), by M. François. The *tromomètre* (seismometer) set up in this mine at a depth of 250 metres two months ago recorded, for the first time, extraordinary vibrations between 6.15 and 6.30 a.m. on February 23.—Reports on the same phenomenon, by MM. A. Issel (Porto Maurizio), M. E. de Rossi (Rome), and Perrotin (Nice).—Observations on M. Donnadieu's recent note on the winter incubations of Phylloxera, by M. Balbiani. In reply to M. Donnadieu, the author maintains his views regarding the hibernation of this parasite.—Observations of Barnard's Comet II. and of Palisa's new planet made at the Observatory of Algiers with the 0·50 m. telescope, by MM. Trépied and Rambaud.—Distribution in latitude of the solar phenomena during the year 1886, by M. P. Tacchini. From the tabulated results of the year's observations it appears that the eruptions, spots, and faculæ, were more numerous in the southern, and the protuberances in the northern, solar hemisphere. The latter occurred in all zones, whereas the other phenomena were almost entirely confined to the region between the equator and ± 40°.—On the rectifications of Maclaurin's trisector curve by means of the elliptical integrals, by M. G. de Longchamps.—On the laws of solution, by M. H. Le Chatelier. This is a reply to MM. Chancel and Parmentier's recent communication to the effect that the author's law of solution is not general, and in certain cases is opposed to observed facts.—On some formulæ relating to saline solutions, by M. Duhem.—On a particular case of solution, by M. F. Parmentier.—On an acid obtained by the action of potassa on a mixture of acetone and chloroform, by M. R. Engel. The compound substance here described has been obtained by M. Willgerodt by treating acetone with chloroform and a small quantity of solid potassa. Its formula is $C_4H_7OCl_3$, and it takes the name of acetone-chloroform.—Synthetical researches on some derivatives of diphenyl, by M. P. Adam.—Note on active camphene and ethyl-borneol, by MM. G. Bouchardat and J. Lafont.—Action of the bibromide of ethylene on the alkaline alcoholates: preparation of acetylene, by M. de Forcrand.—On the spores of *Bacillus anthracis*, by M. S. Arloing. It is shown that these spores are really killed by the light of the sun.—A new method of attenuating the virus of ovine pox, by M. P. Pourquier. The experiments here described yield an unlimited supply of an attenuated virus or vaccine, with which sheep may be safely and efficiently inoculated.—Researches on the structure and development of the cysts in *Echinorhynchus angustatus* and *E. proteus*, by M. R. Kœhler.—On the food of the sardine, by MM. G. Pouchet and J. de Guerne. It is shown that the food of the sardine varies according to circumstances, and does not depend, as recently asserted, on the animal refuse drifting from the Newfoundland fisheries.—New researches on the mode of formation of double monsters, by M. Camille Dareste.—On the variations of structure in the carboniferous porphyries of Renfrewshire, by M. A. Lacroix.—On the minerals associated with the basalt of Prudelles, near Clermont-Ferrand, by M. Ferdinand Gonnard. The prevailing mineral disseminated among these as among most of the Puy-de-Dôme basalts is a christianite apparently confused by the old mineralogists with mesotype, or vaguely described under the name of zeolite.—Researches on the contraction of the terrestrial radius since the formation of the solid crust, by M. A. de Lapparent. Several arguments are adduced against the general theory that the radius of the globe has diminished by one-half since the gneiss or oldest rock formation.

