THURSDAY, JUNE 4, 1885

THE DEINOCERATA OF WYOMING

Dinocerata, a Monograph of an Extinct Order of Gigantic Mammals. By O. C. Marsh. Monographs of the U.S. Geological Survey. Vol. X. (1884.)

ON the high plateau that lies to the west of the Rocky Mountains, along the southern borders of Wyoming Territory, the traveller who is moving westwards begins to enter upon a peculiar scenery. Bare, treeless wastes of naked stone, crumbling into sand and dust, arise here and there into terraced ledges and strange tower-like prominences, and sink into hollows where the water gathers in salt or bitter pools. Under the cloudless sky, and in the dry clear atmosphere, the extraordinary colouring of these landscapes forms, perhaps, their weirdest feature. Bars of deep red alternate with strips of orange, now deepening into sombre browns, now blazing out again into flaming vermilion, with belts of lilac, buff, pale green, and white. And everywhere the colours run in almost horizontal bands, the same band being continuous and traceable from hill to hill, and tower to tower, across hollow and river-gorge for mile after mile through this rocky desert. These parallel strips of colour mark the nearly horizontal stratification of the rocks that cover all this wide plateau country. They are the tints characteristic of an enormous accumulation of sedimentary rocks that mark the site of a vast Eocene lake or succession of lakes on what is now nearly the crest of the continent. These lacustrine sediments, in all somewhere about two miles in vertical thickness, were doubtless laid down during a slow subsidence of the lacustrine area, when the subterranean movements were in progress that finally gave the mountain-ranges and plateaux their present forms and altitudes. They represent a vastly protracted period of quiet sedimentation, in the immediate proximity of an extensive land-surface plentifully clothed with a tropical vegetation, and abounding in varied forms of animal life. They consequently offer to the geologist peculiar facilities for investigating the evolution of a fauna apparently exposed to the minimum of interference from changes in its environment.

It is now about fifteen years since the wonders sealed up within the sediments of these vanished lakes first began to be known. The wandering Indian, indeed, had long been familiar with the skulls and skeletons which, by the decay of the inclosing rock, looked out upon him from the side of *butte* and *cañon*. But he revered them as the bones of his ancestors, and left them untouched, to be disinterred by the ceaseless working of wind and rain. The earliest trappers, squatters, and prospectors brought back news of marvellous monsters grinning from the ledges of rock beneath which they camped. At last these tales attracted the notice of some of the enthusiastic naturalists in the eastern States. Prof. Leidy, of Philadelphia, obtained a number of bones from which he was able to bring to light an entirely novel, and now wholly extinct creature, to which he gave the name of *Uintatherium*. Prof. E. W. Cope likewise described some forms disinterred by him in the same region. But the earliest and most successful investigator of these remains is Prof. O. C. Marsh, who, as far back as 1870, began the search in the Green River basin, and who, after many years of most laborious research, both among the western deserts and in his wonderful collection at Yale College, has at last been able to publish this splendid monograph on the Deinocerata. No trouble or expense has been spared to obtain material for the study of these strange extinct creatures. One expedition after another has been despatched to the West, and many tons of bones have been deposited at Yale, where it is believed there are now represented more than two hundred individuals of the Deinocerata alone. Some of these remains are admirably preserved; indeed, had the animals been still living, the materials for a knowledge of their osteology could hardly have been more perfect than it is.

The Deinocerata form an order established by Prof. Marsh to include some peculiar and well-marked forms found in the lacustrine deposits of the Green River basin—a tributary of the Colorado River of the West. This order belongs to the Ungulates, some of the characters allying it with the Artiodactyls (*Paraxonia*), others with the Perissodactyls (*Mesaxonia*); while in others, again, it is linked with the Proboscidians. The points of resemblance, however, are usually, in the author's opinion, such general characters as seem to point backward to some ancestral ungulate, rather than to any near affinity with existing forms of these groups. The Deinocerata include three genera which occupy three successive stratigraphical horizons. The oldest, Uintatherium, found in the lower strata of the Eocene lake, appears to be the most primitive type; the youngest, *Tinoceras*, found at the highest level, is the most specialised; *Dinoceras* being an intermediate form. The number of species belonging to the order has not been satisfactorily determined, but about thirty forms more or less distinct have been recognised.

