THURSDAY, JULY 9, 1885

THE INTERNATIONAL SANITARY CONFERENCE IN ROME

THE late Conference in Rome, which for some unknown reason stands adjourned for the present to reassemble again in November, has arrived at certain results, the details of which are not published yet, and until the full and authenticated report is at hand it would be unjustifiable to subject them to criticism. But as far as the gross results achieved and the methods followed by that Conference have already become known through the reports sent to the daily papers, there is no reason for viewing those results with any peculiar satisfaction. As far as we can follow the proceedings of the Conference, its achievements cannot be considered an advance on those of its predecessors held in Constantinople in 1866 and in Vienna in 1874.

During the present century Europe has been visited six times by cholera, and after the second visitation (1847-50) the first International Sanitary Conference was convened to Paris in 1851, in order to arrive at some common understanding as to quarantine, and to discuss various questions of hygiene, as well as the etiology of the disease.

Between 1852-56 Europe was again visited by cholera (England in 1853-4), and very important knowledge was then gained as to the intimate relations existing between general insanitary conditions and the spread and severity of the disease. After the next visitation of Europe by cholera (in 1865-6) the second International Sanitary Conference met at Constantinople (in 1866). The results of the deliberations of this Conference have been in many respects important. The Conference agreed, with few dissentients, that cholera has for its starting-point India; that its invasion into other countries is effected by human intercourse, including linen and wearing apparel; that its spread depends in a great measure on general insanitary conditions of habitation, air, water, and food. In order to avert and check the invasion of Europe by the disease, the Conference agreed to a certain complicated system of quarantine both by land and sea, which embodied and enlarged on the scheme laid down by the preceding Conference of 1851, but which had been found incapable to avert the introduction of the disease in 1865-6.

Next cholera appeared in Europe in various countries between 1869-73, and after the epidemic came to an end another International Conference assembled in Vienna in 1874. This Conference, while confirming the results of the deliberations of its predecessors, arrived at certain important conclusions as to the value of disinfection and quarantine. As regards the latter the Conference agreed that all measures of quarantine, as far as they are practicable, are fallacious and incapable of averting or checking the introduction and spread of the disease; that all measures of land quarantine are to be condemned; and that maritime quarantine is to be replaced by competent medical inspection. Cholera appeared next in Egypt in 1883, and from here was introduced into Marseilles, where it assumed, in July 1884, alarming proportions; thence it spread into Toulon, the south and north of France, into Italy and Spain, raging everywhere with great severity. If at any time land and maritime quarantine had a fair trial it was in 1884 in France, Italy, and Spain. Every one remembers the dictum of M. Fauvel, then at the head of medical affairs in France, that the disease that broke out in 1884 in Marseilles and spread thence into Toulon and other parts of France could not be Asiatic cholera, because quarantine, after the appearance of cholera in Egypt in 1883, had been very perfect and had been carried out in French maritime ports with great rigour. Every one remembers also that, in spite of all the measures of land quarantine practised in France, Italy, and Spain in 1884—and at the present moment practised in Spain—its lazarettos, fumigations, and military cordons with its attendant troubles, miseries, and cruelties, cholera spread and raged with great severity in France and Italy, and is at the present moment assuming alarming proportions in the eastern and south-eastern parts of Spain; while, on the other hand, this country, without any maritime or land quarantine, but with an efficient and competent medical inspection of all shipping in its maritime ports, has remained free from cholera in 1884 and hitherto, notwithstanding its vast communications with Egypt, Italy, and Spain. Maritime and land quarantine have had a repeated and fair trial, but have been found utterly wanting, and countries like France, Italy, and Spain placing the utmost faith in them have dearly paid for it. Now, what lesson is to be learned from all this, and let us ask at the same time what lesson has the late Conference in Rome learned from this?

The Conference of Constantinople (in 1866) had adopted ten days as the furthest limit of the period of incubation—that is to say, if any ship coming from an infected part had been at sea for ten days and no case of cholera has appeared on board, the ship is to be considered "clean" and is to receive free *pratique*. Now, steamers sailing from Bombay arrive under favourable conditions off Suez on the eleventh day, and therefore if no cholera has appeared during the whole of the voyage, the ship ought, according to the above, receive free *pratique*. But instead of this every ship is detained and kept under "inspection" for at least twenty-four hours at Suez, at the instance of the Egyptian authorities acting under the instructions of the General Board of Health. The majority of the medical members of the late Conference at Rome carried this still further in recommending that all ships coming from India should be detained and kept under inspection at Suez for five days, some delegates even for ten days. Another still more iniquitous recommendation, and one which, if carried into practice, is likely to have serious consequences for Egypt and Europe, is this: that if any "suspected" ship—the decision as to this "suspicion" resting with an Egyptian official of self-estimated competency—arrive off Suez, the passengers and crew are to be turned out into lazarettos, kept there under observation, disinfected, &c. Now, the Conference, in order to establish a permanent focus of cholera from which the disease might, and in all probability would, spread into Egypt and the adjoining countries, the Mediterranean Basin and Europe, could not have recommended any arrangement that is more likely to further such a hazardous and dangerous object. In vain did Dr. Thorne, one of the English delegates, urge at the Conference the iniquity and danger of this recommendation. The French delegates leading the majority turned a deaf ear to any reasonable suggestion; they seem to have learned no lesson from the misery that lazarettos, fumigations, and all other measures of land quarantine, without stopping the introduction and spread of cholera, have in the past inflicted on their country.

If we ask ourselves, What new facts, what new experiences have in the last cholera epidemic in 1884 been gained in order to justify these recommendations of the majority of the Conference? we have to answer—None; and those that have become known point in the opposite direction. The recommendation as to five to ten days' quarantine off Suez for ships coming direct from India seems to imply that the late outbreak of cholera in Egypt owed its origin to importation from India. This view has during 1883-84 been stated and re-stated by French writers with their usual self-confidence, but not a tittle of evidence has been brought forward to support it. Moreover there exists a good deal of evidence showing that that outbreak, which, as is well known, commenced in Damietta, owed its origin to importation from an altogether different direction—viz., overland by pilgrims from Mecca. As Prof. Lewis, another delegate from England, has urged at the Conference, no English ship coming from India has ever been known to have imported cholera into Egypt and Europe; and, considering the enormous number of vessels arriving from Indian ports in Egypt, the Mediterranean countries and Europe, it is certainly a very remarkable fact that importation, if it happened in this manner, should not be of common occurrence.

The real danger from cholera for Egypt, Turkey, and Europe does not lie at Suez and the Suez Canal, but at Mecca and the countries about the Caspian Sea, this being the route in which cholera has hitherto travelled—viz., from Mecca, Mesopotamia, and Persia, into the Red Sea coast, Egypt, Syria, the Levant, Turkey, and Russia—and therefore these are the portals, if any, which the European Powers ought to guard. As England has urged in the past, and as it has also urged on this occasion, every country may, and has a right to protect itself as it thinks best. France and Spain may make their own maritime quarantine as rigorous, their land quarantine as vexatious as they choose; but that these countries should dictate measures to others, which past experience has proved to be fallacious and futile to achieve the end they aim at, is as iniquitous as it is against common sense.

Cholera in Europe being dependent on importation from the East, it is quite clear that absolute prevention of such importation would theoretically be the best safeguard; but then the question arises, and it is one that has been repeatedly asked—viz., can this be practically achieved? To stop unconditionally every and all communication with an infected locality involves, apart from the great practical difficulties in carrying it out, such enormous hardships, material loss and misery, that the remedy would entail greater misfortunes than the evil it tries to cure, even granting, for the sake of argument, that it is capable of so doing.

Prof. von Pettenkofer in his various writings on the subject of quarantine has fully and clearly stated the case, and their perusal would have materially enlightened many of the members of the late Conference. They would also find in those writings what they might have found already in the protocols of the former conferences (in Constantinople and Vienna), viz. that one of the *chief* and *first duties* of the State in order to prevent and check the spread of cholera is a *proper attention to general sanitation.* Make your military cordons as strict as you please, stop and impede all traffic by sea and land as much as you like, fumigate your railway travellers and mails as carefully and rigorously as possible, you will not hereby succeed in stopping all communication with an infected country. On the other hand, give up all those silly and harassing limitations, but keep a good look-out for infected ships coming to any of your ports, detain the infected persons in a specially-fitted hospital, disinfect the ship and articles, but allow the rest of the passengers and crew to depart, keeping their names and addresses, and notify their arrival to the sanitary authorities of the place they are bound to. Further than this, see that your dwellings, your water and air are in sanitary respects looked after, and that filth is properly disposed of, and you will hereby have done what is compatible with all past and present experience in order to check the entrance and dissemination of cholera. It is admitted on all hands that general insanitary conditions of dwellings, water, and air are the most powerful allies of cholera; without them, cholera is as unable to spread as typhoid fever.

The principles just mentioned are practically those on which the sanitary authorities in this country have been acting in the past, and on which they are acting in the present. The danger to this country from importation of cholera from Spain is greater than perhaps to any other, seeing the vast maritime communications existing between this country and the east and south coast of Spain; but there can be little doubt that, if cholera should unfortunately be imported, it can never assume those gigantic proportions that it has assumed in France, Italy, and that it is now assuming in Spain.

If one reads of the unspeakably filthy conditions prevailing in Spain, and reads at the same time of the silly and arbitrary proceedings of the authorities in carrying out quarantine, one is reminded of the General who, in trying to keep out a powerful enemy is putting up on the frontier a few dummy soldiers and toy guns, but who has omitted to provide the interior of the country with a real army and guns. The result is, of course, clear: the enemy cannot be prevented from entering, and, having entered, cannot be kept from overrunning and devastating the country.

A NATURALIST'S WANDERINGS IN THE EASTERN ARCHIPELAGO

A Naturalist's Wanderings in the Eastern Archipelago, a Narrative of Travel and Exploration from 1878 *to* 1883. By Henry O. Forbes, F.R.G.S. With numerous Illustrations. (London: Sampson Low, Marston, Searle, and Rivington, 1885.)

MR. FORBES' Wanderings in the far East extended over about four and a half years, during which time he visited the Keeling Islands, Java, Sumatra, Amboyna, Timor Laut, Buru, and Timor. In Java, Sumatra, Buru, and Timor he made extensive inland journeys through districts rarely or never before visited by European naturalists; and as he everywhere collected assiduously and observed intelligently, the record of his travels is exceedingly interesting. His special studies were botanical and ethnological, and in these departments he has added much to our stores of knowledge. His observations on the manners and customs, the myths and superstitions of the various tribes among whom he resided or travelled will be of great value to anthropologists, owing to the wide range of his observations and the time and trouble he devoted to the inquiry. In zoology he did not collect largely, and indeed it was simply impossible for him to do so, since the continuous labour and attention needed to form a well-preserved herbarium in the damp equatorial climate and while almost constantly moving about, leave the traveller but little leisure to devote to other departments of natural history. To collect effectually in any wild tropical country, the naturalist should settle himself for at least six months at a time in a good central position from which short excursions in various directions can be made; and if these headquarters are well chosen it is possible to obtain an almost perpetual "fine season," and thus greatly increase both his collecting power and his personal enjoyment.

Mr. Forbes appears to have had rather more than his fair share of accidents to his collections, and in every case what was lost was of especial interest. His insect collection from the Keeling Islands was destroyed on the way back to Java, and we thus lose the opportunity of comparing the list with that made by Mr. Darwin more than forty years before. In Timor Laut a large part of his herbarium was destroyed by fire, while a smaller collection made in the interior of Buru was actually left behind for want of porters to carry it. The Timor Laut collection is especially to be regretted, as it was obtained with great difficulty in perhaps the least known island of the whole archipelago, while it is probable that many years will elapse before any other naturalist will venture to explore so remote and inhospitable a country.

Mr. Forbes' residence for three weeks in the Keeling Islands enabled him to note what changes had occurred since Darwin's visit nearly half a century earlier. These are very slight, and seem incompatible with the theory that any subsidence has taken place, because the inner margin of some of the islands next the lagoon are sometimes half a mile distant from the outer edge, and the greatest cyclones do not carry the coral *débris* nearly so far. It is now generally admitted that the celebrated "subsidence theory" of the formation of atolls and barrier reefs is unsound as a general explanation of the facts; yet it so fully and plausibly explained all the details of coral structure known at the time, as to command universal acceptance and unbounded admiration. We have here a remarkable instance of the danger of founding a general explanation of widespread phenomena on an assumed basis, for the fact of long-continued subsidence, which was the very foundation of the whole theory, was in most cases quite incapable of proof. It is also now apparent that the theory was to some extent inconsistent with the views as to oceanic islands which Darwin himself originated and which are now generally admitted to be sound. His great argument, that no single oceanic island possessed ancient stratified rocks or contained a single indigenous mammal, was equally an argument against the view that the widespread coral archipelagoes of the Pacific and Indian Oceans were due to the subsidence of co-extensive tracts of land, since it is almost impossible that all the higher points of these submerged lands, spread over nearly half the surface of the globe, should be without exception of volcanic origin.

Crabs of two or three species were the most abundant terrestrial inhabitants of the Keeling Islands living in narrow corkscrew burrows, which are so numerous that one hundred and twenty of their holes were counted in an area only two feet aquare. Around these holes little mounds are formed, and the crabs carry into their burrows twigs of trees, pieces of seaweeds, seeds, &c., thus fulfilling in many ways the functions of earthworms in this newly-formed land. Their numbers are enormous, and Mr. Forbes thus describes the curious optical effect produced by them:—

"On placing the foot on the region occupied by them, one perceives an undulation of the surface followed, over a circular area, by a surprising change of the pure white ground into a warm pink colour, which for the moment the stranger puts down to some affection of his eyes from the reflection of the light. He soon perceives that this movement is caused by the simultaneous stampede of the dense crowd of the peopled shore into their dwellings, just within the door of which they halt, with the larger of their two pincer-claws, which is of a rich pink colour, effectually barring the entrance except where one watchful stalked eye is thrust out to take an inquiring look if the alarm is real. As one advances the pink areas again change into white, as the Crustaceans withdraw into their subterranean fastnesses. On traversing a broad field occupied by these crabs, the constant undulations and change of colours produce a curious dazzling effect upon the eyes."

During his long residence in the mountains of Java, Mr. Forbes made many interesting observations on the fertilisation of orchids. He was surprised at the large number of these plants which, though often possessing the combined attractions of showy flowers and fragrant odours, yet never or rarely produce seed-capsules. In one case, for example, out of 360 flowers examined till they withered or dropped off, only six produced capsules. Again, he finds a considerable number of species with showy flowers which are yet specially adapted for self-fertilisation and never seem to be visited by insects. The most extreme and marvellous example of this phenomenon is found in a plant related to *Chrysoglossum*, which fertilises itself without ever opening its flowers at all. Mr. Forbes observed these plants in the forest as well as in numerous specimens grown in a garden, and all were fertilised in the same way; and he adds:—"In opening the locked-up petals, I found the labellum beautifully marked with lines of purple, carmine, and orange, and the column also; but no insect eye could ever be fascinated or allured by its painted whorls."

These observations are of extreme interest, and they certainly prove, as Mr. Forbes remarks, that the rule "that the flowers of orchids are fertilised by the pollen of their flowers," is by no means so universal as has been supposed. Yet the phenomenon does not seem so extraordinary if we look upon it as one of the normal phases in the developmental life-history of species. The overwhelming amount of evidence which has now been obtained of adaptations for cross-fertilisation, not in orchids only, but throughout the whole series of flowering plants, and the almost constant association of conspicuous form, colour, and odour with adaptations for insect fertilisation, force us to the conclusion that in almost all the cases adduced by Mr. Forbes we have species which were once adapted for insect-fertilisation. But in the terrific struggle for existence ever going on in tropical regions, insects are subject perhaps more than any other group of organisms to excessive fluctuations of numbers, sometimes culminating in the complete extermination of species; because they are equally liable to severe injury by physical and organic causes—by adverse seasons which destroy them in some of their earlier stages, or by the excessive attacks of insectivorous animals in both their larval and perfect states. It must therefore often happen that certain species of insects almost disappear in districts where they are usually abundant, and if any particular plant has had its flowers so highly specialised as to be adapted for fertilisation by one of these insects only, it must become extinct unless it occasionally produces varieties which are capable of self-fertilisation. The species of orchids in which a very small percentage of flowers produce seed capsules are evidently those in which the special insects adapted to fertilise them have become either temporarily or permanently scarce, and if that scarcity goes on increasing one of three things must happen—either the flower must become modified so as to be fertilised by some more abundant insect, or it must become capable of self-fertilisation, or it must become extinct. No doubt all these three cases occur, but it is of the second alone that we can obtain any knowledge, because we there find, as in our own bee-orchis, the special attractions of conspicuous form and colour which have yet ceased to be of service to the species. But no naturalist can doubt that these attractions were once serviceable; and we are thus led to conclude that all such instances are forms of functional degeneration which under changed conditions of the environment have afforded the only means of preserving the species.

Mr. Forbes's record of his thirteen months of travel in Sumatra are perhaps the most interesting portions of his book. He here met with some of the most marvellous productions of the vegetable kingdom—strange parasitical Rafflesiaceæ, an eccentric fig which ran underground and there produced its fruit, just showing their tops above the surface, and the giant arum (*Amorphophallus titanum*), some of which were seventeen feet high and with tubers six feet six inches in circumference. In the same forest huge earth-worms raised tubes of mud four and a half inches in circumference and eight inches high; and were so numerous as to render the whole surface of the ground as rough and hummocky as that of a newly-ploughed field. Here too, as well as in Java, he found a wonderful case of mimicry in a spider which deceived him even a second time; and he here obtained the rare *Ornithoptera brookeana*, perhaps the most chastely beautiful of all butterflies. Grand mountains, active volcanoes, glorious forest scenery, strange antique monoliths, and many interesting races of men, combine to render Sumatra one of the finest hunting-grounds yet left for the naturalist, while over the greater part of it there are facilities for travel or for residence rarely to be found in so little known a country.

In his later and more adventurous explorations of Timor Laut and Timor, Mr. Forbes was accompanied by his wife, a lady who seems to have endured all the annoyances, privations, and dangers of such a journey with truly heroic fortitude. Although these islands are far less known to naturalists than almost any other part of the Archipelago, they seem comparatively poor in a natural-history point of view. A considerable proportion of the birds and butterflies of Timor Laut were new species, but the collections were scanty, and there is, no doubt, much still to be done there if a collector could freely explore the country and not be confined, as was Mr. Forbes, to a limited tract owing to tribal warfare. One of the interesting discoveries here was another example of mimicry among birds, in which a new species of oriole mimics a new honeysucker, just as do corresponding species in Ceram, Buru, Gilolo, and Timor. A most interesting case of protective colouration was also observed in the white-headed fruit-pigeon of Timor (*Ptilopus cinctus*). These birds sat motionless during the heat of the day in numbers on well-exposed branches, yet Mr. Forbes states that it was with the greatest difficulty that either he or his sharp-eyed native servant could detect them, even in trees where they knew they were sitting. The strongly-contrasted white and dark colours of this species are such that any person looking at a specimen in a museum might take it as an example of a defenceless bird with very conspicuous plumage, and might ask triumphantly how our theory of protective colouration can be applied here. Yet it turns out that these strongly-marked colours so exactly harmonise with the colours of the branches of the trees on which it sits, exposed to the glare of the tropical sun, as to be completely protective; and we thus have another illustration of the impossibility of forming any correct judgment on this question unless we are able to observe each species in its native country and among the exact surroundings to which it has become adapted.