BERLIN

Physiological Society, February 11.—Prof. du Bois-Reymond in the chair.—Dr. König spoke on acuteness of hearing and its estimation by means of tuning-forks, the sound of which gradually died away. He laid stress on the distinction between acuteness of seeing and acuteness of hearing, the latter of which was represented by the time from the beginning of hearing a tuning-fork struck till no sound from it was any longer perceived. It was now customary to say when one person could hear a certain tuning-fork for 100 seconds after it had been struck, and another could hear the same tuning-fork, struck at the same intensity, for only 50 seconds, that the second had only half the acuteness of hearing possessed by the first. In point of fact, such a statement was not accurate, seeing that the amplitudes of a vibrating tuning-fork declined in geometrical progression. It was only in very special circumstances that the specification of the amount of acuteness of hearing, as commonly employed, could be correct. As an empirical method of measurement according to a conventional standard, the expressions a half, a quarter, or whatever be the measure, of acuteness of hearing would be permissible, if in such cases the same tuning-fork were always applied, and it was always struck with the same intensity. To come to an understanding on this point was the business of practical aurists. During the animated discussion which followed this address, Prof. du Bois-Reymond produced an apparatus in which an equal amplitude of vibration in a tuning-fork was obtained by placing between the prongs of the fork a revolving elliptical disk of such dimensions that the small axis left the prongs in their natural position, while the large axis forced them apart from one another. The large axis having been put in, and the disk rapidly turned through 90°, the fork commenced to vibrate, and with each impulse the amplitude was the same.—Prof. Zuntz reported the results of the experiments, partly instituted in conjunction with Herr Potthast, respecting the alimentary values of various albuminous substances. As a most important principle in conducting these experiments, the speaker laid down the maxim that the albuminous substance to be examined should not be administered in too large quantities. It was only with very small doses that the alimentary value of the different albuminous substances beside the same nourishment free of nitrogen could be determined. The dog was used for the purpose of the experiment. The proteine substances compared were: the albumen of lentils, that of lupines, that of gluten, and caseine. In the normal feeding, which regularly alternated with that of the albumen to be tested, the proteine of nourishment was imparted in the form of flesh-meal. The result of the long and laborious experiments was that the alimentary value of the albumen of lentils and that of gluten were each found to be equivalent to that of flesh-meal. That is to say, when to the food (which, apart from the additions to be specified, was the same in all the different cases) there were added equal quantities of albuminous nitrogen—in one case in the form of flesh-meal, in another in the form of gluten, and in a third in the form of lentils—in each such case a quantity of nitrogen was developed, and therefore a quantity of albumen withdrawn from the nourishment, which was equal in all three. The albumen of lupines had a lower alimentary value than the albumen of flesh-meal, seeing that from the lupines more albumen was decomposed than from the flesh-meal. Finally, from caseine, less albumen was decomposed, and therefore more was absorbed by the body and utilised, than in the case of any of the other albuminous classes. By means of this investigation two facts of general importance were established: first, it was ascertained that by changing the species of albumen employed by way of nourishment, a better utilisation of the nutritive albumen was obtained, *i.e.* less albumen was decomposed, than if one and the same species of albumen were given for a long period; second, the paradoxical observation was made that during lactation, when the animal made use of a large quantity of albumen for the formation of milk, more of the albumen administered in the food passed away in waste than would have been the case in the same circumstances at a time of non-lactation. The following explanation of these phenomena was given by the speaker. During lactation the animal used a certain quantity of albumen for the milk. The albumen of milk, as was known, was caseine. This caseine was not, however, administered in the food, but had first to be produced from the nutritive albumen (the various species of albumen being chemically different. Now, from the nutritive albumen only certain groups of molecules could be utilised for the formation of caseine. Far more albumen must therefore be decomposed than corresponded with the quantity of nitrogen in the caseine. Hence, therefore, the greater decomposition and the less utilisation of the albumen of the nourishment. Nor was the albumen which the animal needed for incorporation with the body offered to it in the albumen of the nourishment, but the albumen taken by the body was built up from the constituents of the albumen of the nourishment. If only one kind of albumen was given to the animal, it required to decompose a large quantity in order to obtain sufficient constituents for the albumen appropriated by the body. If, on the other hand, different sorts of albumen were given in the food, then the animal decomposed on the whole a less percentage, seeing that in the differently composed albuminous substances it sooner found the different molecular groups which it needed for the building-up of the albumen of the body.

BOOKS, PAMPHLETS, and SERIALS RECEIVED

Records of the Geological Society of India, vol. xx.—The A B C of Photography, 22nd edition (London Stereoscopic Company).—The Perfect Way, or the Finding of Christ, 2nd edition: Kingsford and Maitland (Field and Tuer).—English Tobacco Culture: E. J. Beale (Marlborough).—Through the Fields with Linnæus, 2 vols.: F. Caddy (Longmans).—Report of the Meteorological Council of the Royal Society for the year ending March 31, 1886 (Eyre and Spottiswoode).—Quarterly Weather Report, part 2, April-June, 1878 (Eyre and Spottiswoode).—Monthly Weather Report, September 1886 (Eyre and Spottiswoode).—Report of the Third Meeting of the International Meteorological Committee, held at Paris, September 1885 (Eyre and Spottiswoode).—Scalelia Chemica: a Series of Aids for Beginners in Chemistry: Part 1, Analysis of Simple Salts: H. Adrian (Lewis).—Genesis of the Elements: W. Crookes.—The House in Relation to Public Health: J. B. Russell (Anderson, Glasgow).—Descriptive List of Anthropometric Apparatus (Cambridge Scientific Instrument Company).—Annalen der Physik und Chemie, No. 3, 1887 (Barth, Leipzig).—Journal of Physiology, vol. viii. No. 1 (Cambridge).

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