Comparing *Dinoceras* with the large living Ungulates, Prof. Marsh points out that in size and proportions it was intermediate between the elephant and rhinoceros, but had also features akin to those of the hippopotamus, while in its stature and movements it probably resembled the elephant as much as any existing animal. It presented certain striking peculiarities which at once marked it off from any form now familiar to us. The skull in particular wore an altogether extraordinary aspect. It was long and narrow, and on its top it supported three separate transverse pairs of high osseous protuberances or horn-cores, which may have been covered with bosses of thick skin, and were no doubt powerful offensive weapons. The canine teeth were enormously developed in the male, forming short, trenchant, decurved tusks, which were protected by a dependent process on the lower jaw. The nasal bones were so elongated as to form nearly half the length of the entire skull, projecting forward and overhanging the premaxillaries. There was probably no proboscis, for the neck was long enough to allow the head to reach the ground without it, but there is some evidence of a thick flexible lip, perhaps like that of the rhinoceros. The brain was proportionately smaller than in any other known mammal, recent or fossil, and even less than in some reptiles. In one species at least it was so diminutive that it apparently could have been drawn through the neural canal of all the pre-sacral vertebræ, certainly through the cervicals and lumbars. The limbs were massive and heavy, the bones, like those of the rest of the skeleton, being nearly or quite solid. The fore-foot was larger than the hind-foot, its component bones being comparatively short and massive, with five well-developed digits, as in Proboscidians, but the carpal bones interlocked with the metacarpals as in Perissodactyls. The feet, as in the modern elephant, were plantigrade, and were doubtless covered below with a thick pad.

We can picture these dull, heavy, slow-moving creatures haunting the forests and palm-jungles around the margin of a great lake. Into the quiet depths of that lake their carcases from time to time found their way, swept down perhaps by river-floods. Among their contemporaries were other forms whose remains have also been more or less abundantly preserved in the same deposits. Of these, two genera next in size to the Dinocerata were Perissodactyl ungulates somewhat larger than a tapir (*Palæosyops* and *Limnohyus*). Another interesting form is *Orohippus*—a four-toed ancestor of the living horse, while additional varieties of the ungulate type were related, though distantly, to the tapir and rhinoceros (*Colonoceras*, *Helaletes*, *Hyrachyus*). Two remarkable genera (*Tillotherium*, *Stylinodon*), nearly as large as a tapir, possessed characters resembling those of the ungulates, carnivores, and rodents, and have been embraced by the author in a new order called by him *Tillodontia*. Among the carnivores there was one (*Limnofelis*) nearly as large as a lion, and another hardly less in size (*Oreocyon*), while *Dromocyon* was somewhat smaller and *Limnocyon* about as large as a fox. There were likewise lemurs having some affinities with South American marmosets; also representatives of the Marsupials, Insectivora, Chiroptera, and Rodentia, but no true Quadrumana or Edentates. Reptiles abounded, especially crocodiles, turtles, lizards, and serpents, while fishes of many kinds swam in the lake.

The structure and history of the Deinocerata with their place and affinities in the animal kingdom are fully discussed in this important monograph. Like his previous work on toothed birds in the same series of memoirs, Prof. Marsh's present volume is an admirably executed and exhaustive research. Every bone is carefully worked out and drawn. Every available fragment of evidence is patiently collected, compared, and tabulated. Whatever may be disputable regarding the conclusions drawn, there can be no variety of opinion as to the actual data. No fewer than fifty-six lithographic plates, and nearly 200 woodcuts depict with singular fidelity every part of the skeleton of the Deinocerata as at present known.