The hasty journey through the interior of Timor, among strange scenery and strange people, is full of interest. Most of the mountain tops, where alone a rich and interesting vegetation was to be found, were strictly taboed, and it was often only by stratagem that specimens were collected; while the difficulties of travel in a country absolutely without roads and consisting almost wholly of an endless series of rugged mountains and deep valleys were exceptionally great.

The book is on the whole very well written, and will give the reader an excellent idea of some of the less known parts of the Malay Archipelago. The weakest part of it are the illustrations, which, though numerous, appear to be for the most part reproductions of rough sketches by some unsatisfactory process of photo-zincography. For this the author was probably not responsible, but his readers will regret that the strange and beautiful scenery he has so graphically described is not more effectively presented to the eye. The portraits of many of the natives are, however, very well done, while several good maps and a full index greatly add to the value of the book as a useful work of reference.

ALFRED R. WALLACE

FIVE ELEMENTARY TEXT-BOOKS OF HYGIENE

A Manual of Health Science. Adapted for Use in Schools and Colleges and suited to the Requirements of Students preparing for the Examinations in Hygiene of the Science and Art Department, &c. By Andrew Wilson, F.R.S.E., F.L.S. (London: Longmans, Green, and Co., 1885.)

The Laws of Health. By W. H. Corfield, M.A., M.D. (Oxon.). (London: Longmans, Green, and Co., 1880.)

Principles of Hygiene. Expressly Adapted to the Requirements of the Syllabus of the Science and Art Department, South Kensington. By Albert Carey, F.R.G.S. (London: Thomas Murby.)

Hygiene. Its Principles as Applied to Public Health. Adapted to the Requirements of the Elementary and Advanced Stages of the Science and Art Department, the Sanitary Examinations at the Universities, &c. By Edward F. Willoughby, M.B. Lond., San. Sci. Cert. Lond. & Camb. (London and Glasgow: W. Collins, Sons, and Co.)

Hygiene: a Manual of Personal and Public Health. By Arthur Newsholme, M.D. Lond. (London: Geo. Gill and Sons, 1884.)

THESE works are partly if not principally intended for the use of students of the Science and Art Department, South Kensington. It is very essential, therefore, that not only should the matter be put in a pleasant and readable form, but that there should be no serious errors, as students of elementary works cannot be expected to recognise errors as such, from any knowledge they may possess on allied subjects. In fact they, and many others besides, find a difficulty in conceiving that what is printed in a book need not necessarily be correct. It is also necessary that the chapters should be well arranged, with the matter well assorted under headings, and that nothing of importance should be omitted.

"A Manual of Health Science," by Andrew Wilson, F.R.S.E., F.L.S., cannot be said to be in agreement with the above principles. Many of the chapters are ill-arranged, and important points are omitted, especially in the chapter on Removal of Waste. It is not by any means free from errors, of which we may cite a few as specimens: thus on p. 20 it is stated that "the solids" of the gastric juice "amount to over 990 parts per 1000, the remainder being water;" if such were really the case, the juice instead of being a liquid like water, would be a solid of a very dense character. Again, on p. 80, "the cistern" for drinking water "becomes a necessary article of furniture in our houses on any system," whereas the chief advantage of a constant supply is that cisterns for drinking water are unnecessary. Again, at p. 91, it is stated that "each individual exhales about ·6 cubic foot CO_2 per 24 hours" instead of per hour. At p. 112 we find that "propulsion draws foul air out, and aspiration drives fresh air in." There are several other misstatements, but the above will suffice. An unnecessary amount of space is devoted to soaps and hair-washes. The notice of a soap of a particular manufacturer in a work of this class is, we think, undesirable as having somewhat the character of an advertisement. The illustrations, which are numerous, are very good.

"The Laws of Health," by Prof. Corfield, M.D., is a very valuable little work, and although not originally intended to form a class-book for the Science and Art Department, is admirably adapted for this purpose. It contains nearly all that it is necessary to know in a very small compass, and bears throughout the impress of the high scientific attainments and practical knowledge of the author. The chapter on Small-Pox and Vaccination is especially good, and its arguments very convincing.

"The Principles of Hygiene," by Albert Carey, F.R.G.S., is only of use for the first or elementary stage in Hygiene of the Department, although it is not so stated in the preface. The book is without illustrations, a great drawback to elementary students; and a good deal of space is devoted to matters of only secondary importance. It is therefore but moderately suited for the class of readers for whom it was written.

"The Principles of Hygiene," by E. F. Willoughby, M.B., S.Sc.C. Lond. & Camb., is intended for the use of students of all three stages of the Science and Art Department. It is also very well suited for the preparation of candidates for the University Examinations in Public Health. We can speak highly of this work, which contains sound and useful information on every subject necessary for the above courses, and is well up to the latest improvements and most generally received opinions in the science of which it treats. In our opinion it is perhaps better adapted for the advanced and honours students than for the elementary, as some parts intended for the latter are somewhat needlessly complex. The chapter on Vital Statistics is likely to be extremely useful to the University candidates, this somewhat difficult subject being here ably and intelligently treated.

"Hygiene, a Manual of Personal and Public Health," by A. Newsholme, M.D. Lond, is very well suited for students in the elementary and advanced stages. They will find here all that they require to know in an easily assimilable form. We do not, however, agree with Dr. Newsholme in thinking the "Banner" system of drainage one to be recommended, and our opinion coincides with that of several practical sanitarians. In every other respect the subject is ably treated by the author, and his work deserves a wide circulation amongst the science teachers of the country.

OUR BOOK SHELF

Euclid, Book I.; with Notes and Exercises for the Use of Preparatory Schools and Candidates preparing for Naval Cadetship and Sandhurst Preliminary Examinations. By Braithwaite Arnett, M.A. (Cambridge: Deighton, 1885.)

As the examinations for which this work is intended to prepare pupils rigidly require what are called Euclid's proofs we have here merely an edition mainly on the lines of Simson's text. This text is so presented that the pupil may see how to write out his "props" in such a way as shall please the examiner. Everything is done that can be done by another to secure success. That the pupil may not be physically incommoded more than is absolutely necessary the text is so printed as to involve the minimum of exertion.

On the sinister page of the open volume behold the text printed as the dreaded examiner desires to see it broken up, each new step in the reasoning claiming a fresh line, the figure correctly drawn (a really important matter), and to every page its own private "prop." These are merits which the editor can rightly appropriate to himself (which he does in his Preface).

On the dexter page, *in ordine longo*, come the "references," saving the pupil the horrid nuisance of turning back (as he lies prone on the ground) to see what "def. 15" is, and this kind (?) action is carried on to Prop. 48. So that if this one definition had obtruded itself into each proposition, it would have been printed forty-eight times and ever would it have greeted the student with a cheery "Here we are again!"

But this is a fault—unless all the first book could be printed on one side of a not too unwieldy page—which Mr. Arnett's book must be content to share with our "Revised Bible" references to such words as "slave" for the A.V. "servant."

Below the "references" come a very copious collection of riders. We have looked at the ludicrous side of matters, but it would be doing Mr. Arnett a very great injustice if we confined our attention to all the conveniences he has got together to ease the work of this class of students, of whom (*horres cimus referentes*) we have had experience in time past, in getting up this particular subject.

Throughout there is plenty of judicious explanation and illustration: the theorems are grouped in sections of subject-matter, as direct and converse theorems, so are the problems in sections, and there is a genealogical chart for the first twenty-six propositions. In fact nothing is scamped.

To return to the dexter page, the riders are exceedingly varied and well-grouped, and are calculated to draw out the intelligence of a thoughtful pupil if such an one uses the book.

If the first book of the glorious "Elements" must be edited at such length, we commend Mr. Arnett's edition to those who require such "props" as are here supplied, feeling convinced that if they cannot master the "props" with them, then the study of geometry is not their proper work.

Botany. A Specific Subject of Instruction in Public Elementary Schools. By Vincent T. Murché. (London: Blackie and Son, 1885.)

THE preface to this little volume states that "the three books which form this series are emphatically children's books, and not text-books for South Kensington students." As long as the author confines himself to that part of the science which is, in our opinion, best adapted to the mind of a child, his "chatty, experimental method" may very probably gain the attention of youthful readers. The first forty-eight pages, which he devotes to external morphology, are unpretentious and successful. We may well wish that the author had confined himself to external morphology; but he launches out into anatomy and physiology—branches of the science which are ill-adapted at best to the mind of a child: in this middle section of the book his success leaves him when he states that "the epidermis of the orange consists . . . of a thick peel;" that "there is in every plant . . . a peculiar vital fluid which is the source of all its solid parts;" this, we are told, is found in spring "in an active state between the bark and the wood. In this condition it is called *cambium!*" It is also stated (p. 58) that the cells of the pith "form the channel by which all the fluids absorbed by the roots are carried upwards towards the leaves and flowers," while the part played in the transfer of fluids by the lignified walls is systematically ignored, and it is expressly stated on p. 78 that "there can be no passage of fluids up or down, except by the process of osmosis." When the author leaves this part of the subject, on which he is, to say the least, not very sound, his success again returns: he describes simply and clearly the chief characters of the flower and fruit; but concludes with a condensed and not very satisfactory treatment of some of the lower forms of vegetable life.

It is unfortunate that a book, parts of which might prove so useful, should be disfigured by serious blunders; why should not the proof-sheets, in cases like the present, be submitted to some competent authority, who would easily sift out the grosser errors? F. O. B.

Journal of the Royal Agricultural Society of England. Second Series. Vol. 21, Part I. (London: John Murray, 1885.)

THIS journal fully maintains the high character it has acquired under the able editorship of Mr. H. M. Jenkins. The part under notice is a bulky volume of nearly five hundred pages, and includes some eight or ten original papers by well-known agricultural writers, besides the always valuable annual reports of the entomologist, chemist, and botanist to the Society. Prof. Wortley Axe reports on a recent outbreak of abortion in Lincolnshire ewe-flocks, and Prof. Robertson on anæmia in sheep. Mr. S. B. S. Druce, Barrister-at-Law, has a significant paper on the alteration in the distribution of the agricultural population of England and Wales between the returns of the census of 1871 and 1881. Dr. J. H. Gilbert, F.R.S., contributes a sympathetic memoir of the late Dr. Augustus Voelcker, the paper being accompanied by a graphic portrait. Sir J. B. Lawes, F.R.S., writing on sugar as a food for stock, concludes that even at its present low price, sugar does not appear to be an economical substance to use when brought into comparison with other foods which are available to the farmer. Mr. H. Ling Roth writes on Franco-Swiss dairy farming, and Mr. W. Little on the agriculture of Glamorganshire, while the longest contribution to the current part is the first instalment of a report on Canadian agriculture, by Prof. Fream. The author confines his remarks chiefly to the prairie region of British North America, and after discussing the physical and geological features of this vast region, the character of its soils, the composition and value of its native herbage, and the peculiarities of its climate, he proceeds to give an exhaustive description of the agriculture of Manitoba and the North-West Territories, and concludes with an expression of his opinions as to the probable future of prairie farming. The moderate and impartial spirit in which this paper is written will enhance its value to readers on both sides of the Atlantic, and lead them to look forward to the publication of the second part, in which it is proposed to deal with the agriculture of the Eastern Provinces of the Dominion. In the course of his inquiries, Prof. Fream appears to have discovered in "goose wheat" a novelty both of botanical and agricultural interest. This part of the *Journal* also contains a report on the field and feeding experiments at Woburn, by Dr. J. Augustus Voelcker, in which the author gives evidence of the same attention to accuracy and matters of detail as were so eminently characteristic of his late father, to whose vacant post as consulting chemist to the Society he was recently elected by the Council.

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

"An Earthquake Invention"

WITH reference to the correspondence on this subject in this week's NATURE (vol. xxxii. p. 213), will you permit me to state that the gentleman to whose paper in the British Association Report for 1884 Prof. Piazzi Smyth refers has long been a resident of Japan, that he is now on a voyage from that country to Australia and New Zealand, and that it must, therefore, in the ordinary course of things, be some months before he can see and reply to the correspondence in question. In the mean time, it may not be amiss to point out that the capital of Japan is about 12,000 miles from the learned societies of Europe and their *Proceedings*, and that there, as described, a man must be content to work with what he finds at his hand; there are no great public libraries in which we can find out readily what has been done before in any particular field. Mr. Stevenson's paper appears to have been published twenty years ago, and the chances are that it never, from that time to the present, reached the East. That it never came to the knowledge of "the B.A. man" will be readily believed by the many readers of NATURE who know what a careful and conscientious worker that man is. Besides, unless it be presumptuous in an unscientific person to say so, the learned Professor's solitary premiss does not at all support his amiable conclusion. If he will again examine the letters, to the publication of which he appears to have given his consent without a clear notion of what he was doing, he will doubtless perceive that one man may carry out experiments in Japan in 1884 without knowing that similar experiments had been carried out by another man in England in 1864; and when Prof. Piazzi Smyth has reached this point, it may occur to him that the tone and expressions of his letters, so far as they refer to the gentleman in Japan, require more consideration than they received when they were penned.

It should also be added that these experiments with regard to buildings in earthquake countries form only one of a long series of investigations which the gentleman in question has for years past been pursuing over the whole domain of seismology. Most of his numerous papers on this subject have been noticed from time to time in NATURE. M.

Gray's Inn, July 3

On the Occurrence of Lumpenus lampetriformis and Gadiculus argenteus off Aberdeen

I RECORDED and figured in the *Proceedings* of the Zoological Society for 1884 the first species of *Lumpenus lampetriformis* obtained in Great Britain. It was a male 10.7 inches long, captured trawling by Prof. McIntosh, fifteen miles off St. Abb's Head. On June 20 I received a letter from Mr. Sim, of Aberdeen, inclosing a sketch of a fish which had become entangled in the net of a steam trawler, and which specimen he was good enough to forward for my inspection. It is a female of the same species 8·6 inches in length, in which the caudal fin differs from that of the male example in that its form is lanceolate. The second specimen, which I received at the same time from Mr. Sim, was that of a *Gadiculus argenteus*, Guichenot, which was cast up on the beach after a slight storm on April 13, 1885. To this latter fish a considerable amount of interest attaches itself. Pertaining to a genus whose habitat is considered intermediate between the littoral and deep-sea zones, I have been in doubt whether it has or has not been previously obtained off our shores. Couch labelled a fish of this species from the *Porcupine* Expedition as *Macrourus linearis*, and which is in the British Museum collection. Of it he wrote as follows:—"Much resembling a whiting, but shorter in proportion to its depth and with a much larger eye. Caught from a depth of 183 fathoms, muddy ground, 54° 10′ N. and 10° 59′ W. Length about 6 inches; no barb; the head short, eye large, mouth capacious, teeth small, dorsal fins three, anal two, tail a little concave, colour in spirit pale yellow. If we can suppose that a whiting can live at such a depth, we can suppose also that the eye might become larger and the body rather shorter, proportionally, but otherwise it is a distinct species and yet nearly alike; but from the latitude, and especially the longitude, it is scarcely a British fish."

I should have deemed a fish from such a spot undoubtedly British, but as I was not quite sure whether Mr. Laughrin, who had been in charge of the fish collection in the *Porcupine* Expedition, might not have inadvertently mixed up Mediterranean forms with those from higher latitudes, and as *Gadiculus argenteus* originally was obtained from the coast of Algiers, I wrote to him on the subject. However, he would only reply that "I do not think he [Mr. Couch] had any of the Mediterranean fish; I cannot remember, it is so long ago." It is very interesting being able, after so many years' interval, to adduce corroborative evidence as to this fish being entitled to a position in the British fish fauna, the *Porcupine* specimen having been obtained on the west coast of Ireland, Mr. Sim's on the east coast of Scotland. The specimen is 3·3 inches in length, D. 11/13/15, A. 16/16, L. l. 56. There is a dark spot at the base of the anterior rays of the first and second dorsal fins.

Cheltenham, July 4 FRANCIS DAY

Swallows

If "E. H." will take down a swallow's nest (*Hirundo urbica*) directly after the young brood has left it, he will find the lining swarming with two species of active insects altogether out of proportion as to size of the swallow on which they are parasitic. At the same time also the nest contains numerous ovate *pupæ* as black as jet, evidently the offsprings of the insects which, if kept during the winter following, will develop into wonderfully active wingless *imago*, which, when liberated, are difficult to capture and kill. These are the gnats, &c., to which "E. H.'s" informant alluded, but they approach in size nearer to sheep lice. Under the microscope they are interesting objects. Circulation can be watched, and in addition to a peculiarly-formed head, pointed rudimentary wings can be seen in shape much like the swallows. It appears to me that swallows do not hatch their parasites on their bodies, but incubate them in the lining of their nests; but a high degree of heat is not necessary to develop the pupa. In my opinion there is no design or intention on the part of the swallow to breed or cultivate parasites for consumption during migration. The life of the parasite depends on the existence of the swallow, and not the swallow upon the parasite. At the present time I have nests in the corners of my windows, and when the migratory season arrives I can safely rely upon a collection of insects and pupa from them which I would gladly send to any of your readers who care to write for them about the middle of autumn. WM. WATTS

Piethorn, Rochdale, July 4

SWALLOWS are infested by at least three genera of parasitic two-winged insects, *Ornithomyia*, *Stenopteryx*, and *Oxypterum*. Figures of these flies may be found in F. Walker's "Insecta Britannica Diptera," vol. ii. Tab. xx. O. S.

Heidelberg, Germany, July 4

"The Evolution of Vegetation"

AS the science of botany is interesting to many people according as it throws light on biological questions, perhaps just now, while the Darwin Memorial is still fresh in your mind, you will allow one of the many to make known a want by inserting this letter in your paper.

Prof. Bower, in his article, NATURE, vol. xxxi. p. 460, seems to tell the young botanist to go to the other side of the globe in order to find fresh fields of labour. This sort of work, I should think, is very much needed; but if Prof. Bower or some other master in the science would publish his views relating to the evolution of vegetation, perhaps another motive would be added for the enterprise. I hope I am not asking too largely, though aware that men who have won good reputations may hesitate to print their theories. Yet a Parker has given us "Mammalian Descent," and, what he has done to teach us in one direction, surely some one else will in another.