But Prof. Marsh is much more than a comparative anatomist. It is not enough for him to describe the bones he has unearthed, and to point out their analogies in the living world. He is instinctively an evolutionist, and every extinct animal seems to propound to him the problem of its ancestry and its descendants. One of the most suggestive chapters in his present memoir is devoted to the genealogy of ungulate animals, and the place of the Deinocerata among them. He believes that from some primitive form, of generalised type, probably small in size, resembling generally an insectivore, and going back at least as far as Permian time, all the mammalian tribes have descended. Such a genealogical mammal, belonging to Prof. Huxley's group of *Hypotheria*, would possess all the general characters of the subsequently developed mammalian orders. But special characters, acquired in adaptation to conditions of environment, would be developed in the course of time, and would lead to the establishment of different modified types. The general characters would thus alone be a safe guide in tracing a community of ancestry, while those of a special kind need not necessarily indicate affinity, but may have independently arisen from the influence of the same surroundings in groups already quite distinct from each other. In the Cretaceous system, a well-marked group of mammals is found which is represented now by the living Hyrax, along what appears to have been the main stem of ungulate descent. From this stem, after the remarkable waning of reptilian life at the close of the Mesozoic ages, there diverged, in Cretaceous times, a branch which terminated in *Coryphodon*—a tapir-like form which, both in America and in Europe, probably quite equalled if it did not surpass in size and power any of the representatives of the fading reptilian types of an older creation. Another branch which may have been given off about the same time reached its full development in the Deinocerata, which were certainly the monarchs of the region where they lived. But nothing is more striking in the history of these and the other colossal mammals than the rapidity with which they appear and disappear from the scene. *Dinoceras* and its allies, so far as the evidence yet goes, appear to have been restricted to the middle part of the Eocene period. Their remains are not found in the earlier deposits of that period, and cease to occur before we reach the upper parts of the series. The cause of this speedy extinction is to be sought, according to Prof. Marsh, in the small brain of the animals, their highly specialised characters, and huge bulk, whereby they were unfitted for adapting themselves with sufficient rapidity to new conditions; and a change of surroundings brought about their extinction. But this is a point on which the geologist may not unnaturally claim to be heard when he demands some evidence of such change of surroundings. Had the supposed geological vicissitudes been sufficiently serious to cause the extinction of a whole tribe or sub-order of large mammals, they might have been expected to have left some palpable evidence of their passage in a corresponding change in the nature of the deposits accumulated in the lakes. But there is certainly nothing in the nature or succession of these deposits to suggest that any important modifications of topography or climate took place during the time when they were being deposited. On the contrary, they seem to point to protracted uniformity in the conditions of sedimentation. They afford no indication whatever that the successive appearance of *Coryphodon*, *Dinoceras*, and *Diplacodon* was accompanied, far less was determined by, any essential change of physical conditions. That such change actually took place is of course quite conceivable, but when it is demanded as an essential factor in mammalian evolution, some admissible proof may very fairly be demanded.

Like Prof. Marsh's previous memoir on "Odontornithes," the present volume may be regarded as a model monograph. It is complete without being overloaded, exhaustive and yet lucid and interesting from beginning to end. After reading it one feels that the Deinocerata are no longer extinct, vanished forms, but familiar acquaintances which one could not fail to recognise anywhere. Every part of their structure is methodically presented to view, and restorations are given showing the relations of the parts to each other and what is the author's conception of the general form of the animals. It has hardly ever been possible in the Old World to reconstruct the mammalia of so early a period from such ample materials as are now amassed at Yale College. Hence the restorations attempted have often been little more than more or less probable conjectures which might be conformed but were more usually corrected or even effaced by the progress of discovery. So full, however, is the evidence for Prof. Marsh's restorations, that there remains very little room for future emendation. He is still engaged in continuing these remarkable memoirs on the ancient life of the North American continent. A third monograph on the *Sauropoda* is approaching completion, and a fourth, on the *Stegosauria*, is far advanced. These large and profusely illustrated works are issued as part of the work of the United States Geological Survey. They reflect the highest honour on their indefatigable author, and on the Survey which undertakes their publication.

ARCH. GEIKIE

REMSEN'S "ORGANIC CHEMISTRY"

An Introduction to the Study of the Compounds of Carbon; or, Organic Chemistry. By Ira Remsen, Professor of Chemistry in the Johns Hopkins University. Pp. x., 364. (Boston: Ginn, Heath, and Co., 1885.)

THIS is chemistry. Of how few books professing to be books on chemistry can it be said that they teach us anything of the science. The student who begins the study of the carbon compounds has to suffer many things from the text-books. Some of them present him with dry bones in the shape of isolated facts and bold assertions regarding structural formulæ and the linking of atoms. Others lead him into speculations which he is unprepared to follow; he makes little flights into these and comes back fancying he is a chemist. Other books (there are not many of them) proceed on the true scientific lines; but very frequently their pages are encumbered with too many facts about more or less widely separated compounds, or they deal so much with groups of compounds, rather than with typical individual bodies, that the beginner soon loses his way, becomes perplexed, and is ready to abandon the pursuit.

Prof. Remsen has shown us a more excellent way than any of these. He leads the learner by degrees through the early difficulties; he places before him distinct and detailed accounts of a few typical compounds; he shows him how these compounds are mutually related; and then he takes him back to the beginning again and teaches him how each compound he has learned to know represents a group, and how, when he knows the properties of one member of the group he also knows much about all the members.

At the outset Prof. Remsen makes a few wise and pregnant remarks on the meaning of structural formulæ. These "enable the chemist who *understands* the language in which they are written to see relations which might easily escape his attention without their aid. In order to *understand* them, however, the student must have a knowledge of the reactions upon which they are based; and he is warned not to accept any chemical formula unless he can see the reasons for accepting it." The whole book is a practical sermon on this text.

In no other elementary book in the English language will the student find so many admirably chosen examples of the formation of structural formulæ. The important facts are noted; then the inference is drawn; then the hypothesis is ventured upon; analogous facts are recalled; the hypothesis is strengthened or weakened; suggestions are made; experiments are conducted; and all is finally summarised in the formula. But the book is more than a selection of examples showing how structural formulæ ought to be gained. It is a systematic although elementary treatise on organic chemistry. The student is first taught about the two paraffins, methane and ethane; then he learns how the halogen derivatives of these are prepared, and what relations they bear to the parent hydrocarbons. By this time he has had his first taste of isomerism. Then he proceeds to the oxygen derivatives of methane and ethane; he learns what an alcohol is; he becomes acquainted with ether, aldehyde, formic and acetic acids, some ethereal salts, and acetone. This method of studying a few simple compounds in detail is pursued until the student is more or less familiar with representatives of all the principal groups of compounds derived from the paraffins. He is now in a position to study these hydrocarbons as a group, and to deal in some detail with the questions of isomerism. When the paraffins and their derivatives have been thus studied, the more difficult subject of the benzenes and their compounds is approached. And here the author shows an admirable power of dealing with facts as facts, and with theories as theories. What could be better than the following remarks regarding saturated and unsaturated compounds?

"In the aldehydes and ketones, carbon is in combination with oxygen in the carbonyl condition. When they unite with hydrogen and some compounds, such as hydrocyanic acid, the relation between the carbon and oxygen is probably changed, the latter being in the hydroxyl condition. The changes are usually represented by formulas such as the following:—

$$CH_3.C\begin{matrix}\diagup O \\ \diagdown H\end{matrix} + H_2 = CH_3.C\begin{matrix}\diagup OH \\ \diagdown H_2\end{matrix},$$

$$\begin{matrix}H_3C\diagdown \\ H_3C\diagup\end{matrix}C = O + HCN = \begin{matrix}H_3C\diagdown \\ H_3C\diagup\end{matrix}C\begin{matrix}\diagup CN \\ \diagdown OH\end{matrix}.$$

In the carbonyl group the oxygen is represented as held by two bonds to the carbon atom, while in the hydroxyl condition it is represented as held by one bond. The signs may be used if care is taken to avoid a too literal interpretation of them. There are undoubtedly two relations which carbon and oxygen bear to each other in carbon compounds. These relations may be called *the hydroxyl relation*, represented by the sign C—O—, and *the carbonyl relation*, represented by the sign C=O" (pp. 209–10).

How different this is to the crude, glaring statements that annoy the reader of the commonplace text-book written by the Philistine.

The fact that structural formulæ help us to understand the relations existing between the parts of specified molecules is strongly insisted on throughout this book. When we know nothing of these relations the author does not hesitate to tell us so. Thus, regarding the formula of benzene, as commonly written with successive double and single bonds, he says (p. 239):—"This formula, however, expresses something about which we know nothing, and concerning which it is difficult at present to form any conception. The simpler formula [*i.e.* the hexagon without any double bonds] leaves the question as to the relation between the carbon atoms entirely open, as it is in fact." And again, speaking of the structure of the molecule of ethylene, Prof. Remsen remarks (p. 213):—"As regards the relations between the two carbon atoms of ethylene we know nothing, save that it is probably different from that which exists between the carbon atoms of ethane."