On pp. 4 and 5, "Mammalian Descent," we are told that there are three groups of workers all labouring to build up the truth as it is in Darwin—the zoologists, the palæontologists, and the embryologists. Now there are some botanists who would gladly make a fourth group if a teacher would arise to direct them where and how to work, even if that work was with the zoologists in the land of the Monotremes or at home with the embryologists watching the development of plants, though the plants were of cellular tissue only.

I do hope that I have not written to you in vain.

Bradford, June 23 J. CLAYTON

Foul Water

ALLOW me to call attention to the fact every year—generally some time in May—the sea-water on this coast becomes in a condition that fishermen call "foul." It is due to the presence of enormous quantities of gelatinous masses of small size and spherical, cylindrical and irregular forms, in which nucleated granules are imbedded. After immersion, even for a few seconds, ropes, nets, &c., feel as if they had been dipped in thin glue.

The men allege that this "foul water" has an injurious effect upon their tackle, and also lessens their take of some kinds of fish. It continues for about a month and then disappears. This year I have had and still have some of the organisms under microscopic observation, and I am very anxious to know if they have already been the subject of scientific inquiry, or not; and also information as to the geographical extent of their diffusion.

Sheerness-on-Sea W. H. SHRUBSOLE

Composite Portraits

IT is most unfortunate, but an obvious fact, that in the sheet of composite portraits of American notabilities in NATURE of June 25, Figs. 2 and 3 are impressions from one and the same negative. Not only are they alike, but they present the same peculiarities, even the same defects. If it were not so, they would serve to blow to shivers the whole edifice founded upon such averages; for if 16 naturalists and 31 academicians present two composites which are indistinguishable, to what purpose is the average? C. M. INGLEBY

Athenæum Club

IRIDESCENT CRYSTALS OF CHLORATE OF POTASH

THE appearance of Mr. Madan's paper in NATURE, vol. xxxii. p. 102, induces me to offer some additional remarks on this subject.

In the discussion that followed the reading of my paper Mr. Crookes referred to the closely analogous spectra exhibited by opals, as described in his paper (*Proc. Roy. Soc.*, vol. xvii.). This paper, though it came before me at the time when it was read, was not in my mind when I wrote my own. I called shortly afterwards at Mr. Crookes' house, and saw the spectra of his opals. Supposing that there were sufficient grounds for the commonly received idea that the colours of the opal are due to fine tubes in the mineral, we did not at the time conceive that the phenomena could be the same; were it not for this, I should certainly have added to my paper a reference to that of Mr. Crookes.

Mr. Crookes was so good as to lend me his opals for more leisurely study. The further examination has so impressed me with the similarity of character of the spectra, that I am strongly disposed to think that the colours of the opal and those of the chlorate crystals may be due to the same cause. This does not, however, lead me to attribute tubes or striæ to the chlorate crystals, the structure of which can comparatively easily be made out, but to doubt very greatly the theory which attributes the colours of opal to fine tubes.

Mr. Madan does not profess to have actually seen in the chlorate crystals such tubes as he supposes to exist, nor could I see anything of the kind on examining some of the crystals I have got after the appearance of his paper. On the other hand, I notice that Brewster did not state that he had actually seen the supposed tubes, but merely inferred their existence from a comparison of the appearance under the microscope of the precious opal with that of hydrophane. And Mr. Crookes tells me that an opal is not spoiled or affected by being immersed in water or even oil. The fact is that it is extremely difficult to make out what the actual structure is with which we have to deal in the case of the opal, whereas in the case of the chlorate crystals it is unmistakable. Moreover, in the case of the chlorate crystals there is a wonderful uniformity in the phenomena presented by the same crystal, extending, it may be, over nearly the whole of even a large crystal, whereas in the opal the colour extends over comparatively small patches; and even a single patch is seen under the microscope to present differences of structure in different parts. Hence if the colours in opal and those in the chlorate crystals are really due to a similar cause, it seems much more likely that a study of the phenomena of the chlorate crystals will throw light on those of the opal, than that the phenomena of the opal should furnish the key to the explanation of the colours of the chlorate crystals.

In truth, I do not see how the presence of tubes, if such there be in the opal, would account for the phenomena, and especially for the very peculiar spectrum exhibited. The supposition of the existence of rows of tubes leads one to look in the direction of diffraction. But I do not see how monochromatic light, or, at least, light almost monochromatic, can be obtained by diffraction. And even independently of this consideration there is one feature of the production of colour in the chlorate crystals which shows, at once and decisively, that at least in *their* case the colour cannot be due to diffraction. If an iridescent crystal be chosen with an even surface, and the flame of a candle in a dark room be viewed by reflection in it, it is found that the colour is seen in the direction of the regularly-reflected light. In fact, the coloured light forms a well-defined image of the flame of the candle, coinciding with, or overlapping, the colourless image due to reflection from the first surface. This differs altogether from what we get in the case of a grating, or in that of mother-of-pearl or Labrador spar. It agrees so far with the colours of thin plates, or the colours shown by reflection by certain quasi-metallic substances, such as several of the aniline dyes, though the production of colour in these three cases is due to three totally different causes.

It has been conclusively proved that the seat of the colour in the chlorate of potash crystals is in a very thin twin stratum; and I entertain myself little or no doubt that the colour depends in some way on the different orientation of the planes of polarisation in the two components of a twin, and on the difference of retardation of the two polarised pencils which traverse the thin stratum. But anything beyond this is at present only a matter of speculation. I see only two directions in one or other of which to look for a possible explanation; but as these could only be propounded at considerable length, and the matter has not at present advanced further, I refrained from saying anything about it in my former paper, nor will I further mention it here.

In conclusion, I would mention an interesting paper on "The Spectrum of the Noble Opal," by Prof. H. Behrens, a copy of which I have just received by the kindness of the author. In this paper, which is printed in the *Neues Jahrbuch für Mineralogie*, &c., 1873, the author, who was evidently unacquainted with Mr. Crookes's paper when he wrote his own, has described and figured the peculiar spectra of several opals. G. G. STOKES

EXPERIMENTAL FARMING

ENGLISH farmers are not readers. They do not know, apparently, that there is much to unlearn in the practice of their art, old as it may be. But although they will not allow themselves to be enlightened by books or newspapers, they are not incapable of imitation, and for that reason experimental farming, carried out in any particular district in a practical manner, has always proved useful. Up to the present time the history of experimental farms in England is, so far as their number is concerned, a meagre one. In the whole of Europe there are 160 experimental farm stations, of which number the United Kingdom can boast of about half a dozen, including Rothamsted; Woburn, which, by the Duke of Bedford's munificence, has become a field of experiments for the Royal Agricultural Society; the stations of the Highland and Agricultural Society, of the National Board of Education in Ireland, and of the Agricultural Association of Sussex. It is a characteristic feature of our English system that the State lends no assistance to either of these establishments, while that of Sir John B. Lawes, at Rothamsted, has been conducted for many years on a princely scale by the owner at his sole cost.

The Rothamsted station, founded in 1843, has become the most prominent teaching establishment in the world. There is not a single point of interest connected with the cropping and manuring of the land, the forming and treatment of pastures, and the feeding of animals, which has not been made the subject of exhaustive experiment at Rothamsted, while the silo experiments which have been lately undertaken for the purpose of testing the value of ensilage, will probably do more for the instruction of those land-proprietors and large farmers who are watching them than all else which has been said or done in regard to this much-praised cattle food. It would be strange indeed if agriculturists refused to listen to Sir John Lawes, but although certain facts of prime importance in the long catalogue of useful lessons from Rothamsted have been widely distributed, the voluminous writings of the great experimenter, trusted as he is, are not read by one per cent. of those on whose behalf they were undertaken. Some of the more important teachings of Rothamsted have become so familiar that they have passed into agricultural axioms, such as "phosphorus for turnips, nitrogen for corn." We have ourselves known farmers who have travelled a hundred miles—a long flight for such men—for the purpose of seeing for themselves at Rothamsted how corn might be grown continuously by means of small dressings of nitrogenous manures, and thus they have solved a problem of vital importance to themselves and their families. But comparatively few farmers will trust themselves so far from home, even on a matter of life and death, and it has become a business of grave importance to the rent-receiving portion of the landed interest to convey to the rank and file of tenant farmers the necessary knowledge which they are too inert and ignorant to acquire for themselves.

In the hope of teaching farmers, the Royal Agricultural Society, the Bath and West of England Society, some landlords in Sussex, and others, are endeavouring to increase the number of experimental farms. Minds that are entirely untrained or ignorant can only be taught orally or by imitation. Put an attractive story into the hands of an ill-instructed boy, and he will soon lay the book aside; but, read or relate the story to him, and he will probably be found a fascinated listener. It is the same with farmers and scientific farming. They cannot learn from books, but they will listen to the story by word of mouth. The leading agricultural societies are therefore making a timely move in considering the best methods of teaching farmers by example—that is, by the multiplication of experimental farms. Lectures delivered by professors, and listened to with stubborn incredulity, are of little use compared with experiments tried by the roadside and discussed at the market tables of the neighbourhood. It is gratifying to notice, therefore, that at a recent Council meeting of the Royal Agricultural Society a new departure was announced in the appointment of a committee to consider how the National Society could best co-operate with local societies in carrying out investigations into subjects of practical utility in agriculture. An additional reason for multiplying stations is that, in consequence of the variation of climate and other causes, farming is conducted under different conditions in the several districts. In one locality, for example, the special problem to be solved may concern the management of grasses, in another that of corn. In all alike the object of the teachers of agriculture must be to substitute, so far as may be possible, the rule of three for the rule of thumb at present in vogue.

At Rothamsted the experiments of the past forty years have related to the growth of continuous crops year after year on the same land, to the growth of crops under rotation, to the use of every kind of artificial manure, or of farm-yard dung, in varying quantities on every kind of crop, and, for the sake of comparison, to the omission of all manure on some of the land, to the manuring of permanent pasture, fallowing, the use of various feeding stuffs, town sewage, the question whether plants assimilate free nitrogen, ensilage, rainfall, and the waste of nitrogen in land-drainage water. It has been stated that some of the elaborate investigations which have been conducted at Rothamsted are too "scientific" for humbler establishments. If by science we mean a complete knowledge of facts the phrase is hardly accurate, but no doubt some of the Rothamsted experiments were accompanied by the analyses of animals, plants, and soils, and could not therefore be repeated at ordinary stations. On the other hand, the most useful experiments for the instruction of farmers are those which relate to the effects of the different foods employed for plants and animals, and in these cases farmers can themselves form estimates of the results which will prove sufficiently accurate for practical purposes and may lead to the saving of millions which are now annually wasted through the ignorant use of manures and improper feeding of animals.

H. E.

ELECTRICITY AT THE INVENTIONS EXHIBITION

The Secondary Generators of Messrs. Gaulard and Gibbs

HITHERTO there have been two means employed for electric illumination and the electric transmission of energy—viz. supplying the electricity required for the lamps or other receivers (1) direct from the dynamo machines, and (2) from secondary batteries charged by means of dynamos. A third method has been recently introduced, by means of secondary generators, of which a small installation has been made at the Inventions Exhibition, to which we propose to refer in this article.

The object of this invention is to supply a current which may be varied at will both as regards electromotive force and quantity, and thus be made applicable to work at the same time arc lamps, incandescent lamps, and motors. The means by which this result has been effected is by interposing between the dynamo machine and the lamp or other receiver of electricity a supplementary apparatus, by the use of which an induced current is produced proper to the particular receiver which it is desired to work.

The National Company for the Distribution of Electricity by Secondary Generators, which works the patents of Messrs. Gaulard and Gibbs, originally used secondary generators of the following construction. They were composed of a thick insulated copper wire, surrounded by smaller coils formed of a number of thin insulated copper wires; the thick central wire receiving the current from the dynamo, which was distributed through the secondary wires. This method of construction has been replaced by one of exceeding simplicity, in which the difficulty of insulation and complication of manufacture of the original form are done away with.

The conductor for the primary current and the conductor in which the induced current is produced consist of a series of annular disks of sheet copper $\frac{1}{4}$ millimetre in thickness and $3\frac{1}{2}$ centimetres in width, slit across at one part and furnished with projecting pieces extending outwards on either side of the slit. The conductor for the primary circuit is made up of a series of these annular disks, and the conductor for the induced current is made up of a second similar series, the two series being so interlaced that the convolutions of the helix formed by the disks for the primary circuit alternate with the convolutions of the helix formed by the disks of the induced circuit. An annular disk of insulating material, such as paraffined cardboard, is placed between each convolution of the double helix thus formed, so as to prevent short circuiting between the helices and the several convolutions thereof, and the projecting pieces of all the disks for the primary current are soldered or electrically connected together, and the projecting pieces of all the disks for the induced current are similarly electrically connected. In constructing the secondary coils, they are fixed together between two insulating surfaces by bolts and nuts, the projections by which the several conducting disks are connected projecting helically or spirally around the coil (the projections of the primary alternating with those of the secondary coil), and form convenient means for connecting up any number of convolutions as required.

The end disks of one of the helices thus formed are connected to the leads of the primary circuit by binding-screws, and the end disks of the other helix are similarly connected to the leads for the induced or secondary current. In the centre of the disks is a hollow cylinder of paraffined cardboard or other suitable insulating material, around which the helices are arranged, and in this cylinder is a core of soft iron, or of soft iron wires, which is capable of being automatically raised and lowered in the cylinder, so as to regulate as required the current passing through the coil.

The main wire from the dynamo is connected up in series to the primary helices of a group of secondary generators, and, in passing through the primary helices, induces a current in the secondaries, the tension of which, according to the experimental investigations of the inventors, increases first with the intensity or quantity of the primary current, and, secondly, with the rapidity of the interruptions or alternations, or the variations of its potential. Each secondary generator forms a complete installation, and can be put in or out of circuit at pleasure. The secondaries may be connected up in series, in multiple arc, or in multiple series, as desired, the connections being readily altered by means of a switch-board; tension or quantity is thus obtained according to the nature of the current required. The lamps or other receivers fed from the secondary generator can be connected at will to their respective circuits, and are also independent of one another.

These generators are made to work in connection with alternate-current machines, because the latter can be constructed up to almost any power, as no two parts of the machine having great difference of potential need be in close proximity, and the alternation of current may be made as quickly as desired. The generating dynamo is so constructed and operated that the quantity of current is preserved constant, and the tension is varied to carry this current through the primary conductor against the varying counter electromotive force due to variations in the work done in the secondary circuits of a number of secondary generators. If W represents work, C current, E electromotive force, and R resistance, and if either of these factors be changed, the others must be altered in the same ratio, according to the formula—

$$W = CE = C^2R = \frac{E^2}{R},$$

if uniform effects in the secondary circuits are to be desired.

One of the chief characteristics of this system is that if the primary current be kept constant the loss due to resistance remains fixed, no matter what energy is transmitted—so that if an increase of energy is desired, the only factor that has to be increased is the electromotive force, which bears no ratio to the loss in the conductor. This circumstance is of importance in any house-to-house lighting scheme, where a conductor may be laid down to supply a certain area, and if the lights are not taken up at once, the necessary current can be supplied later within the limits of the dynamo, by increasing the electromotive force, without increasing the size of the conductor, the strength of the current, or the loss in the line.

As regards the very high potential required upon the secondary generator system, the danger is limited to the supply station, as between the two poles of the main dynamo there is an unbroken metallic circuit, which maintains the continuity of the flow of current; and as regards each secondary circuit the work done is represented by a secondary generator, and the only danger would be in grasping both primary terminals at once, which may be made impossible of performance. It will be necessary as regards the dynamo that it shall be insulated from the earth, and also that such parts of the circuit as carry high tension electricity shall be so protected that it shall be impossible to make contact between them and the earth.

In comparing this system, in which there is a loss in the transformation of the energy by the secondary generator, with the direct system, this loss will have to be balanced against that caused by resistance due to distance, whilst as regards the regulation of the supply of energy, this is effected by means of a regulator working the exciting machine of the dynamo at the station; by its means, when a secondary generator is cut out of circuit, a proportionate amount of power is saved. The secondary generators also regulate the energy absorbed, so that a perfect control of power is obtained, which is especially important for domestic supplies of electricity, as, when a suitable current measurer has been designed, consumers will be able to pay simply according to the amount consumed.

At present the extreme northern end only of the East Arcade at the Exhibition is being lighted on this system; it is proposed, however, to extend it to the full length of the East Arcade and to the concert-room.

THE AFGHAN DELIMITATION COMMISSION

We are indebted to the courtesy of the Kew authorities for the opportunity of publishing the accompanying letter from Surgeon-Major Aitchison, C.I.E., F.R.S., which gives the most recent account of his work as naturalist to the Expedition:—

Camp Tir-Phul, Northern Afghanistan,
6 miles from Khusan

Dear Sir Joseph Hooker,—

I am now able to write to you with some pleasure, as I have been able to put together this year some 300 species in all. The last 100 I obtained on a ten days' trip that I made from this camp. I left this on April 25 under very bad auspices, as it had blown all night and was blowing a terrible gale with every chance of a heavy fall of rain from the north. But I started and got as far as Khusan, in the vicinity of which, beside the ruins of an old "serai," I halted. I picked up a few odds and ends, the chief attraction was the *Rosa margerita* (if a new sp.) *mihi.* It covers the whole country in localised patches, and being very dwarf in habit, not above 2 feet, the flowers are seen to perfection; they open out expanding almost flat, when the brilliant eyes, formed by the claret colour of the bases of the petals, gives it quite a character. Amongst my rose hips sent to you last year this was one of the species. I hope to be able to supply you with a lot more, it would make a lovely flower border.

I marched next to a place on the right bank of the Hari-rúd River opposite Tomăn-ághá, fifteen miles. Our route lay over a plain that had once been the bed of the river where the river had made a great bend; the river, after silting up this bend, had left it. The most characteristic plant here was a Rhubarb, usually with 3-root leaves of immense proportion for the size of the flowering stem; these leaves are so pressed flat to the ground that it reminds one more of the *Victoria regia* leaves (without the margin), and this is the habit of the plant; the plant was fruiting, having large winged fruit of a most brilliant scarlet; it will make a grand thing in gardens. The beautiful colour of the fruit is much helped out by the splendid green of the leaf background. There are, one may almost say, no leaves on the flowering stem—one or two most minute. I measured one of the largest on the ground: it was 4 feet from the base to apex and 5 feet across; the other two with this one were a little smaller; the three together gave it a very curious look. I hope soon to get the seeds home. I have collected a good deal of the root; it is called "Fool's Rhubarb" owing to its purgative qualities, and curiously enough the fruit is employed in preference to the root as a purgative, given as a decoction. With the exception of an occasional woody shrub that may rise to five feet, the place was covered with a species of Artemisia (probably several) about 2 feet high, and occasional Umbelliferæ. There were no trees of any sort: these are only to be found in the river bed—viz. *Populus euphratica*, and two species of Tamarisk and a Lycium. At Tomăn-ághá, in the bed of the river, was a woody salsolaceous shrub which I do not know. I got good specimens of the wood and flowering branches.

I left Tomăn-ághá on the 28th, passing the remains of some old ruins two miles from my encampment, and turned east by north towards "Galicha" (a carpet). As we marched along, fancy crossing the markings of two pairs of carriage wheels! These had been made some months ago by the carriage of a Persian Prince who had come to our camp at Gulran to be doctored The route lay now across towards the base of the Paropamissus range over a most extensive plain on which the attraction was a miniature forest of a species of Umbelliferæ, excessively like, but not the, Assafœtida. This was in full bloom, the stem and flowers being at first all of a light orange yellow; as the fruit ripens, the whole colour changes to a russet brown. Each flowering stem is from 3 to 5 feet high, and there are usually 50 plants to 100 yards square, the interspaces being altogether filled up by a grass of a foot in height. On the 29th, left Galicha for the Kambao Pass to enable me to cross through the range. Our march lay over a plain the continuation of that of yesterday, and which from its extent is lost to the sight. This is celebrated as the plain of the wild donkey, and here I counted sixteen herds of at least 10,000 in each. The nearest was a mile off, and their presence was recognised by a cloud of dust rising in a swirl on their galloping—like the smoke from the chimney of a steamer. It was a most extraordinary sight, watching these clumps moving from place to place. They are occasionally shot and eaten. I forgot to tell you that, except my own party, there was probably not a human being within thirty miles of us. The country has *no* inhabitants, and until the nomads turn up with their flocks from the lower regions it is a desolation. The last part of our march was for six miles within the ridges of the base of the hills, and here in the stream beds Tamarisk was the only (woody) shrub. I halted some five miles to the west of the pass, hoping to make a great haul on the 30th. From the moment of entering these valleys they seem a mass of colour—one from buttercups (one species only), another from a poppy; the bed of the stream purple with a tall onion, and the interstices green with one grass. I had previously got most of the things so promising here, but saw signs of getting into a very fine new lot. On the morning of the 30th a regular hurricane of wind blew from the north, so that I thought the best plan would be to move my camp across the pass, and get a better and more sheltered locality. I just managed to get to the north-east side, when it *did* come down—such a torrent! but as all preparations had been made we were comfortable; had I remained on we must have been swept out of our old camp.

May 1 proved a most superb morning, so I was up and out at 6 a.m., went straight back to my old encampment on the west side, and from there collected back. I got some thirty-five species—a second Arum; a Prunus; an Elæagnus, of which I sent you the fruit last year; one Pistachia bush, a large number of Astragali, which I feel sure will stump Baker; a curious Rubiaceous shrub, a fine Orobanche, only five grasses, and a most lovely everlasting pea, like the ordinary English cultivated one, only dwarf. I believe everything here is dwarfed by exposure to the winds. You cannot understand the difficulty I have with it in collecting. To save my plants at all, I have to put them *at once* into paper. It takes three of us to do this, and not allow paper or plants to blow away. I must say it does not improve one's temper.

I got one or two species of a very nice Gentian like *Gentiana Kurroo* of Royle, the altitude of Hari-rúd River, 2000 feet; Kambao Pass, west side, 2900 feet; pass itself, 3550 feet; Kambao on north-east, 3250 feet. Not a fern of any sort, not even Ophioglossum, which I looked upon as a certain find. I spent my second day—viz. May 2—at the camp on the north-east side of pass; here there is a fine hawthorn, from which I collected flowers in bud on the 1st. Along the whole of this range, well within it, where the water is sweet and the air cool, the hawthorn, a common plum, and *Amygdalus eburnea*, are more or less plentiful. I picked up an Oxygraphis, and a very pretty geranium with a most curious potato-like root, only the tubers are heaped up on each other when there is more than one to a plant. You know they made me naturalist, so, in addition to collecting plants, I have to shoot poor little birds, and I hate it. I got two bee-eaters, the one more lovely than the other, and a nightingale.

On the 3rd I marched to a place 8 miles nearer our first Gulran encampment. I had picked up most of the cream, and there was not much, except additions in the way of fruiting species, to be made. This I did, and got a venomous snake which may be a cobra—all but walked on to him—5 feet long and 6 inches at his thickest, fangs three-quarters of an inch; a most unpleasant fellow to meet. I shot him, and after fancying I had killed him, cut off his head and neck to keep (I could not keep his whole body), when lo! his body, minus his head, walked off searching for escape, the head trying to fang its own neck.

On the 4th I moved still east-by-north some 12 miles to our first encampment at Gulran. I got some nice things *en route*, and had just ticketed and arranged them preparatory to great work for the morrow, when in came a letter from Sir Peter Lumsden telling me to return at once. Alas for my great expectations! I packed up, and we moved camp at 2 a.m. on the 5th, marched up the valley, passing our second Gulran encampment, and on south to the east-by-north side of the Chashma-sabz Pass. I had no time to halt and collect. I passed a Gladiolus and an immense number of things. On the pass I collected the "Siah-chot," which is to me, in all probability, *Cotoneaster nummularia*. I had collected its fruit and sent it to you from these very bushes. I got it in this pass last year. It is from this shrub that "Shir-Khist," the manna of these parts, is collected. I have sent you a bottle of it packed amongst some other things. They have two other kinds—one from a Tamarisk and the other from Alhagi. I myself collected it from a Salsola. I got across the pass by 2 p.m.; halted until 8 p.m. and got into Tir-Phul at 8 a.m., the camels at 10 a.m. of the 6th; did 60 miles in 34 hours—good going for camels, and men more or less on foot.

I am glad I am in, because my plants had to be looked to. I got, as I said before, 100 species in this tour, not less than 1200 specimens. It is much harder work than Kurram; the fact is, I am not younger, and my back wants a good deal of oiling.

Yours very truly,

J. E. T. AITCHISON

AN OLD DRAWING OF A MAMMOTH[1]

As an addendum to the historical review of the mammoth discoveries in Siberia and the traditions to which they have given rise, which I have rendered in the "Voyage of the *Vega*," I have the pleasure of presenting a curious drawing of the animal, discovered among the Benzelian MSS. in the Linköping library. My attention was directed to the original by the president, Herr Hans Forssell, who, in his memoir of Erik Benzelius the younger, has given an account of the proceedings which it occasioned in the Upsala Scientific Society.[2]

The drawing bears the following inscription :—

"The length of this animal, called Behemot, is 50 Russian ells; the height is not known, but a rib being 5 arsin long, it may be estimated. The greatest diameter of the horn is half of an arsin, the length slightly above four; the tusks like a square brick; the foreleg from the shoulder to the knee $1\frac{3}{4}$ arsin long, and at the narrowest part a quarter in diameter. The hole in which the marrow lies is so big that a fist may be inserted, otherwise the legs bear no proportion to the body, being rather short. The heathens living by the River Obi state that they have seen them floating in this river as big as a 'struus,' *i.e.* a vessel which the Russians use. This animal lives in the earth, and dies as soon as it comes into the air."

On the reverse of the drawing we read :—

"This drawing and description is given by Baron Kagg, who has just returned from captivity in Russia and Siberia,[1] 1722, in Decembri."

This drawing was exhibited by Benzelius at the meeting of the Upsala Scientific Society, December 14, 1722. The statement referring thereto in the *Journal* of the Society is as follows :—

"Herr Benzelius exhibited a good drawing of an animal, transmitted by Baron Kagg, who has just returned from captivity in Russia and Siberia, which the

Siberiaks call Mehemoth or Mammont, which has caused many to believe that it was identical with Behemoth of Job. Herr Prof. Rudbeck and Dr. Martin maintained that it was a sea animal, moreover as Herr Kagg stated that it was found at the River Obi. To this was added that Capt. Lundius had said that its bones were mostly found in the earth by the river. With regard to the animal being drawn with claws, Prof. Rudbeck pointed out that as yet no animal *cornigerum* had been found also to be *unguiculatum*, without being *palmipes* or having skin between the toes like geese, &c. It was decided to write to Herr Kagg, requesting some information about the figure, and asking how he had obtained it, so that it might be ascertained whether it was reliable. There is a description about this Mehemot in Capt. Müller's account of the Ostiaks."[2]

At a later meeting, January 11, 1723, Dr. Martin stated that he had carefully examined works of zoology, whether there existed any sea animal like that shown at the last conference, but had found nothing like it, although the head—excepting the horns—and probably also the feet and the tail, were like those of the hippopotamus of the River Nile. At the same meeting Benzelius announced that Lieut.-Col. Schönström had promised to forward a whole tusk of this remarkable animal.

On later occasions too the animal was discussed by the Society. Thus on January 18, 1723, a letter was read from the learned linguist, Sparfvenfelt, wherein he explains the derivation of the words Behemoth and

[1] Published in *Ymer* (Journal of the Swedish Anthropological and Geographical Society), 1884. Parts 7 and 8. (Translation communicated by the Author.)

[2] "Svenska Akademiens handlingar" (*Proceedings* of the Swedish Academy), Part 58. Stockholm, 1883, p. 315.

[1] Major L. Kagg was taken prisoner at the River Dnieper in 1709, and brought to Tobolsk, whence he returned in 1722.

[2] J. B. Müller's "Leben und Gewonheiten der Ostiaken unter dem Polo Arctico wohnende," &c. Berlin, 1720.

Mammont; on February 15 a letter was read from Benzelius, stating that Kagg had received the drawing from a Capt. Tabbert, and that he could give no information as to its correctness. Again, on October 3, Benzelius exhibited a large bone, almost petrified, which was the jaw of a Mammont, or as it was called Behemoth, received from Tobolsk in Siberia, through Capt. Clodt von Jürgensburg, and, on November 22, Benzelius exhibited "part of the tusk of a Behemoth, which was exactly like ivory." Finally, Benzelius communicated with the Russian Chief of Mines, Tatischew, who, in a letter dated May 12, 1725, had given long and important information of the history of the mammoth. This letter is printed in "Acta Literaria Seciæ" (vol. ii. p. 36, 1725).

A. E. NORDENSKIÖLD

NIAGARA FALLS: THE RATE AT WHICH THEY RECEDE SOUTHWARDS

THE diagrams are from the map issued by the New York Commission for the establishing a State reservation at the Falls, based on surveys made in August and September, 1883, by Thomas Evershed, under direction of Silas Seymour, State Engineer and Surveyor. The scale of the diagrams is one half that of

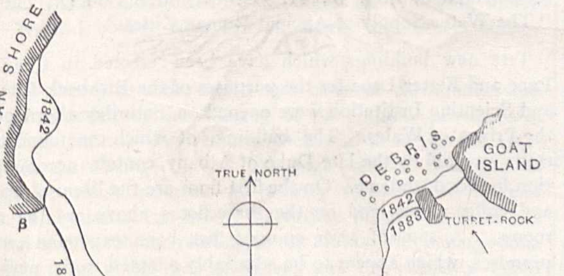

Fig.1.

the map, which is on a scale of four chains to the inch. To have given all on one diagram with the intervening Goat Island would take up nearly an entire page of NATURE, and if the scale were smaller it would fail to show clearly the distinctive features of the changes in progress. Fig. 1 shows the Canadian or Horse-Shoe Fall, Fig. 2 the Eastern or so-called "American" Fall—a misnomer too deeply rooted in usage to be now supplanted by some more fitting name.

The rate at which the Falls are receding has been a matter of interest to geologists for over fifty years, but the results so far reached have been conflicting and inconclusive. The manner in which the Falls work backward, undermining their brink, is so well known from Lyell's clear description, that I shall not repeat it.

In 1830, Bakewell, on the basis of such information as he could gather from old inhabitants and from his own observations, concluded that during the previous forty years the Falls had receded at the rate of three feet per annum.

Lyell, from such materials as he could obtain during his own visit in 1841 and 1842, estimated the annual retrograde motion at only a foot. It is sufficient to recite such discordant results arrived at by two careful investigators to show how imperfect were the materials at their disposal, nor will any one who has been on the spot wonder at their differing so greatly. It would be possible to roughly compute the southward movement of the innermost recess of the Canadian Fall by referring its position from time to time to some fixed points on the adjoining shore, but any conclusive determination of the movement of the entire Fall could not be obtained in this way. The map referred to gives the outline of the Falls as determined by three surveys: the New York Geological Survey of 1842, the U.S. Lake Survey of 1875, and Evershed's Survey of 1883. The contours of the brink as established by these enable us to measure the total movement.

I divide the contour from β to Goat Island into thirty-three sections, disregarding for obvious reasons the overflow north of β, on the Canadian shore. From β to ε are eleven sections, from ε to ζ are twelve sections, from ζ to Goat Island are ten sections. It is obvious that much the greater work has been done between β and ζ, and that the innermost recess has kept in the same relative position.

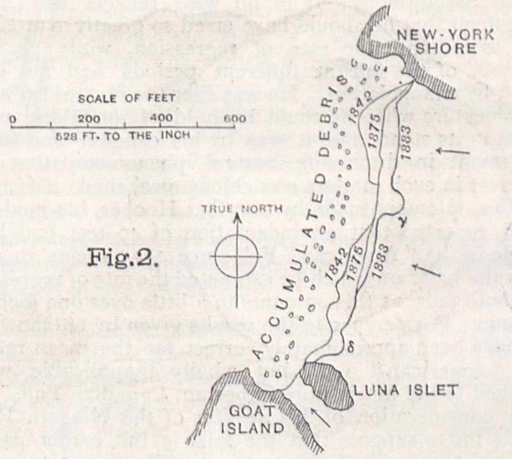

Fig.2.

The means of the measurements on the sections, along perpendiculars from the contour at the date of each survey, measured on a tracing of the published map, give the following results for the Canadian Fall:—

	33 years ending in 1875 ft.	8 years ending in 1883 ft.	41 years ending in 1883 ft.
Mean aggregate recession along contour of 2000 feet, from β to Goat Island = ...	80 ...	— ...	114
Mean aggregate recession along contour of 1200 feet, β to ζ = ...	— ...	60 ...	—
Mean annual rate of regression along the whole contour where a visible change was effected = ...	$2\frac{1}{2}$ ...	$7\frac{1}{2}$ ...	$2\frac{3}{4}$
Total maximum regression at the innermost recess = ...	118 ...	135 ...	253
Annual rate of maximum regression =	$3\frac{3}{5}$ ...	$16\frac{1}{2}$ ...	$6\frac{1}{6}$

The "American" Fall, measured in ten sections, gave a total mean recession of $37\frac{1}{2}$ feet in the 41 years ending in 1883, which is at the rate of about 10 inches per annum.

I do not know that I have seen any estimate attempted of the relative volumes of water passing over the two falls. From such imperfect data as I have, referring to depth and swiftness, I should think that the rate of erosion for each fall gave some approximation to the volume of water discharged over each; that is to say, $2\frac{3}{4}$ feet per annum for the Canadian Fall, $\frac{5}{6}$ foot per annum for the "American" Fall, would signify that the former pours over its brink three times as much water as the latter.

At the rates of recession above shown it is evident that at no very remote age the two falls were united in one when abreast of the point in Fig. 2 marked "New York Shore," and the entire width was about the same as that of the present Canadian Fall alone. Moreover, the mean width of the fall, from the time it commenced its work at the "heights," seven miles below its present position, according to Lyell's statement as to the gorge of Niagara River, was not greater than the present Canadian Fall. Adding together the present work done by both falls, we should have about $3\frac{1}{2}$ feet per annum as the backward work performed when the entire volume poured over a single fall of the width of the present Canadian Fall.

At this rate 10,000 years would seem sufficient time for the cutting out of the present gorge terminating at the "heights" towards Lake Ontario, instead of Lyell's estimate of 35,000 years. All attempts to calculate the rate of movement proceed on the assumption that the hardness of the lime-rock and shale, the volume of water, and the height of the fall, were, for the whole distance, much the same that they now are; I merely use these same assumptions. It in no wise reflects on Lyell's judgment that he should have erred so greatly in attempting to estimate the rate of regression, while yet the contour of the fall at different periods had not been fixed by triangulation. He was ever the first to lay aside a conjecture when he could lay hold of something more solid in its stead, and it was by his candour and sound judgment in discussing natural phenomena that my interest in such matters was chiefly awakened.

The statement made by him that Hooker, his guide in 1841, reported that an indentation of 40 feet had been made in the "American" Fall since 1815 seems to contain the basis on which he estimated the rate of regression for both falls, as this amounts to a little over one foot per annum. A reference to the results given by me show this to have been approximately correct for the mean rate at the "American" Fall, but wholly inapplicable when applied to the much more important Canadian Fall.

A consideration of his section of the Niagara River leads me to suppose that the falls in the earlier part of their history worked even more rapidly than now in undermining the brink, but I will not venture further upon your space at present. EDWARD WESSON

Providence, R.I., U.S.A., June 1

NOTES

THE Hon. William Macleay, one of the members of the Senate of Sydney University, has undertaken to give four fellowships, of 400*l.* a year each, for natural science, and to bequeath a sum sufficient to endow them permanently. In order to prevent any sleepy Fellows, we are told, from being quartered on this foundation, he stipulates that they must all have taken the degree of B.A. in the University, must be actively engaged in original study and research, and must not hold any other lucrative appointment, and the appointments are to be renewed every year, so as to give an opportunity for correcting any abuse.

THE Darwin Medal—founded by the Midland Union of Scientific Societies in honour of the great naturalist, and for the encouragement of original research—has been awarded for the current year to Mr. W. J. Harrison, F.G.S., of Birmingham.

THE long excursion of the Geologists' Association this year will be to Belgium (the Meuse and the Ardennes, Brussels, Dinant, Namur, Liége, Maestricht), under the direction of M. Ed. Dupont (Director of the Museum, Brussels, and of the Belgian Geological Survey), Prof. A. Renard, Dr. E. Purves, and Prof. J. Gosselet. The party will meet in Brussels on Monday, August 10, and will proceed the same evening to Charleroi. Further particulars as to fares, routes, &c., will be given in a special circular, which will also contain full particulars of the geology, with illustrations and references. The total expense during the five days of the excursion (Tuesday to Saturday) will vary from 15*s.* to 20*s.* per day for each person. This will include conveyances; also a special steamer on the Meuse, stopping at the various points of interest. By this arrangement much can be seen in a short time. The papers on the geology of Belgium read at the July meeting will be printed, with map and illustrations, for the use of the members during the excursion. Those proposing to join this excursion are requested to give early notice to the Secretary, who will supply further information if required.

A MONUMENT was unveiled last week at the École Normale, Paris, to Dr. Thuillier, the member of the French scientific mission to Egypt who died of cholera at Alexandria in 1883.