A most instructive example of the methods pursued in organic chemistry, and at the same time of the scientific method of inquiry, is to be found on pp. 318-321, where the reactions of phenol-phthaleïn are discussed. The facts are given, but they seem only facts until some light is shed on them by the appearance in one reaction of triphenylmethane, a substance already familiar to the student. The student is shown how "this suggests that all the substances [he has been examining] are derivatives of this fundamental hydrocarbon." And he is asked to note how easily, when this conception has once been formed, the interpretation of all the reactions follows.

Many other admirable illustrations of the scientific method of inquiry are to be found throughout the book. I would especially draw attention to the simple but thoroughgoing treatment of the "equivalency of the hydrogen atoms" in the molecule CH_4 (pp. 28-29), and in the molecule C_6H_6 (pp. 234-236). It is on subjects such as are discussed in the pages referred to that the chemical student so frequently suffers shipwreck. If he will use this little book by Prof. Remsen as his pilot, and will keep a good look out as he proceeds, he may hope to pass the shoals of the hexagon-formula, and the shallows of the ortho-, meta-, and para-derivatives of benzene.

The author of this book deserves the thanks of all chemical teachers who have tried to teach organic chemistry to beginners for the clear and short directions which he gives for preparing the more important compounds of carbon. The book may well be used as a laboratory guide, no less than as an introduction to the science of organic chemistry.

Prof. Remsen has already done good service to the science of which he is a student, by publishing his "Principles of Theoretical Chemistry;" he has now given us a book which must be of great use in advancing the study of organic chemistry; could he not supplement these by an elementary but scientific treatise on inorganic chemistry? M. M. PATTISON MUIR

MINERALOGY IN CALIFORNIA

Fourth Annual Report of the State Mineralogist of California. By H. G. Hanks. 8vo, pp. 410. (Sacramento: State Printer.)

ALTHOUGH a systematic geological investigation of the State of California has been commenced at different times since 1853, the Legislature has generally got tired of providing the funds after a few years' continuance, and the work has been stopped. The most notable effort towards the provision of a complete geological description of the State was that made by Prof. J. D. Whitney, who, with a body of assistants, including men of the highest attainments in every collateral branch of natural science, carried on the survey from 1860 to 1873, when it was suddenly discontinued, to the great regret of scientific men both in America and Europe. No attempt to continue or supplement Prof. Whitney's work was made until 1880, when the author was appointed State mineralogist with the object of investigating questions more particularly connected with mining industry than with geology in the larger sense. The author during his period of office, which appears to be terminable and held for four years only, has founded a valuable mineral museum and library, more than 6000 specimens illustrative of the mineral deposits of the State having been collected and arranged. These do not, however, appear to be very sumptuously housed, as the author calls attention to the danger from fire, "as well as other inconveniences, such as the prevalence of ammoniacal and hippuric odours, and the disturbance of arranged specimens in the cases by the jarring made by the hoisting of hay by tackles attached to the underside of the museum floor. The California State Museum is well worthy of a good and thoroughly fireproof building." With the latter opinion our readers will no doubt heartily agree.

Besides the work of organising the museum the author has published annually a report upon some branch of mineral industry as carried out in the State—for instance, that for 1883 was largely devoted to the borax deposits of the mud lakes in the interior of the State. The present volume, described as the fourth and last report of the State mineralogist, is mainly devoted to a catalogue and description of the minerals of California as far as they are yet known. This is alphabetically arranged, and contains descriptions of the composition physical properties and uses of the different species, together with detailed information as to localities, and methods of working in the more important ones. Altogether 161 different species are described as having been found in California, but this number will no doubt be considerably increased by future explorers. At the present time, in addition to gold; mercury, petroleum, and borax are the chief products of importance, although as regards all of them the prevailing complaints of over-production and unremunerative prices appear to be as prevalent as in less favoured localities in the Old World. The condition of the gold-mining industry appears to be a very healthy one, for although the enormous annual yield, ranging from 10 to 13 millions sterling in 1850–55, has diminished to 3 and 4½ millions in the past four years; the increased facilities for working render it possible to handle at a profit rock not containing more than 12*s.* worth of gold in the ton; while in the earlier days 20 dollar (80*s.*) rock was not considered to be worth removal. The total value of the gold raised in California since 1848 is estimated at above 230,000,000*l.* in value, which if reduced to a single mass would be contained in a cube 14 feet 4 inches in the side.