THE anniversary meeting of the Sanitary Institute is held today at the Royal Institution at 3 p.m. The chair will be taken by Sir John Lubbock, Bart., D.C.L., F.R.S. An address will be delivered by Prof. W. H. Corfield, M.A., M.D., entitled "The Water Supply of Ancient Roman Cities."

THE new buildings which have been erected in Chancery Lane and Fetter Lane for the purposes of the Birkbeck Literary and Scientific Institution were opened on Saturday afternoon by the Prince of Wales. The building, of which the foundation-stone was laid by the late Duke of Albany, contains accommodation for 6000 students. On the first floor are the library, reading and coffee rooms, and on the three floors above are the class rooms. A sum of over 20,000*l.* has been expended on the premises, which appear to be admirably adapted to the purposes for which they are intended.

THE Swedish Government have despatched Capt. R. Nissen to Kiel and Hamburg for the study of the chronometer observatories there and matters relating thereto. A sum of 250*l.* has been further awarded to Capt. Nissen for his valuable meteorological, astronomical, and magnetic observations during the recent cruise of the *Vanadis* around the world. A sum of money has also been granted to Dr. G. Tiselius, for the study during the summer of the attempts in progress in certain parts of Sweden of forest-cultivation from seeds; and a similar sum to Herr L. Baltzer for the drawing of the Runic inscriptions in the province of Bohus. It has further been decided to appoint an agent in London for one year to study and report on the fresh fish trade between Sweden and England, and the means to be adopted for its advancement.

THE Swedish Government have granted Dr. A. W. Liungman a sum of 350*l.*, in addition to his yearly salary, for the study of the herring and herring-fisheries of the west and south coast of Sweden, and the publication of the material collected.

AN unusually bright meteor was observed at Södertelje, near Stockholm, on the night of June 5, at 11.5 p.m. It came from the south, and went in a straight line west-east at about the height of Orion above the horizon. It could be followed with the eye in its course between Sirius and Algol, where it disappeared. The apparent size was one-fifth of that of the moon, and the colour brilliant white.

ADVICES received from Iceland by the last mail are of a very disquieting character. Of the bodies of those killed by the avalanche in February last, twenty-four have been recovered, and the authorities have prohibited rebuilding in the valley. The weather during the spring has been exceedingly bad, snow falling incessantly from May 18 till June 5, and although the sea is open the fishing has in consequence been very bad. Agriculture and cattle-grazing are also very backward in consequence of cold winds and night-frost. In many places cattle have died from starvation, and if things do not soon mend there will probably be famine in the island next winter. In some valleys the snow was 30 feet in depth in the middle of June.

WE have received the report of the Liverpool Naturalists' Field Club for the year 1884–85. Steady, quiet prosperity appears to be the order of the day in this and similar associations in this country and in America. An elaborate system of prizes has been carefully organised, and the society appears exceptional in this respect. The report of the committee draws attention to the fact that in botany alone has much work been done; in the wide fields of zoology, geology, and microscopy little has been done. The presidential address is very interesting; it is called "Ornithopolis; bird-life under the shrubs, and what may be seen from my study chair." For the rest, there are the usual reports of excursions and of the evening meetings, and a list of books and scientific apparatus useful in the pursuit of natural history.

A SHARP shock of earthquake, accompanied by a loud rumbling noise, was felt at Kopreinitz in Styria on the night of June 28, which was followed by two others the following morning. Several houses were thrown down, and other damage done.

A NEW theory as to the origin and cause of earthquakes has been propounded by the Viceroy of the Chinese provinces of Shensi and Kansu. In a recent memorial to the throne, published in the *Peking Gazette*, this high official describes an earthquake which occurred on January 15 in various parts of Kansu, and summarises briefly the various reports which he has received on the subject relating to the motion, the damage done (which in some places was extensive), and the measures taken for the relief of the sufferers. He then proceeds to say that for years past earthquake shocks have been so frequent in these regions that people have grown quite accustomed to them; indeed, one officer informs him that in certain villages there were indications of a movement of the earth every night during the fourth watch, but these always ceased after a heavy fall of snow. The memorialist concludes by attributing the earthquake to the mildness of the winter, which caused an excess of the *yang*, or male element of Nature; "but it was due in a measure also to the perfunctory performance of their public duties by the local officials, who thereby failed to call down the harmonising influence of Heaven, and the memorialist can only endeavour to remedy this fault by encouraging his subordinates to cultivate habits of introspection and examination of their own shortcomings, himself setting the example."

ON the morning of June 15 a lovely mirage was seen at sea from Oxelösund, in Sweden, representing two islands, covered with trees, on one of which there was a building. Two monitors were seen steaming off the islands. It may be of interest to add that two Swedish monitors are at present cruising in the Baltic, and were about that time several degrees further north.

THE second annual issue of the "Year-Book of the Scientific and Learned Societies of Great Britain and Ireland" (Griffith and Co.) has appeared. We must still express surprise at finding the Royal Institution placed alongside of the Royal Society as a scientific society, while the London Institution is omitted entirely. A list of the papers read at the various societies is given this year; but it is difficult to see what purpose the publication serves in its present form.

HERR J. MENGES describes, in a recent number of *Globus*, the language of signs employed in trade in Arabia and Eastern Africa. This appears to have been invented to enable sellers and buyers to arrange their business undisturbed by the host of loafers who interfere in transactions carried on in open markets in Eastern towns, and it enables people to conclude their business without the bystanders knowing the prices wanted or offered. It is especially in use in the Red Sea, and its characteristic is that beneath a cloth, or more generally part of the unfolded turban, the hands of the parties meet, and by an arrangement of the fingers the price is understood. If one seizes the outstretched forefinger of the other it means 1, 10, or 100; the two first fingers together mean 2, 20, or 200; the three first, 3, 30, or 300; the four, 4, 40, or 400; the whole hand, 5, 50, or 500; the little finger alone, 6, 60, 600; the third finger alone, 7, 70, 700; the middle finger alone, 8, 80, 800; the first finger alone and bent, 9, 90, 900, while the thumb signifies 1000. If the forefinger of one of the parties be touched in the middle joint with the thumb of the other, it signifies $\frac{1}{2}$, and if the same finger is rubbed with the thumb from the joint to the knuckle it is $\frac{1}{4}$ more, but if the movement of the thumb be upward to the top instead of downward to the knuckle it means $\frac{1}{4}$ less. An eighth more is marked by catching the whole nail of the forefinger with the thumb and finger, while the symbol for an eighth less is catching the flesh above the nail—*i.e.* the extreme tip of the finger in the same way. It will thus be seen that, by combinations of the fingers of the seller and buyer, a large range of figures can be represented. It is, of course, understood that average market value of the article is roughly known and that there can be no confusion between, for example, 1, 10, 100, and 1000. This language of symbols is in universal use amongst European, Indian, Arab, and Persian traders on the Red Sea coasts, as well as among tribes coming from the interior, such as Abyssinians, Gallas, Somalis, Bedouins, &c. It is acquired very rapidly, and is more speedy than verbal bargaining; but its main advantages are secrecy and that it protects the parties from the interruption of meddlesome bystanders, who in the East are always ready to give their advice.

THE additions to the Zoological Society's Gardens during the past week include a Collared Peccary (*Dicotyles tajaçu* ♂) from South America, presented by Mr. R. Forrester Daly; a Common Peafowl (*Pavo cristatus* ♂) from India, presented by Mrs. Courage; two Black-bellied Sand-Grouse (*Pterocles arenarius* ♀♀), two Bonham's Partridges (*Ammoperdix bonhami* ♂♂) from Asia, presented by Mr. W. E. R. Dickson; a Siamese Blue Pie (*Urocissa magnirostris*) from Siam, a Hunting Crow (*Cissa venatoria*) from India, presented by Mr. C. Clifton, F.Z.S.; two Rooks (*Corvus frugilegus*), British, presented by Mr. C. A. Marriott; a Lion (*Felis leo* ♀) from Africa, a Great Kangaroo (*Macropus giganteus*) from Australia, a Grand Eclectus (*Eclectus roratus*) from Moluccas, a Red and Yellow Macaw (*Ara chloroptera*) from South America, deposited; a Striated Coly (*Colius striatus*) from South Africa, purchased; a Mule Deer (*Cariacus macrotis* ♂), a Mesopotamian Fallow Deer (*Dama mesopotamica*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE COMET OF 1472.—M. Celoria of Milan has discussed the elements of the last comet observed by Toscanelli, which is the celebrated one of 1472, also observed by Regiomontanus, whose description of its path in the heavens enabled Halley to make a rough approximation to its orbit, as he states in his "Synopsis of Cometary Astronomy." The Chinese account of the Comet's track contained in the supplement to the great collection of Ma Twan Lin, of which Edouard Biot published a translation in the appendix to the "Connaissance des Temps" for 1846, enabled Langier to make a further calculation of the orbit, though the somewhat full description of the comet's course amongst the stars is unfortunately very deficient in dates.

M. Celoria remarks that possibly from the advanced age which Toscanelli had attained, and the inclement season at which the comet was visible, the Florentine astronomer has not left for the comet of 1472 a representation of its track relatively to the stars as he has done for those of 1433, 1449, and 1457, nor an ephemeris of positions as in the case of the comet of Halley at its appearance in 1456; but two pretty definite places are assigned in Toscanelli's manuscript for January 9 and 17, and with the help of provisional elements a third position for January 22 is deducible. Still, in determining the most probable orbit, M. Celoria has found it desirable to utilise the one definite observation on January 20 which has been left by Regiomontanus. The principal available data are:—

Paris Mean Time	Comet's Longitude	Comet's Latitude
	° ′	° ′
January 9·6326	193 0	+13 0
17·6007	190 20	26 30
20·4021	185 12	46 3
22·2347	110 30	+80 32

Two orbits result from the discussion of these positions, and M. Celoria concludes that it is difficult to decide which is preferable. These orbits are as follows:—

	Orbit II.		Orbit III.
Perihelion passage Paris mean time	1472, Feb. 29·89097	...	Feb. 29.94555
	° ′ ″		° ′ ″
Longitude of perihelion ...	39 14 56	...	39 46 27
,, ascending node	296 7 49	...	285 53 25
Inclination ...	14 11 46	...	9 9 54
Log. perihelion distance	9·68072	...	9·68654

Motion—Retrograde.

Both sets of elements have the degree of precision compatible with the nature and number of the observations, and beyond doubt afford a closer approximation to the true orbit than either of the previous computations. Perhaps we may attach a slightly greater weight to M. Celoria's orbit II., from which it appears that the nearest approach to the earth took place at midnight on January 22, when the comet in right ascension 293°·5 and declination +76°·6 was distant 0·0652, with an apparent motion of 40° of a great circle daily. On this day Toscanelli refers to the interference of moonlight, and it appears certain that the presence of the moon must have greatly diminished the imposing aspect of such a comet while in the earth's vicinity. In fact we find that the moon was at the first quarter on January 18, and consequently at full soon after the nearest approach of the comet, when the theoretical intensity of light was one hundred times greater than at the end of the first week in January.

One of the European chronicles dates the first appearance of the comet on December 25, 1471, when it will be found from elements (II.) that it was in right ascension 194°·4, declination + 5°·5 at 6 a.m. in London; intensity of light, 0·38. In a quaint description of the comet's track by John Warkworth, Master of St. Peter's College, Cambridge, and a contemporary, which was published in the *Philos. Mag. and Journal of Science*, vol. xiv. (1839), we read: "And some men saide that this sterre was seen ii or iii oures afore the Sunne rysynge in Decembre iiij days before Chrystynmasse in the Southwest . . .;" calculating for 6 a.m. on December 21 we find the comet was in right ascension 193°·8, declination + 5°·2: it would consequently be near the meridian two hours or so before sun-rise, instead of the western quarter of the sky. It is clear that as regards position it might have been found three weeks earlier than Toscanelli's first observation. Warkworth says the comet disappeared on February 22. The Chinese saw it on February 17 approaching one of their constellations composed of α, δ, &c., in Pisces, and it is added in Biot's translation "elle fut longtemps à s'effacer;" calculation gives the place in right ascension 11°·9, declination + 0°·7, intensity of light 3·3, in the early evening at Pekin on that date.

M. Celoria's notice contains the geocentric track of the comet, according to both sets of elements, from January 9 to February 27. There is some reference in Pingré to a comet at the beginning of May, 1472, when the comet of Regiomontanus and Toscanelli would rise in Central Europe before 2 a.m., with an intensity of light about equal to that it possessed at the previous Christmas.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, *JULY* 12–18

(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 July 12

Sun rises, 3h. 59m.; souths, 12h. 5m. 20·7s.; sets, 20h. 11m.; decl. on meridian, 21° 56′ N.: Sidereal Time at Sunset, 15h. 35m.

Moon (New on July 12) rises, 4h. 31m.; souths, 12h. 20m.; sets, 20h. 2m.; decl. on meridian, 16° 47′ N.

Planet	Rises	Souths	Sets	Decl. on meridian
	h. m.	h. m.	h. m.	° ′
Mercury ...	5 18 ...	13 14 ...	21 10 ...	20 23 N.
Venus ...	5 35 ...	13 25 ...	21 15 ...	19 30 N.
Mars ...	1 28 ...	9 40 ...	17 52 ...	22 54 N.
Jupiter ...	8 5 ...	15 4 ...	22 3 ...	10 52 N.
Saturn ...	2 32 ...	10 42 ...	18 52 ...	22 32 N.

Occultation of Star by the Moon

July	Star	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image
			h. m.	h. m.	° °
18 ...	*m* Virginis	... 6 ...	10 10 ...	10 27 ...	184 215

Phenomena of Jupiter's Satellites

July	h. m.		July	h. m.	
13 ...	20 50	II. occ. disap.	15 ...	21 15	I. tr. egr.
14 ...	21 38	I. occ. disap.			

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

July	h.	
13 ...	12 ...	Mercury in conjunction with and 5° 39′ north of the Moon.
13 ...	15 ...	Venus in conjunction with and 5° 22 north of the Moon.
15 ...	7 ...	Jupiter in conjunction with and 3° 7′ north of the Moon.
17 ...	14 ...	Mercury in conjunction with and 0° 11′ south of Venus.

GEOGRAPHICAL NOTES

Dr. Gottsche, formerly a professor in the University of Tokio, has, as we have already intimated, returned to Europe after a long journey in Korea, during which he acquired much information with regard to that country. The length of his journey was over two thousand miles, and he visited all the eight provinces of Korea, as well as 84 out of the 350 districts. The main object of Dr. Gottsche's explorations was to ascertain whether coal and other useful minerals existed in the country; but, on account of influential support which he received he was able to obtain from the native authorities information with regard to the population, taxation, harvests, trade, &c. He has also collected much statistical information which is wholly new and which it is expected will show that the recent English consular reports are quite incorrect. Amongst others the population of the peninsula has been greatly underrated. It has generally been put down at nine millions, whereas it really is over twelve millions, for the official census from which the former estimate is taken only takes into account adults. Dr. Gottsche's principal stations on the journey were Söul, Ichhön, Kwisan, Mangyöng, Kyöngyn, Pusan, Changwön, Cwangyn, Chinsan, &c. He was 138 days *en route*, and, although this was not rapid, he was compelled to neglect some branches of investigation, such as botany and zoology, for his main business was with geology. In this respect Korea appears to belong to the bordering Manchuria. He found but few traces of the high development which the art and science of the country reached in early ages, and which made it the instructress of Japan. Dr. Gottsche, it is said, intends publishing an account of his journey.

Prof. Blumentritt, in an article in *Globus* on the Negritos of the Philippines, points out that the notion which was general at one time that these aborigines of the Archipelago were almost extinct, or absorbed into the Malay population, is an error. It may be said with certainty that they no longer exist in the Babiuyanes, Batanes, and other groups lying to the north of Luzon: but we know too little of the interior of Sámar and

Leyte, as well as of the great island of Mindoro, to say this. We know from Montano's explorations that they live in great numbers in Mindanao and elsewhere; but nevertheless, the *Negrito puro* sooner or later adopts the dress and customs of his Malay conqueror. All the efforts of the Spanish Government and of the Catholic missionaries tend to efface the peculiarities of the Negrito; and the Professor therefore states that, before it is too late, some scientific traveller should visit Mindanao to study the Atás and Mamanuas thoroughly; likewise an investigation of the Negritos of Panay and Negros is much to be desired.

M. LE MONNIER contributes to the last number of the *Deutsche Rundschau für Geographie*, &c., an article on the Island of Hainan, off the coast of China, to which some attention was recently directed on account of the rumoured occupation of it by the French. It has been known to the Chinese since 110 B.C., but it was not till the 13th century that it received its present name. From the earliest times to the present the aborigines, the Li, who inhabit the mountains in the centre, have maintained a struggle against the Chinese. It is even less known than Formosa, for no Europeans have travelled in it. One port, Kiungchow, has recently been opened to foreign trade, the north and south coasts have been surveyed, but there is no survey of the east coast. As to size, it is a little smaller than Formosa, and is larger than either Sicily or Sardinia. The centre is exceedingly mountainous, and from it rivers radiate in all directions to the sea. It is so near the mainland that its flora and fauna are in all respects continental. The direction of the mountain system is from south-west to north-east. Volcanoes have been examined there, but they appear to be now extinct. Earthquakes are frequent. As in Formosa, the population consists of three elements—the Chinese, the subjugated and the independent natives. Amongst the former are the Miaotsze, who have crossed over the narrow strait from time to time from Kwangsi and We tern Kwangtung, and have taken possession of some of the smaller hills. Their language is said to be similar to that of the Li; they are good husbandmen, and are on friendly terms with both the Li and the Chinese. The independent Li appear to be an aboriginal race which has been driven back to the hills by the Chinese immigrants. Information with regard to them is very scanty, but they appear to have a reddish skin and to be of small stature; their language resembles that of the Miaotsze of the mainland. The women are tattooed after their marriage, and they paint their faces with indigo. The Li are expert hunters and shots; the weapons are bamboo bows and arrows and a short sword in a sheath. The main sources of information with regard to Hainan are a paper by the late Mr. Mayers in the *Journal* of the North China Asiatic Society (No. vii., 1873); one by Mr. Swinhoe, entitled "Narrative of an Exploring Visit to Hainan," in the same periodical (No. vii., 1871-2); and a map of the Kwangtung Province, and other publications by Dr. F. Hirth.

HERR GLASER, the Arabian traveller, has returned to Arabia to resume his explorations. This second journey is to be mainly geographical, but archæology will also receive attention. Besides visits to Marib and Nejdran, Herr Glaser contemplates a long journey through the interior from Hadramant to Omaun, and a second across South Arabia.

M. BAUX, member of the Geographical Society of Paris, has been despatched on an ethnographical mission to China; and M. Guerné proceeds to Kiel to take part in the labours of the commission for the scientific examination of the German coasts. These missions are undertaken by direction of the Minister of Public Instruction of France.