Although the work is essentially a compilation, it is well arranged, and will be of great use to those interested in Californian minerals. A general introduction on the resources and industries of the State precedes the catalogue of minerals. This, though interesting matter, seems rather out of place. H. B.

ALGÆ

Rabenhorst's Kryptogamen-Flora von Deutschland, Oesterreich, und der Schweiz. Zweiter Band. Die Meeresalgen. Bearbeitet von Dr. F. Hauck. Nos. 7, 8, 9, 10. 8vo. (Leipzig: Ed. Kummer, 1883-1885.)

A Monograph of the Algæ of the Firth of Forth. By George William Traill. 4to. (Edinburgh: Printed for the Author, 1855.)

Notes on Marine Algæ. By Edw. Batters, F.L.S. (*Proceedings* of the Berwickshire Naturalist Club, 1884.)

THE concluding numbers of Dr. Hauck's work have recently appeared. To the description of species is added an appendix in which some new species are described. Then follow a comprehensive key to the genera; an index of families, genera, species, and synonyms; lists of illustrations, and of works on algæ, arranged alphabetically, according to the names of the authors; also the title-page, preface, and table of contents—all most useful auxiliaries to a scientific work.

To the favourable opinion of this work, already expressed in the columns of NATURE (vol. xxix. p. 341), it may be added that the later numbers, treating of the Chlorozoosporeæ and the Schizophyceæ, fully justify this opinion, and Dr. Hauck must be congratulated on the successful completion of what has undoubtedly been an arduous undertaking.

In turning over the pages of the work, one cannot but be struck by the variety of views which, in spite of the closest examination by competent observers with the aid of the best microscopes, still prevail among algologists as to the systematic position of certain algæ.

Not to multiply instances, it will be sufficient to mention the genera Porphyra and Bangia. By Dr. Berthold and Dr. Hauck they are classed with the Florideæ; while Dr. Agardh and M. Rosanoff place them among the Ulvaceæ. As to Goniotrichum, which Dr. Agardh relegates to the Ulvaceæ and Dr. Berthold includes in the Bangiaceæ, Dr. Hauck, in despair of discovering its affinities, places it at the end of the description of species, as of still doubtful position.

Although it may be doubted whether all Dr. Hauck's identifications of British Algæ will be admitted by our botanists, yet the work cannot fail to prove extremely useful in this country, and is, in fact, much needed.

Mr. Traill's work, entitled "A Monograph of the Algæ of the Firth of Forth," consists of an alphabetical list of the marine Algæ of this locality, with their habitats, time of appearance and of fruiting, and the names of the host-plants on which grow such species as are epiphitic. Each copy of the work is intended to be illustrated with some half-dozen herbarium specimens of the rarer Algæ. Those in the copy before the writer are in excellent condition, and are interesting from their rarity.

That Mr. Traill is a most patient and painstaking observer goes without saying. An analysis of the list will show how many species he has collected and observed, which are new, not only to the Firth of Forth, but to the British marine flora. He has watched the growth and development of these plants from their first appearance until their maturity. Among them will be found several Algæ which, though frequent in the south, have not previously been seen so far north; and he has also met with some arctic and northern species which are not only new to the British marine flora, but are not described in Dr. Hauck's work.

Among these northern species may be mentioned *Phlæospora tortilis*, which has a range in this country, so far as is known at present, from the Firth of Forth to Bamborough. While this plant is so abundant in the Baltic as to cause much inconvenience to fishermen by getting entangled in their nets, its existence is not recorded on the German shore of the North Sea. *Urospora penicilliformis*, one of the Algæ found by Dr. Kjellman on the coast of Spitzbergen, is another of Mr. Traill's "finds."

It will be observed that he mentions having obtained the cystocarps of *Rhodymenia palmata*. If he has really met with the true crystocarps of this plant he is fortunate, since Dr. Agardh, Dr. Harvey, Dr. Hauck, and other botanists have hitherto searched for them in vain. Harvey has shown ("Phyc. Brit.," Pl. 217) that bodies outwardly resembling cystocarps are common enough; probably these are what Mr. Traill has found. They are not, however, true cystocarps.

The establishment of the Biological Station at Granton, near Edinburgh, will certainly give a fresh impetus to the study of marine botany in that locality; and there is no doubt that Mr. Traill's work will be found extremely serviceable to local collectors of Algæ.

The *Proceedings* of the Berwickshire Naturalist Club for 1884 contain notes by Mr. Edward Batters on seventeen species of rare and little known Algæ found by him at Berwick-upon-Tweed. A short and clear description is given of each species, and the rarer kinds are illustrated by lithographic plates.

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.*]

Ocular After-Images and Lightning

IT will no doubt be of interest to many of your readers to know that the curious optical phenomenon observed by Prof. C. A. Young, when working with a large Holtz machine, and referred to in Mr. Newall's letter (NATURE, vol. xxxii. p. 77), may be produced with very small apparatus.

I have in my possession one of the small Voss machines with 10-inch plates which are now so common. Upon the stand of this instrument I placed two ordinary Leyden jars, about 5½ inches high, in such a position that their tinfoil-covered bottoms touched the brass sockets in which rest the fixed condensers of the machine, while the rods connected with their inner coatings were in contact with the sliding electrodes; with this arrangement sparks of great brilliancy from 1½ to 2 inches in length could easily be produced at the rate of about six per minute. A copy of NATURE was set up against a dark background 4 feet distant from the machine, and at every discharge the paper appeared to be illuminated by two, or sometimes three, distinct flashes of decreasing brightness, which succeeded one another with great rapidity. Each flash was sufficiently powerful to enable the pictures on the cover to be clearly seen. By throwing the light upon a quickly rotating disk of zinc with a strip of white paper pasted across it, I convinced myself that the phenomenon was a subjective one: the successive images of the white strip always occurred in exactly the same position.

I think these experiments go far towards explaining a matter which must have occurred as a difficulty to many besides myself. Why is it that the illumination produced by a brilliant flash of lightning invariably appears to be of a quivering or intermittent character? We know that the actual duration of a single discharge is sensibly infinitesimal, and both reasoning and laboratory experiments would lead us to believe that a rapid series of discharges between two insulated bodies must at all events be of infrequent occurrence, and due to exceptional circumstances. Yet the quiver of the lightning-flash is proverbial. It would be interesting to ascertain by means of a revolving disk with a single white band across it, whether this is not in most cases a purely subjective phenomenon, due to a succession of after-images. SHELFORD BIDWELL

Wandsworth, June 1

Iridescent Crystals of Potassium Chlorate

WITH regard to the above crystals, described by Prof. Stokes in NATURE (April 16, p. 565), I should like to suggest, with some diffidence, that the colours may be due, not to a continuous hemitropic crystal-film, but to a series of fine tubular cavities ranged parallel to each other between the two main portions of the crystal, such as not unfrequently occur on a large scale in Iceland spar, and appear to be due to bad fitting (so to speak) of hemitrope-films on the rest of the crystal (see Groth's "Physikalische Krystallographie," p. 441).

The surfaces of these prismatic cavities, which may be of almost wave-length fineness, would form a series of furrows from which light would be reflected under the same conditions as from grooved surfaces like those of mother-of-pearl; and, according to the usual laws of interference, we should expect such phenomena to occur as are described by Prof. Stokes: *e.g.*, non-polarisation of the light, predominance of rays of a particular refrangibility in the reflected beam, and total disappearance of this beam at two azimuths differing by 180°, when the length-dimension of the tubes lies parallel to the plane of incidence.

I may mention that plates of opal—at any rate those portions which give a uniform colour—afford spectra extremely similar in character to those of the iridescent crystals: definite bright bands in the reflected light, and dark complementary bands in the transmitted light, changing their position in the spectrum with change of incidence. Now the iridescence of opal is pretty well known to be due to the reflection of light from the surfaces of rows of filaments imbedded in the mass (see Sir David Brewster's paper in *Brit. Ass. Reports*, 1844, part 2, p. 9).

The above hypothesis would also account for Prof. Stokes's observation that the iridescent crystals were best formed when the solution was gently stirred; the molecules then, like a harassed army, being too much disturbed to "fall in" as they should do.

I cannot say that I have yet succeeded in actually bringing out such rows of tubes under the microscope. It is easy to see with a $\frac{1}{8}$-inch power, when the illuminating beam is properly adjusted, a sort of wavy structure at the twin-film (like that seen in opal under the same conditions); but I have not yet made out such definite rows of cavities as would seem to be required to produce the singularly uniform sheet of colour. They may be beyond the power of a microscope altogether.