PROF. SEELSTRANG, of the University of Cordoba, has been appointed by the Argentine Government to superintend the publication of an atlas of the Republic, and a considerable sum has been appropriated for the work. It is to consist of twenty-seven parts, and four of these are already in hand.

AT the last meeting of the Geographical Society of Paris, M. Alphonse Milne-Edwards in the chair, M. de Saint-Pol-Lias, who is now in Cochin China, presented a map of the upper course of the Red River, prepared by the Annamites. Another map of importance is that of the navigable water-ways of southern Indo-China, prepared by M. Rueff, who has established a company for navigating these waters. A letter was read from Jeddah stating that the collections of the unfortunate M. Huber, including his remarkable examples of Semitic epigraphy, were safe in the hands of the French Consul, and that the explorer's remains were buried in Jeddah on May 27.

THE last number (Band viii. Heft 2) of the *Geographische Blätter*, published by the Bremen Geographical Society, contains a study on the Congo region by Dr. Oppel, dealing with the scientific and economieal importance of this district. The paper is divided into two main sections: (1) The discovery and investigation of the Congo (*a*) between 1484 and 1872, (*b*) the systematic exploration since 1872; (2) The extent and boundaries, geology, &c., of the Congo region. Prof. Seelstrang writes on the Argentine province of Buenos Ayres, its geography, fauna, flora, climate, inhabitants, trade, industry, &c., in short, a kind of encyclopædic article on the province. Another paper on South American geography, or rather geology, is that by Dr. von Thering on the Lagoa dos Patos, in the province of Rio Grande do Sul, the largest lake in Brazil. This is accompanied by a map of the extent of the sea in the province at the beginning of the alluvial epoch. Herr Zöller writes on the Batanga River; the number also contains a report of the late *Geographen-tag* at Hamburg.

ON A RADIANT ENERGY RECORDER

SUNSHINE-RECORDERS may be divided into two classes, viz., those which roughly measure solar energy by the burning of card and wood, and those which, by means of some photographic process, yield a record of the relative intensity of some more or less definite ray. The principle of the instrument which I am about to describe differs from those referred to in this respect—that it depends upon the evaporation of water *in vacuo*, and its indications are therefore readily expressible in heat-units.

The form of instrument with which I have sought to test the applicability of the method consists of a Wollaston's cryophorus (of the form pictured in Ganot's "Physics," p. 272, edition 1872), in which the vertical tube and lower bulb are replaced by a simple glass tube graduated in cubic centimetres. The bulb containing the water to be evaporated is blackened by holding it in the smoke of burning camphor, and is then exposed to the sun, the rest of the apparatus being silvered or properly protected by bright sheets of tin. At sunset the quantity of water which has distilled over can be read off on the graduated tube.

An experiment on June 6 showed 1·8 cc. to have passed over from a bulb of about 2 inches in diameter, and to have condensed in a narrow measuring tube between the hours of 10.40 and 3.20. The instrument seems very sensitive, and may well find many applications. In a suitable form of instrument the total nett solar energy gained by the blackened absorbing surface will be almost exactly represented in heat-units by multiplying the number of cubic centimetres of water distilled by the latent heat of steam. To measure the loss of the earth's radiation at night a similar instrument containing alcohol or some other liquid of low freezing-point might be employed. In either case, when a continuous time record is required, the graduated tube might be used as a cylindrical lens to condense light on photographic paper.

The following are the more important conditions which the apparatus in a future form should probably fulfil:—

(1) To present a constant and known absorbing surface to the sun.

(2) To preserve a constant surface for evaporation which should be the same in the condenser, so that a reversal of the direction of distillation can take place under the same conditions when the black bulb is losing energy.

(3) To give rise to the minimum of reflection and convection currents on the absorbing surface.

(4) The apparatus should be so screened as to be at the temperature of the air apart from the gain of energy at the blackened surface.

Some of these conditions seem likely to be more or less fulfilled in an apparatus consisting of two glass bulbs of equal diameter connected together by a tube bent through an angle of about 150°, to bring the bulbs near together, and thus keep them in air of the same temperature. In the bulb containing the water to be evaporated, a black bulb might be fixed to absorb the solar radiation, whilst to the upper part of the second bulb should be sealed a graduated tube in which the distilled water might be measured by inclining the instrument. If metal globes were employed the connecting tube might be made to form the beam of a balance.

The completion of other work will prevent my return to this subject at present—perhaps altogether—but I have ventured to publish this incomplete account of an apparently promising method for the measurement of solar radiation, in the hope that it may be of use and interest to others.

University College, Liverpool. J. W. CLARK

P.S.—It may perhaps be found advantageous to use an apparatus like an inverted cryophorus, in which the absorbed radiant energy generates a vapour-pressure, and is made to lift a column of water in the tube—the height of the column and the time being registered photographically.

THE GROWTH OF CEREALS

PERHAPS nowhere is the influence of the different climatic factors on the rapidity of growth so well illustrated as on the plains of Russia. Therefore W. Kowalewski's careful researches into this subject, summarised in the *Memoirs* of the St. Petersburgh Society of Naturalists (xv. 1), are especially worthy of attention. The author has gathered all necessary information for showing the periods of growth of various cereals on the soil of Russia, from the far north of Arkhangelsk, to the southern province of Kherson, and he has arrived at most interesting results, of which the following is a summary. If the periods of growth of the same cereal be taken throughout Russia, it appears that, altogether, it is in the higher latitudes that it ripens fastest. Oats and spring wheat take 123 days and barley 110 days to ripen about Kherson, and only 98, 88, and 98 days at Arkhangelsk, the difference in favour of the north being respectively thus: 25, 35, and 12 days. The intermediate regions show also intermediate differences, while for each latitude the growth of cereals proceeds faster in the eastern parts of Russia than in the western. It is obvious that if the rapidity of growth were due to temperature, the phenomena would be the reverse of what they are. Moreover, the want of moisture in the southern steppes is also a condition in favour of the rapidity of growth: so that it is in the insolation that we must seek for the cause of the above-stated difference. In fact, oats being usually sown about May 17 at Arkhangelsk, and the harvest usually occurring about Sept. 1, the insolation continues there for 2000 hours in 98 days, not to speak of the 240 hours of bright nights; while at Kherson, during 123 days (from April 1 to Aug. 1) the insolation lasts only for 1850 hours. The difference in favour of Arkhangelsk is thus equal to 150 hours (to 400 hours, if the bright nights be added), and it compensates for the influence of temperature. It is useless to add, moreover, that the cereals cultivated in the north have already undergone a certain accommodation to their conditions. As to the intensity of light, Prof. Famintzin's work on the subject, corroborated by ulterior researches, shows that the great intensity of light in Southern Russia, combined with the great transparency of the atmosphere, is rather a condition against the rapidity of growth, the intensity of light exceeding the limits of the maximum of decomposition of carbonic acid. Winter rye shows the same differences as the spring cereals. It appears from M. Kowalewski's tables that in the Arkhangelsk district winter rye takes 375 days to arrive at ripeness, of which there are 202 days of winter rest, 68 days of autumn growth, and 105 days of spring and summer growth, making thus a total of 173 days of growth. At Kherson the total growth lasts for 290 days, of which only 101 days of winter rest and 189 days of productive growth (63 during the autumn and 126 during the summer). The difference reaches thus 16 days in favour of the north, and it would rise to 20 or 25 days if only spring and summer be taken into account. The graphical representation of all these data is most interesting. Thus the lines of simultaneous sowing of winter rye from north-west to south-east correspond to the isochimenes, while the lines of simultaneous ripening of the spring cereals—oats, barley, sarrazin, wheat—run from south-west to north-east, corresponding to the lines of equal summer temperatures. The retarding influence of rain comes out also pretty well.

THE ROYAL SOCIETY OF NEW SOUTH WALES

THE annual general meeting of the members of the Royal Society of New South Wales was held on May 7. The president, Mr. H. C. Russell, B.A., F.R.A.S., occupied the chair, and delivered an address, from which we give the following extracts:—

"There is a very general impression, borne out by the evidence which geology has furnished, that at least the east coast, if not all Australia, is rising in relation to the mean level of the sea. The late Rev. W. B. Clarke, in a report to the Port Jackson Harbour Commission, said 'that the coast has risen in former geological epochs, and that it has risen during the present epoch is capable of distinct proof.' 'Raised beaches of shells, which are not kitchen middens, may be seen about twenty-five feet above the sea, near Ryde, on the Paramatta estuary, and at Mossman's Bay, in Port Jackson, at a height of 132 feet above high-water.' Again, 'regarding the whole coast from Broken Bay to Botany Bay as mere peninsulatic fragments, united only by low isthmuses, bare or covered with sand, as they actually are, one may still see that there must have been oscillations of level, and finally elevation.' Speaking of other portions of the coast, Mr. Clarke says:—'At Adelaide in 1855 the railway between the city and the port was being constructed, and Mr. Babbage has since shown that in four years a difference of four inches of rise between the levels of those places has taken place.' And again, 'according to Mr. Ellery, the accomplished and accurate Williamstown observer, the self-registering tide-gauge at that place indicated a rise of the bottom of Hobson's Bay of four inches in twelve months, and a deposit of recent shells and imbedded bones of sheep and bullocks which had been thrown into the bay is now seen at a level above the reach of the sides.' Again, quoting from a letter by the late Mr. John Kent, of Brisbane:—'A survey was made of a shelf of rocks in Brisbane River in 1842 by Captain Gilmore, Mr. Petrie, and myself, and in making a re-survey in 1858 Mr. Roberts found the relative depths were singularly correct, but that the general depth of water over the shelf of rock had decreased eighteen inches in sixteen years since the first survey was made.' Sir Roderick Murchison, in the *Proceedings* of the Royal Geographical Society of London (vol. vii. p. 42) quotes from a letter he had received from the late Mr. Kent, of Brisbane:—'I have lately drawn the attention of the Rev. W. B. Clarke to the fact that the eastern coast of New Holland is rising at the rate of (say) one inch per annum, as ascertained by the height of rocks in the river Brisbane above tide levels, through a period of twenty years, and he assures me that to the south the same result has been inferred, though the observations have not extended over so long a period. At what rate the rise is now going on there are no data to establish. Till a series of mean tidal levels are marked on the rocks of the harbour, and the alteration made as distinct as that in Hobson's Bay, any deduction as to the rate of rise must be conjectural and unreliable.' I have but taken a few extracts from a great mass of evidence which Mr. Clarke brought forward in proof of the rapid elevation of the coast of Australia. I was deeply interested in this report when it was published in 1866, and as soon as I had opportunity determined to make such observations with a self-registering tide-gauge as would determine the rate of rise, if any, and in collecting information bearing upon this subject during the past thirteen years. I wrote to Mr. Ellery and asked him for further particulars of the rise going on in Victoria, and in reply he said that Mr. Clarke had in some way misunderstood his remarks, which had reference to the silting up of the harbour, not the elevation of the land; and he at the same time sent me a copy of his paper on 'The Tidal datum of Hobson's Bay,' read before the Royal Society of Victoria, August 14, 1879. After giving the history of the tide-gauge, which was started in 1858 under the Harbour Department, and was not under his control till 1874, Mr. Ellery says:—'It is to be regretted that no precise references to mean tide level in the earlier days can be found. Where measurements do exist in Hobson's Bay they are lacking in accurate information as to the state of the tides, and I find nothing trustworthy upon which to base any statements as to change of sea level since surveys have been made. I think it desirable that permanent bench marks on the natural faces of the rock *in situ* should be established around our bay, carefully connected by accurate levelling with one another and with the tide-gauge, for it is very doubtful if bench marks on buildings can be assumed to afford a permanent datum.' The first self-registering tide-gauge in Sydney was erected on Fort Denison by the late Mr. Smalley in 1867. Unfortunately the design was so faulty that all the records of the heights of tides made by it are of no value, although the times of high and low water are correct. The reason for this fault in its records was that an ordinary hempen cord was used to connect the float and the pencil, and this gradually got longer by use, and also varied with the weather. Finding it impossible to remedy this fault satisfactorily in view of the necessity for exact records of the heights of the tides, in 1872 I had a new gauge made, which, without losing the accuracy of the time record, which the old one possessed, insured the correct record of the height of the tides. This instrument is figured and described in the 'Sydney Meteorological volume for 1878,' and to that work I must refer you for particulars. The record by the new gauge was begun on June 27, 1872, and at that time the precaution was taken of measuring the length of the chain connecting the float and the wheel, so that should any change take place its exact amount could be ascertained. The wisdom of this has been evident on several occasions when the chain was broken by accident, and the exact length restored. The well made for the tide gauge is in part cut in the solid rock, and from the rock to the surface of the ground the sides of the well are built up (round) with solid masonry, so that the top ring of the well is practically part of the solid rock, and cannot move unless the rock does so. On this ring the frame of the tide gauge stands, and the instrument, therefore, has a permanent relation to the rock, and there can be no change in its parts which might be mistaken for a change in sea level. I have been particular in detailing the conditions under which the tide measurements have been made, to show you that sufficient precautions to ensure accuracy have been taken. In each year the mean of all the tides is taken as the mean sea level for that year, and when these results for the past twelve years are placed side by side, it is at first sight rather puzzling, for although the greatest departure from the mean of all is only one inch, yet within this small range the land seems to rise and fall in an erratic way. The cause of these variations, however, was found in the varying relative positions of sun, moon, and earth, and perhaps, to some extent, in the effects of heavy gales. Taken as a whole, these results seem to prove conclusively that no change whatever has taken place in the relation of land and sea during the past twelve years. Of course the question is not settled—a slow change that would be visible in centuries might be altogether hidden in the results before us; but so far as they go these results will be interesting to scientific men, for they are the first that have been taken with such accuracy as the investigation demands. Mean Sea Levels: 1873, 2 feet 5·9 inches; 1874, 2 feet 7 inches; 1875, 2 feet 6·3 inches; 1876, 2 feet 5·5 inches; 1877, 2 feet 6·7 inches; 1878, 2 feet 6 inches; 1879, 2 feet 5·5 inches; 1880, 2 feet 6·2 inches; 1881, 2 feet 5·2 inches; 1882, 2 feet 6·1 inches; 1883, 2 feet 6·8 inches; 1884, 2 feet 6·95 inches—2 feet 6·11 inches. In examining this question I looked for some mark of old surveys which might show what the evidence of a longer period would be, but I have failed to find any mark put in with such care as the investigation demands. There is, however, one mark on the north-east face of the round tower on Fort Denison which was put in by H.M.S. *Herald* during her survey of Sydney harbour. It is cut in the stone three feet above mean sea level, and is marked with the broad arrow under it. I have been at some trouble to find out on what observations this mark was based; but although I have learned that the survey was made in 1857, and that the *Herald* was in port from February 26 to December 21, 1857, I cannot learn how long the tide observations were continued, but I hope still to do so. The time and method of taking mean sea level might account for a difference from the true mean of four or five inches, as is shown by the different monthly means from the recording tide gauge, and until I can learn on what observations the *Herald's* mark depends, it cannot be used as evidence of change of level of the land. I have, however, connected it carefully with the zero of the tide gauge, and if it exactly represents mean sea level in 1857, it proved that the land has risen five inches in twenty-seven years; but, since the tide gauge shows no change whatever during twelve of these years, I think the evidence of the mark cannot be taken without full particulars of the observations on which it depends. In the course of conversation with the late Rev. W. B. Clarke on the question of the elevation of the coast, he pointed out to me evidence not only of the elevation of this coast, but also of its subsidence, and expressed his conviction that Port Jackson, Hawkesbury River, and other places on the coast had been cut out by the action of fresh water, when the coast was much higher than it is at present—in fact, that these inlets had been at one time gullies exactly similar in character to those which now exist in the Blue Mountains, and which have been so obviously cut out by fresh water. Since that time many bridges have been made along the coast, and the borings made for foundations for these bridges have special significance in connection with Mr. Clarke's opinion; and by the kindness of the Engineer-in-chief for Railways and the Engineer-in-chief for Roads and Bridges I am able to quote here some of these measures, which prove conclusively that the sea was at one time much lower than it is at present. The soundings taken for the Parramatta Railway bridge show 26 feet water, 32 feet mud and silt, 8 feet loose sand, 12 feet hard sand, 10 feet loose sand: total, 88 feet. George's River bridge—8 feet water, 87 feet mud and sand, 9 feet black clay, 16 feet sand, 4 feet hard sand: total, 121 feet. Hawkesbury River bridge—44 feet water, 31 feet light mud, 87 feet black mud, 8 feet very hard sand: total, 170 feet. In the road-bridge over the Parramatta River—41 feet water, 16 feet shells and mud, 15 feet sand, 9 feet blue clay, 6 feet clays and shells: total, 87 feet. Ironstone Cove road-bridge—26 feet water, 7 feet stiff blue clay, 36 feet very stiff blue clay, 15 feet yellow clay, 5 feet stiff black clay, 11 feet sand and clay, 2 feet clean sand, 3 feet gravel and wood: total, 105 feet. Shoalhaven River road-bridge—14 feet water, 103 feet mud and silt: total, 117 feet. The bottom of the Hawkesbury, therefore, where the railway-bridge is to be, is 170 feet below the level of the sea to-day; and when the rocks were washed away to form the river-bed to that depth, the sea must have been at least 170 feet below its present level, and the bearings in Sydney Harbour and George's River indicate a similar fact, if not to the same extent. Without going further into this question, which is foreign to my present purpose, I think I have said enough to show that the evidence for elevation and subsidence of the land are about equal, the question before us being, In which direction is the change going on now? In estimating the value of the evidence quoted as to the rate of rise in Queensland and South Australia, we must not forget that when engineers adopt the usual rule as to mean sea level—that is, as to the mean of high and low water at any time of the year—they assume that all such means are equal or represent a constant level, when in point of fact two such determinations of sea level may differ by 8 inches or even more, and in the absence of a self-registering tide-gauge, or constant observations extending over a year, no levelling referred to the sea in the usual way is of any value whatever in such an investigation as that required to determine whether the relative level of land and water varies. I have already shown that Mr. Ellery thinks there is no evidence of present rising in Hobson's Bay, and the fact that at the time the engineering levels referred to were taken in South Australia and Queensland there were no self-registering tide-gauges to determine accurately mean sea level, is sufficient to warrant us in hesitating before we receive the evidence as to the rate of elevation furnished from these colonies, which I quoted from Mr. Clarke's report. Some few months since it occurred to me that it would be desirable to put a self-recording gauge on Lake George, with a view of keeping a continuous record of evaporation and other changes of level in it; and as soon as the instrument could be got ready I put it up on the west side of the lake, in front of Douglas House, which is about a mile from the present southern end. The work of erecting the instrument was completed on the afternoon of February 18, and the pencil was put down on the paper to begin its curious record at 7 p.m. on that day. At the time the lake seemed calm as a millpond, and, looking at its smooth surface, no one would have dreamed that such changes were going on in it as began to reveal themselves so soon as the pencil touched the paper, and in two hours the pencil had recorded a rise and fall of about 2 inches. This is not a motion like the ordinary wind-made waves, which pass by in two or three seconds, but a slow and gradual rise, occupying an hour, and then a corresponding fall in about the same time, to do which a current must first have set from north to south for an hour, and then reversed; and if we consider for a moment the force necessary to put a body of water 18 miles long, 5 wide, and 15 or 20 feet deep, in such motion, we shall get some idea of the magnitude of the forces at work. The record had not been going 24 hours when it became obvious that these periodic motions in the level of the water had a period of about two hours, and on the afternoon of the second day a heavy thunderstorm passed over the south end of the lake, and threw a little light on the cause of the pulsations. The storm rain was very heavy and much of it must have run into the lake, tending to raise the waters there. With the storm there came a violent squall of wind from the south, on to the south end of the lake; in a few minutes great foam-crested waves could be seen in the middle, and the recording gauge at once showed what was the matter; the wind had blown the water away from the south end and reduced the general level 3 inches. In 10 minutes the squall was over, and the water began to recover its level, in doing which the current set towards the south end of the lake, and could be seen running past the jetty at the rate of about two miles per hour. But it did not stop when the old level was reached, the momentum carried it beyond that point, and raised the water up at the south end of the lake. Then it turned and ran back again, repeating this process time after time at intervals of about two hours, the rise and fall getting gradually less until in about eight hours the water was almost still, when suddenly, at 11.30 p.m., the water began to rise faster than ever, and in 30 minutes had risen 4 inches; it then turned and fell nearly as fast as it had risen, and reached its lowest point in 1 hour 41 minutes, having fallen exactly 6 inches. At Douglas House the night was fine and calm, without the sign of a storm. Yet it seems probable that a storm passed over the north end of the lake, and started the motion, which kept on at intervals of about two hours for 14 hours, the rise and fall gradually getting less. I was fortunate enough to be present and see so much of the record and the corresponding weather. You have no doubt noticed that one set of pulsations was started by a sudden fall, and the other by a sudden rise, in the lake, and that the impulse which caused the water to rise was greater than the other. Similar impulses have kept the lake in almost constant motion ever since, and when once under way, they will go on throughout a gale of wind with just as much regularity as in a calm. Ordinarily such a set of motions lasts 10 or 12 hours, decreasing gradually as if the friction of the water stopped it; but on several occasions they have kept on for days together. The most remarkable impulse yet recorded was on the 14th of April, when the water was remarkably still, and had been so during the 11th, 12th, and 13th. At 11 a.m. on that day Mr. Glover, who has charge of the gauge, saw a thunderstorm coming down from the north, and went into the recording-house to see its effect. The lake was rising fast, and in 30 minutes rose 4 inches; as the storm passed overhead the rising ceased, and the lake at once began to fall, getting back to its previous level in 15 minutes; passing this point it fell 2 inches more—in all 6 inches—and then began to rise again, so starting a series of pulsations that lasted five days. Rain came with this storm, and on the 14th and 15th measured by gauges at each end of the lake 1·10 inch rain fell, and this caused a rise of 1½ inches in the lake, which can be distinctly seen in the record as something independent of the pulsations. With the rain there was a strong breeze of wind, and by the third day after the water had returned to its old level, all the rain having evaporated in three days. In each of the cases I have mentioned so far the impulses seem to have been given by a sudden storm breaking over the lake, but there are other instances in which the impulse was of a totally different character, and it seems as if a small force properly managed was made to do duty for a large one, just as we should set a heavy weight suspended by a string in motion by giving it first a little push, and then adding impulse at each swing. So the force, whatever it be, which in these cases acts on the water in the lake, gives it a little start and gradually gets it in motion. The best instance of this occurred on the afternoon of April 5, at the time the lake was very quiet, and suddenly the water rose an inch, and fell again within 30 minutes; next time it rose an inch and a half, and fell 2 inches in three-quarters of an hour; the next time it rose 2 inches, and fell 3½ inches in an hour; it then rose 3¾ inches in 40 minutes, and so started a series of pulsations which settled down to two-hour intervals, and lasted twenty hours. Usually, the rise and fall take about equal times, but now and then the whole fall will take place in 14 or 15 minutes, and the corresponding rise takes 116 minutes, and it is not very unusual to find one in a set of twice the period of the others, as if one had been left out. In fact the variations in the conditions of vibration are very puzzling. With a view of finding out the most common period I have measured 54 of the best defined amongst those already recorded. Of these 33 have a period of 2 hours 11 minutes, five a period of 2 hours 5 minutes, six a period of 2 hours 17 minutes, and ten a period of 1 hour 12 minutes. The periods of those on the Lake of Geneva are 72 minutes and 35 minutes. Of those in Lake George which have a period of 2 hours 11 minutes, some are the largest yet recorded, and others only a half or a quarter of an inch rise and fall; so that there must be something which makes or tends to make the period 2 hours 11 minutes. It is noteworthy that at Lake George as well as the Lake of Geneva, the short seich is not half the long one; but they bear about the same proportion one to the other in each case. As to the cause of these motions in the lake I am not prepared to say much at present. Further investigation is needed, and I hope, by the aid of a recording aneroid already there, and a recording anemometer to be erected shortly, to be able to compare the changes of wind and pressure with the changes in the lake; but I do not expect to find everything. Changes of level, &c., are going on in the earth surface, which, from an astronomical point of view, are intensely interesting, because they affect the instruments, and therefore the measures. They are very minute, and we have no means of keeping a continuous record of them; but it is possible that if such changes affect the lake they will be so magnified by its comparatively enormous extent as to show themselves on the recording instruments there. The baragraph at Sydney has shown long since that thunderstorms come on with a sudden rise of the barometer, which at times amounts to a tenth of an inch. If such a change could affect one end of the lake for a few minutes it would be equivalent to putting suddenly on to it an inch of water, which would make itself known at once by a rush to the other end; but although such changes must have some effect, I do not think it can be considerable, because, as I have elsewhere shown, these storms move at the rate of about 60 miles per hour, and are often 70 miles wide, so that such a storm coming on to the lake would spread all over it too rapidly to cause much motion in the water. I am here assuming that the storms there are of the same character as those which pass over Sydney, but they may be smaller when passing the lake, and travel more slowly. Certainly the storm which I saw coming down the lake did not traval with anything like such velocity. M. Vaucher, who studied for years the motions of the same kind which take place in the Lake of Geneva, considered himself justified in saying: "The lake is disturbed when the barometer is unsteady, and because of the varying pressure." From what I have seen so far, the first part of this is true of Lake George, but it is not because the barometer is unsteady, but because at such times the wind is puffy and variable, and imparts to the water its own peculiarity. Of the power of the wind to set the water in motion I have mentioned several instances to-night, which I need not repeat, but I may add that the large impulses come from the north, because, as it seems to me, the wind from that direction acting on the water, the whole length of the lake has greater power than when blowing from the south over a short stretch of water, the gauge is fixed about a mile from the south end. But, although the wind is such an obvious cause of the phenomena under discussion, I think the barometric changes have some share in it, and there are some changes recorded which, so far, I am unable to refer to any cause. Mr. Russell then entered into details of the surroundings of Lake George, which, he stated, are of very great interest, viewed in the light of discussions as to the possible change in the amount of rainfall in the colony during long periods. The persistence of level in Lake George, he pointed out, is very strong evidence in favour of the view that there has been no great change in the rainfall there for thousands of years, and probably the same may be said of Australia. The rainfall on the lake in 1870, Mr. Russell said, was 50 inches, double the average rainfall, which is 25 inches, and it is not to be wondered at that the lake rose at an unusual rate. Still this rain, heavy as it was, only served to cut little gutters in the older deposits which had been brought down the gullies. The primary object in placing the recording gauge on Lake George was to ascertain the rate of evaporation from such a large body of water, the conditions at the lake being very favourable for such an investigation. The record began on February 18, and the time since is too short to justify any assumption of the rate of evaporation there; but I may mention some of the facts that have been recorded bearing upon this question. In 68 days the level of the lake has fallen 7 inches by evaporation; in this interval, according to the records of rain-gauges at each end of the lake, 3·55 inches of rain has fallen, so that, ignoring the water which may have run from the hills during these rains, the lake has lost all the rain falling into it and 7 inches more, that is, 10½ inches. During the past 14 years the lake has lost by evaporation 12 feet; and in May, 1878, the railway suivey carried down the western side showed that the lake was then

6 feet below its 1871 level, or 2225 feet above the sea. It appears, therefore, that in 7 years, 1871 to 1878, the lake lost 6 feet; and again, from May, 1878, to February, 1885, say seven years, the lake again lost 6 feet by evaporation, and this of course in addition to all the rain which fell during that period. Taking the records at Goulburn and Gungahleen, near the lake, the average rainfall for the first 7 years was 27·95 inches, and during the next 7 years 23·68 inches. One would expect to find more evaporation during the drier years, but this is not borne out by observations. From the rainfall and recorded evaporation the lake, therefore, lost by evaporation at least 3 feet per annum. I say at least, because some rain water must have run into the lake in addition to that which fell into it directly, but its amount cannot be determined. In future the recording gauge will determine this, and perhaps then we may apply the experience gained to estimating how much ran in during the past fourteen years. Lake George is called a fresh-water lake, and some have even gone so far as to propose to use it as a reservoir for the supply of towns. When there I ascertained that no one could use the water on account of its purgative properties, one glass full being quite enough to satisfy those who made use of it; and it is there said that the water running into the lake from the Currawang copper mine had poisoned all the fish. This is not literally true, for there are still fish in the lake; but very many were killed some years [since, presumably by the cause mentioned. I obtained some of the water, and am indebted to Mr. Dixon, of the Technical College Laboratory, for the following interesting information as to what the water contains:—It is quite evident that with 187·5 grains of mineral matter per gallon the water cannot be used for domestic purposes, and from the fact that this matter is constantly being added to, it cannot improve, unless it were possible to withdraw large quantities of the water, and supply its place with rain-water; but during by far the greater number of years during which the lake has been known, viz., 64 years, the supply of rain-water going into it annually has not been equal to the evaporation, and there is no other outlet. After the great flood of 1870 the lake, during the last 14 years, has gradually decreased by nearly a foot per annum, and similar conditions existed before; and it is therefore obvious that it would not be possible to wash out the salts with rain-water and artificial drainage except in wet years—perhape once in 20 years. Extract Mining Department's report, 1880:—'Three samples of water from the Currawang Copper mines were sent for analysis, with special reference to their poisonous action on the fish in Lake George, and were therefore only examined with regard to the metals in solution. The metals were present as sulphates, and are stated below:—Water from the creek contains: Sulphate of copper, 1·12 grains per gallon; sulphate of zinc, 16·78 grains per gallon; sulphate of iron, 0·43 grains per gallon. Water from the working shaft: Sulphate of copper, 17·67 grains per gallon; sulphate of zinc, 53·54 grains per gallon; sulphate of iron, 1·42 grains per gallon. Water from the old shaft: Sulphate of copper, 6·42 grains per gallon; sulphate of zinc, 7·20 grains per gallon; sulphate of iron, 0·98 grains per gallon.' This water would necessarily be poisonous to fish, and flowing into a lake without outlet, would ultimately render the whole water poisonous. 'Technical College Laboratory, Sydney, 2nd May, 1885. My dear Mr. Russell,—The water from Lake George contains 187·5 grains per gallon of solid matter dried at 212° F. The residue has a strongly alkaline reaction, effervesces with acid, blackens much on ignition, but does not show the presence of nitrates in doing so. The metals present are aluminium, calcium, and magnesium; the acids chlorine, carbonic acid, sulphuric acid, and phosphoric acid, the last two in small quantity. The salts are probably arranged as chloride of sodium, sulphate of sodium, phosphate of sodium, carbonate of sodium, and carbonates of calcium and magnesium. The purgative properties of the water are probably due to the salts as a whole, and especially the carbonate of magnesia. It should be borne in mind, however, that waters containing much organic matter frequently have a purgative effect.—Signed, W. A. DIXON. P.S.—Zinc and copper are entirely absent.'"

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

SCIENCE AND ART DEPARTMENT.—The following Prizes, Scholarships, Associateships, &c., have been awarded in connection with the Normal School of Science and Royal School of Mines, South Kensington.

First Year's Scholarships:—James Rodger, Andrew McWilliam, Tom. H. Denning, John Richards.

Second Year's Scholarships:—Arthur E. Sutton, Thomas Rose.

The following Prizes were also awarded:—Alfred V. Jennings, the "Edward Forbes" Medal and Prize of Books for Biology; Arthur E. Sutton, the "Murchison Medal" and Prize of Books for Geology; and the "Tyndall Prize" of Books for Physics, Course I.; Henry G. Graves, the "De la Beche" Medal for Mining; John C. Little and James Allen, "Bessemer" Medals with Prizes of Books from Prof. W. Chandler Roberts for Metallurgy; Arthur W. Bishop and Peter S. Buik, the "Hodgkinson" Prizes for Chemistry.

Associateships, Normal School of Science:—Isaac T. Walls (Chemistry, 2nd Class); Alfred Fowler (Mechanics, 1st Class); George H. Wyatt (Physics, 2nd Class); Martin F. Woodward (Biology, 1st Class).

Associateships, Royal School of Mines:—John C. Little (Metallurgy, 1st Class); Thomas A. Rickard (Metallurgy, 1st Class); Percy E. O. Carr (Metallurgy, 1st Class); Walter A. A. Dowden (Metallurgy, 2nd Class); Henry G. Graves (Mining, 1st Class); Ernest Woakes (Mining, 1st Class).

DR. REDWOOD has retired as Emeritus Professor from the Chair of Chemistry at the Pharmaceutical Society. The vacancy has been filled by the appointment of Mr. Wyndham Dunstan, Demonstrator of Chemistry in the University Museum of Oxford.

SCIENTIFIC SERIALS

Rendiconti del Reale Istituto Lombardo, May 21.—A science of criminal legislation in connection with the projected Italian Penal Code, by E. A. Buccellati.—Note on the inscribed Etruscan arms and mirrors in the Fol Museum, Geneva, by Prof. E. Lattes.—The system of projected homogeneous co-ordinates for the elements of ordinary space, by Prof. F. Aschieri.—On the separation of cream from milk, and the conditions tending to accelerate the process, by Prof. G. Morosini.—Further researches on the functions that satisfy the differential equation $\Delta^2 u=0$, by Prof. Giulio Ascoli.—Remarks on the Mexican skulls deposited in the Civic Museum, Milan, by E. A. Verga.—Meteorological observations made at the Brera Observatory, Milan, during the month of May.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 18.—"A Memoir introductory to a General Theory of Mathematical Form." By A. B. Kempe, M.A., F.R.S.

The object of the memoir is the treatment of the "necessary matter" of exact or mathematical thought as a connected whole; the separation of its essential elements from the accidental clothing—algebraical, geometrical, logical, &c.—in which they are usually presented for consideration; and the indication of that to which the infinite variety which those elements exhibit is due.

The memoir opens with the statement of certain fundamental principles, viz.:—Whatever may be the true nature of things and of the conceptions which we have of them (as to which points we are not concerned in the memoir to inquire) in the operations of reasoning they are dealt with as a number of distinct entities or *units*.

These units come under consideration in a variety of guises—as points, lines, statements, relationships, arrangements, intervals or periods of time, algebraical expressions, &c., &c.—occupy various positions, and are otherwise variously circumstanced. Thus, while some units are undistinguished from each other, others are by these] peculiarities rendered distinguishable. For example, the angular points of a square are distinguishable from the sides, but are not distinguishable from each other. In some instances where distinctions exist they are ignored as not material. Both cases are included in the general statement that some units are distinguished from each other and some are not.

In like manner some *pairs* of units are distinguished from each other while others are not. Pairs may be distinguished even though the units composing them are not. Thus the angular points of a square are undistinguishable from each other, and a pair of such points lying at the extremities of a side are undistinguishable from the three other like pairs, but are distinguishable from the two pairs formed by taking angular points at the extremities of a diagonal, which pairs again are undistinguishable from each other. Further, a pair, *ab*, may sometimes be distinguished from a pair, *ba*, though the units *a* and *b* are undistinguished. Thus if *a*, *b*, *c* be the angular points of an equilateral triangle, and barbs be drawn on the sides pointing from *a* to *b*, from *b* to *c*, and from *c* to *a* respectively, the angular points *a*, *b*, *c* will be undistinguished from each other; each has an arrow proceeding from it and to it, but the pair *ab* is distinguished from the pair *ba*, for an arrow proceeds from *a* to *b*, but none from *b* to *a*.

In the same way we have distinguished and undistinguished triads, tetrads, &c.

Every collection of units has a definite *form*, due—(1) to the number of its component units, and (2) to the way in which the distinguished and undistinguished units, pairs, triads, &c., are distributed through the collection. Two collections of the same number of units, but having different *distributions*, will be of different forms. The angular points of a cube and of a regular plane octagon furnish examples of two systems of eight units, having different distributions. In the former case there are three sorts of pairs, in the latter four.

Each of the forms which a system of *n* units can assume owing to varieties of distribution is one of a definite number of possible forms, and the peculiarities and properties of the collection depend, as far as the processes of reasoning are concerned, upon the particular form it assumes, and are independent of the dress—geometrical, logical, algebraical, &c.—in which it is presented; so that two systems which are of the same form have precisely the same properties, although the garbs in which they are severally clothed may by their dissimilarity lead us to place the systems under very different categories, and even to regard them as belonging to "different branches of science."

It may seem in some cases that other considerations are involved besides "form," but it will be found on investigation that the introduction of such considerations involves also the introduction of fresh units, and then we have merely to consider the form of the enlarged collection.

Taking these principles as a basis, the memoir, which is a lengthy one of 426 sections arranged under 42 heads, discusses the various forms which systems can assume, and gives some general modes, graphical and literal, of representing them. The genesis of algebras is considered, and the nature of the particular forms dealt with in geometry, ordinary algebra, formal logic, and other cases, is specified.

Zoological Society, June 16.—Prof. W. H. Flower, President, in the chair.—The Secretary read some extracts from a letter addressed to him by Mr. J. Buttikofer, of the Leyden Museum, calling attention to a paper published in 1857 by the late Dr. Bernstein, concerning the material of which the edible birds' nests of *Collocalia esculenta* are composed.—A letter was read from Major-General Sir Peter Lumsden, K.C.B., giving details of the place and time of capture of two young Snow-Leopards sent down from the Afghan frontier to Quettah, and intended for the Society's collection.—Mr. Oldfield Thomas exhibited and remarked on a specimen of a rare burrowing Rodent (*Heterocephalus glaber*) procured by Mr. E. Lort Phillips during his recent expedition in Somaliland, remarkable for having an almost completely naked skin, and for its extraordinary habits.—Dr. Guillemard exhibited a series of eight skulls of the Kamtschatkan Wild Sheep (*Ovis nivicola*), pointing out the difference existing between it and *O. canadensis*.—Mr. W. T. Blanford exhibited the skull and an imperfect skin of a supposed new species of *Paradoxurus* from the Pulnai Hills, Southern India.—A communication was read from Dr. G. Hartlaub, F.M.Z.S., giving an account of a new species of Parrot of the genus *Psittacula* recently received from Barranquilla, U.S. of Colombia, which he proposed to describe as *Psittacula spengeli*.—Dr. Guillemard, F.Z.S., read the sixth part of his report on the collection of birds formed during the voyage of the yacht *Marchesa*. The present communication treated of the birds collected in New Guinea and the Papuan Islands.—Dr. Guillemard also exhibited a very fine series of Paradiseidæ obtained during the yacht's voyage.—Mr. G. A. Boulenger read a paper containing a description of the German River-Frog (*Rana esculenta*, var. *ridibunda*, Pallas).—Mr. P. L. Sclater read the description of a new species of *Icterus*, obtained by Mr. Hauxwell on the Upper Amazons, which he proposed to name *I. hauxwelli*.—A second paper by Mr. Sclater contained notes on the way in which *Lemur macaco* carries its young, as observed in a specimen living in the Society's Gardens.—Mr. A. D. Bartlett read some notes on the female Chimpanzee now living in the Society's Gardens, which he showed to be different from the ordinary Chimpanzee, and to be probably the *Troglodytes calvus* of Du Chaillu.—Dr. Gadow, C.M.Z.S., communicated a memoir by Miss Beatrice Lindsay, of Girton College, Cambridge, upon the Avian Sternum. The different theories held as to the origin of the sternum having been reviewed, the author proceeded, after an explanation of the various types of structure examined, to give an account of her own views. Miss Lindsay came to the conclusion that the keel is an apophysis of the two halves of the sternum, and is not produced by the clavicles or any other parts belonging to the shoulder-girdle; also that the part of the sternum whereof the keel is an outgrowth is itself of secondary origin, and that the various processes of the sternum are produced by addition and not by resorption of bony matter.—Col. J. Biddulph read a paper on the Rocky Mountain Sheep, in reference to the new geographical race lately named by Mr. Nelson *Ovis montana dalli*, and confirming the view that there are two distinct types or races of this sheep in North America.

Geological Society, June 10.—Prof. T. G. Bonney, F.R.S., President, in the chair.—Dr. A. G. Nathorst, of Stockholm, was proposed as a Foreign Correspondent of this Society.—The following communications were read:—Note on the sternal apparatus in *Iguanodon*, by J. W. Hulke, F.R.S., V.P.G.S.—The Lower Palæozoic rocks of the neighbourhood of Haverfordwest, by J. E. Marr, F.G.S., and T. Roberts, F.G.S.—On certain fossiliferous nodules and fragments of hæmatite (sometimes magnetite) from the (so-called) Permian breccias of Leicestershire and South Derbyshire, by W. S. Gresley, F.G.S.

SYDNEY

Linnean Society of New South Wales, April 29.—Dr. James C. Cox, F.L.S., Vice-President, in the chair.—The following papers were read:—Revision of the genus *Lamprima*, with descriptions of new species, by William Macleay, F.L.S.—Notes on the zoology of the Maclay Coast, New Guinea, by N. de Miklouho-Maclay. This paper consists of a carefully detailed account and description of a rare species of *Macropus*, to which the Baron gives the specific name of *Tibol*, the native name for the animal. A plate accompanies the paper.—On two new species of *Dorcopsis* from the south coast of New Guinea, by N. de Miklouho-Maclay. This contains descriptions and illustrations of *Dorcopsis macleayi* and *D beccari*, two new species in the Macleay Museum. This brings the number of known species of the genus up to five.—The Australian sponges recently described by Carter, by R. von Lendenfeld, Ph.D.—On the fertilisation of *Goodenia hederacea*, by Alex. G. Hamilton.—Notes on the habits of *Falco subniger* and *Glareola grallaria*, by K. H. Bennett.—The geology of Dubbo, by the Rev. J. Milne Curran.—Dr. J. C. Cox exhibited a sandstone nodule, the outer crust of which to a considerable depth was stained with iron, the original colour, as shown by the central portion, having been white. Also a large *Cephalopod*, belonging to the family *Sepiidæ* and genus *Sepia*, which had been recently presented to the Australian Museum by the Hon. William Macleay. This unique specimen is about three feet long from the hinder part to the apex of the arms; the body is about eighteen inches long, and eighteen inches broad, deeply notched at the lower margin, and peaked in the centre at the neck, and arched on each side; the head is about eighteen inches from the body to the apex of the arms. It is of a dark brown olive colour, quite smooth, the tentacles are about two feet long, the cups on the arms do not correspond with any known species, nor do the cups on the tentacles; it is very like *Sepia tuberculata* of Lamarck, but no tubercles exist on the surface, and it is much longer. *Sepia vermiculata* of Quoy and Gaim. is very like it, but is only fifteen inches long; most of the species, however, of the genus have been described from the shell.

PARIS

Academy of Sciences, June 29.—M. Bouley, President, in the chair—Remarks on Poinsot's theory, and on two movements corresponding to the same polhodie, by M. G. Darboux.—On Palmieri's experiments relative to atmospheric electricity, by M. Faye.—Remarks on the same subject by M. Mascart.—Researches on isomery in the aromatic series. Heat of neutralisation of the oxybenzoic acids, by MM. Berthelot and Werner.

—Note on the monument to be erected to the memory of Nicolas Leblanc, inventor of artificial soda, by M. Eug. Peligot. For various reasons it has been decided to place in the Conservatoire des Arts et Métiers the statue raised by international subscription to Leblanc. In the report of the Committee it is stated that the illustrious savant was born, not at Issoudun, as is generally supposed, but at Yvry-le-Pré, Department of the Cher, on December 6, 1742.—Note on the peculiar properties of Poinsot's "herpolhodie" curve, by M. J. N. Franke.—Remarks on the same subject, by M. Darboux.—On the reduction of the problem of the brachistochrones to canonical equations, by M. Andoyer. —On the secular variation of the magnetic declination at Rio de Janeiro, by M. Cruls.—On the crepuscular light, by M. P. J. Denza. These after-glows, which seem to have become nearly extinct during the past winter, have again begun to appear about the beginning of this summer. At Moncalieri, and in other parts of Italy and Sicily, they became very intense towards the end of May, and their brilliancy was even increased during the first days of the month of June. On the 13th especially the effects were most surprising, rivalling those witnessed during the winter of 1883. The phases of the phenomenon have also closely resembled those so often described during the periods of its greatest intensity. The author considers that all this tends more and more to confirm his own theory, that the crepuscular lights are due, not to the Krakatoa eruption, but mainly to the vapour of water disseminated throughout the higher regions of the atmosphere.—On the reappearance of the crepuscular glows, by M. A. Boillot. The author describes the effects seen at Paris on June 12 and subsequently, and also considers that their reappearance can scarcely be brought into connection with the Krakatoa eruption of August, 1883.—On the nacreous crystals of sulphur, by M. D. Gernez.—On the properties of the persulphuret of hydrogen, by M. P. Sabatier.—On the nitrate of anhydrous ammoniacal ammonia on iron, zinc, and some other metals, by M. G. Arth.—Note on the reduction of the hexatomic alcohols, by MM. J. A. Le Bel and M. Wassermann. —On a new method of preparing pyrocatechine, by M. J. Meunier.—On the action of chlorine and iodine on pilocarpine, by M Chastaing.—Note on the quantitative analysis of the phosphoric acid present in the natural and mineral phosphates employed for manuring the soil, by M. E. Aubin.—On the development of the vascular glands in the embryo, by M. Retterer.—On a new type of Sarcosporidies, by M. R. Blanchard.—Calorimetric observations on children, by M. Ch. Richet.—New researches on the regeneration of the nerves in the periphery of animal organisms, by M. C. Vanlair.—A note on the influence of the attraction of the moon on the creation of the Gulf Stream was submitted, by M. Ch. Dufour.

BERLIN

Meteorological Society, June 2.—Dr. Neuhauss communicated meteorological observations instituted by him during a voyage around the world from April to December last year. During the whole passage through the Mediterranean Sea, the Suez Canal, the Red Sea, the Indian and Pacific Ocean, he had regularly every day made observations with a compared thermometer, aneroid barometer, and psychrometer, of the temperature and the atmospheric pressure every two hours from 6 a.m. till 8 p.m., and three times a day determinations of the humidity. His attention was specially directed to determine these meteorological conditions within the tropics and more particularly in the neighbourhood of the equator. Among the more noteworthy results of these observations he showed that the daily range of temperature over the Suez Canal amounted to 29°·2 F., from a maximum of about 86°·0 to a minimum of 56°·8, while the range of temperature on the Red Sea was only about 6°·8 to 9°·0, and that on the Indian Ocean in the neighbourhood of the equator was still less. The maximum temperature under the equator amounted nearly to 99°·5, and always coincided with the culminating point of the sun. The opinion that the maximum temperature in the tropics occurred at 10 a.m. was not confirmed by the observations. What was observed on this point was simply that the maximum temperature frequently began in the region of the tropics at 10 a.m., and lasted two hours, when, from some secondary cause or other, a small abatement of only a few tenths of a degree might be observed just at 12 noon. Squalls and rain-showers were always accompanied by a sinking of temperature which occasionally showed a range of 4°·5. On his voyage from New Zealand to Hawaii in June and July Dr. Neuhauss daily observed within the tropics a constant rising of the temperature till evening, reaching the maximum between 6 and 8 p.m. On the open sea he nowhere found higher temperatures than those he had observed on first crossing the equator. The registrations of the barometer within the tropics exhibited the well-known daily oscillation of the atmospheric pressure with two maxima and two minima. The first maximum showed itself at 10 a.m., the second at 6 p.m. It was remarkable that the squalls and rain-showers did not affect the regular march of the barometer. The hygrometric observations in the tropics on the Indian Ocean yielded considerably less daily amplitudes than on the Mediterranean Sea and on the Suez Canal. The phenomena of the twilight on the Indian Ocean, whose magnificence of colour was described, were particularly beautiful. Very noteworthy were the observations on the duration of the twilight, but a regular difference between the evening and the morning twilight was not established. Their respective durations on particular days were, on the other hand, very unequal. The astronomical twilight—*i.e.* the time from sunset till the last evanescence of light in the western sky—usually lasted from an hour to an hour and a quarter. The end of the twilight at sea could be precisely determined to a second. A great charm was afforded in the observations of the zodiacal light, which Dr. Neuhauss was able to watch every morning before sunrise on the Indian Ocean. In the evening with fatigued eyes the observation of the zodiacal light was not successful. In the morning, on the other hand, the bluish-white light pyramid could be followed by the eye to the zenith. Its brightness excelled that of the brightest parts of the Milky Way; its light was quite steady without any quiverings, and thus showed no polarisation. This phenomenon, still so little understood, was recommended as an object of observation to marine officers.—Prof. Spörer described a whirlwind observed at Potsdam on April 15 at 12 noon. The air was quite still, the sky perfectly clear, when, from a grassy sward begirt by bush, an eye-witness observed the whirlwind arise. He first heard a rustling in the leaves of the shrubs, and then observed a column of dust, of about the height of the surrounding inclosures, which, on its continued movement, split into two vortices. One of these, or perhaps only a branch of one, moving onward, without leaving any traces on its way, arrived at a neighbouring garden, where, at a particular spot, it tore up and carried aloft in a whirling manner to a considerable height the windows of several hot-beds, rending them in pieces. The weight of each of these windows was about 30 lbs. Thence the whirlwind advanced towards a neighbouring garden and tore off the windows, which were open in the direction from which the whirlwind was coming. On its further course, which was marked out by a powerful rushing noise and by a very high dust-column, the whirlwind inflicted no more destruction. Prof. Spörer was of opinion that the whirlwind originated and grew in intensity over ground which was greatly heated, just as happens in volcanic outbursts and high protuberances of the sun, when in the one case ashes and in the other hydrogen are swept aloft over highly heated surfaces.

Physiological Society, June 5.—Prof. Brieger, following up his communications of a year ago, reported on his further investigations into the ptomaïnes. In his former communications the speaker had described five well-characterised bases —neurine, muscarine, neuridine, and two other diamines—extracted from the ptomaïnes, which were developed in putrefying nitrogenous substances, and in the form of beautiful crystallised salts, and had subjected them to precise chemical and physiological analysis. As the result of this analysis, neurine, muscarine, and a base similar to, but not identical with, trimethyldiamine had were found to be very violent poisons, while the two others showed themselves to be less poisonous. Seeing that the ptomaïnes must here be regarded as products o the putrefactive bacteria, Prof. Brieger set himself the task o studying the products of pathogenic bacteria. He proceeded, however, beforehand to investigate the ptomaïnes which developed under natural putrefaction in the case of human corpses, and found that here quite different bases came to light than those which appeared under artificial putrefaction. Immediately after death lecithin decomposed itself, and large quantities of choline became developed, and, along with this base, neuridine appeared on the third day of putrefaction, increasing in quantity with the progress of putrefaction. From the seventh day after death there came to view an entirely new base, which, with hydrochlorate of platinum, yielded very beautiful crystals, and, both in this connection as also in the form of hydrochlorate of gold and in its conjunction with hydrochloric acid, had been searchingly examined. This base, altogether different both in its quantities and in its composition from the bases hitherto known, was named "cadaverine." It increased in quantity with time while choline and neuridine diminished. Later on there appeared another new base which was also characterised by its hydrochlorates of platinum and gold, as likewise by its chemical composition, which the speaker called "putrescine" and was able to show in the form of beautiful crystals, both in a pure state and in the hydrochlorates of platinum and gold. Both these new bases, cadaverine as well as putrescine, acted but weakly on the animal organism. The first possessed the well-known smell of coniine, which former observers had already noticed in putrefying bodies. Besides these weakly acting nitrogenous bases, there were found in the later stages of putrefaction two diamines of very powerfully poisonous effect, which, injected even in small doses in animals experimented on, produced death under paralysis. These two were presented in distinct crystals and isolated. A survey of the whole series of isolated ptomaïnes taken from corrupting nitrogenous substances showed that, contrary to the former assumption, they were all simply compound, that they were all diamines belonging to the series of fats. Their great resemblance to vegetable alkaloids rendered it necessary that in the case of chemical investigations only such alkaloids and bases should be deemed demonstrated to exist in a dead body which had been isolated and had been presented in their characteristic salt-crystals. In the endeavour to study the bases produced by pathogenic bacilli Prof. Brieger had examined artificial cultures of bacilli, and first the typhoid bacillus on peptone. This led to no positive result. It was the culture of the typhoid bacillus on meat infusion and meat jelly which first led to the isolation of two new intensely poisonous bases, one of which, being injected in small quantities into animals, acted similarly to neurine, producing death under a strong flow of saliva, paralysis and diarrhœa, while the other produced only violent exhausting diarrhœa. The small quantities of these poisons did not yet, however, allow them to be sufficiently characterised chemically. They appeared to be triamines, and should be further investigated. The method adopted in the course of this investigation promised additional important results.—Dr. H. Virchow communicated the observations he had made on the cells of the vitreous humour, regarding which the opinion had hitherto been entertained that they were lymph cells which had emigrated from the blood-vessels, and which, by reason of their amœboid movements, presented the most various forms either on the surface or in the interior of the vitreous body. Dr. Virchow had first examined the vitreous body of very different species of fish, and in the case of these animals, which were provided with vessels of the vitreous humour, he had established that the cells were perfectly fixed, invariable formations, which manifested themselves so characteristically that it was possible to distinguish the particular species by the particular form of the cells of the vitreous humour. This conclusion determined the speaker to examine the vitreous humour of other cold-blooded animals, and he chose frogs for this purpose, and had, besides, examined the vitreous body in an Alpaca sheep and in the fowl. After a description of the methods of examination he had adopted, he described minutely the forms of the cells of the vitreous body he had found in these different animals. In the case of the sheep he found them ranged only on the surface in perfectly definite order; they here consisted of small, round nuclei surrounded by large masses of protoplasm manifoldly sinuated and branched. In the case of the fowl the cells likewise lay on the surface of the vitreous body in regular arrangement. The protoplasm surrounding the nuclei was, however, in part drawn out lengthwise and branched at the ends, in part stellate, divided into thin rays, in part irregularly arranged. In the case of the frogs the greatest multiplicity of forms was met with. The cells lay either between the blood-capillaries or on them, and in this case were to be recognised only with great difficulty. The nuclei were mostly longish, and around these nuclei extended the delicate protoplasm, often spun out in fine lines of fibres between the vessels, or covering them. In the case of a few cells long processes extended from the protoplasm, of which single pieces had detached themselves. In the case of others the protoplasm had spread itself out into a very wide, uncommonly delicate film covering the vitreous body. Other cells, again, had granular protoplasm, and were either round, with a large round nucleus, or were more or less lengthened to the degree even of a filiform shape. To relate these different forms of the cells of the vitreous humour each to an integral characteristic difference in the species to which it belonged, was more than the speaker had been able to accomplish. Towards the solution of this problem further investigations would be required. —Herr Aronsohn communicated the further experiences which, in conjunction with Herr Sachs, he had collected relative to the heat-centre in the cerebrum, discovered by him last year. When on a perfectly definite part of the cerebrum he pricked with a needle so deeply as to touch the parts lying under the cortex, then he observed a rise of temperature in the rectum, in the muscles, and in the skin of from about 1° to 2° C. The prick had to touch the corpus striatum in order to produce a rise of temperature, and in point of fact it was only the median part of the corpus striatum which, on being touched, gave rise to this result. No other part, however nearly situated to this spot, could, on being touched, produce this rise of temperature. The increase of temperature continued for about three hours after the prick, and affected the two sides even when the wounding of the brain was only one-sided. Electrical stimulation of the same limited spot produced a similar result. Whether there were ganglions lying on the spot in question, which influenced the production of warmth, or whether only definite nerve-tracts were touched, was a question which could not be decided. In order to ascertain the immediate cause of the increase of temperature, experiments regarding the respiration, and determinations of the urea were simultaneously carried out. These experiments showed that immediately after the corpus striatum was pricked the inhalation of oxygen and the exhalation of carbonic acid were increased, and that the secretion of urea was augmented. It was therefore clear that an increase in the metabolism generally followed the prick, an increase which, in the opinion of the speaker, was due to the heightened innervation of the muscular system caused by the prick or the electrical stimulation.

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