Eton College H. G. MADAN

P.S.—Since I wrote the above, Prof. Stokes has very kindly pointed out that opal spectra are fully described by Mr. Crookes in *Proc. Roy. Soc.*, xvii. 448. One opal micro-section which I have gives a spectrum almost exactly like No. 12 in that paper, but the band is slightly less refrangible than the D line at an incidence of 20°.

Pre-Existence and Post-Existence of Thought

To express any views on these subjects one might well have hesitated some years ago, as hereditary transmission, tolerated as a doctrine, chiefly with regard to the breeding of sheep and dogs, was held to be unphilosophical. Darwin has settled the matter in the domain of science, but perhaps without altogether disposing of prejudices. Mr. Galton and myself have long since dealt with less material aspects of heredity.

What I want to bring on the scene of consideration is the common notion of throwing the great-grandsire. Few now are inclined to doubt about this.

Throwing the grandsire in the case of man may be taken to represent a period of a hundred years of transmission until birth for three generations, and consequently such period of the pre-existence of a thought or habit, which is in one's self, and of which there may be an actual register. It is better to select the example of a man, and of a great-grandsire, rather than of a father, because it carries with it a period of remoteness.

Taking then a period of a century for pre-existence in the past, there comes the consideration of vitality of occurrence in the future, as we know of it from the past. Taking a generation for the birth of offspring, and adding to it three generations for a great-grandchild, we have, say, one hundred and fifty years. Adding together the two periods, we obtain an epoch of transmission in pre-existence and of possible existence of two hundred and fifty years.

One such epoch antecedently and another subsequently may be counted in round numbers five hundred years, and we shall see our way to a thousand.

Perhaps after all we know less in detail of the transmission of osseous peculiarities than we assume. There are the means in some cases of examining bony structures of epochs and intervals of 1,000, 2,000, 5,000, 10,000 and more years, and we can trace forms of development. What we further want is the power of witnessing the successive individual variations, which is attended with diversity from other beings, and constitutes identity. Though identity may to some extent repose in the process of a bone, in the way in which a vein or sinew has traversed, we have evidence of this rather collectively in a species or a variety, than in the mode in which it periodically or irregularly influences a series of individuals.

The transmission of physical peculiarities in the soft tissues is equally permanent, and can be better traced in the individual. There are good examples of it in well-known cases of family features, and of racial types.

We are now familiar with cases of the hereditary transmission of mental qualities, as in that of the Bernouilli family, though perhaps one of the most remarkable instances is that of the Ottoman dynasty, members of which for several hundred years have displayed capacity, and yet here we have only the male elements of transmission, as in the marriages there has been a great mixture of races. It may, however, be that the Turk, the so-called Circassian (sometimes a Daghestani), and the Georgian are more nearly allied than we have been disposed to consider.

The problem now before us may be treated, irrespective of what laws there may be of male or female transmission, as in breeding, the qualities of an ancestor on either side and of either sex may be reproduced, and it is this reproduction and transmission of mental qualities which is to be considered. The mental qualities must be distinguished from the osseous structure or the soft tissues in degree. There is a vast difference in extent, and probably in distinction, between the transmission of some feature and that of conscious or unconscious thought or even of a dream.

My own term of "unconscious thought" I prefer to "unconscious cerebration," because the main distinction between conscious and unconscious thought is chiefly, if not wholly, dependent on the quality of consciousness. One reason for retaining it here is with reference to dreams. Whatever may be the operation of recording other thoughts, dreams are certainly preserved during life as effectually as any kind of thought, although no organ of seeing or hearing is concerned.

If it is remarkable that purely physical properties should be preserved in the germ of a minute animal, it is much more so that any process allied to the operations of thought should be preserved—the influence of events, the influence of dreams, used age after age to constitute the mind of this day. It will be perceived that I am speaking very loosely and vaguely, to some extent of set purpose, to bring under consideration a general question of long time in the transmission of a mental process, whether connected with what is called instinct or unconscious thought, and without limiting the discussion more than is necessary with postulates or set definitions.

HYDE CLARKE

32, St. George's Square, S.W., May 23

Long Sight

I WAS at school at Rossall, between Fleetwood and Blackpool, on the coast of Lancashire. One day, being on the sea-wall with Arthur A. Dawson, an Irish boy, we could see the Isle of Man as if it were ten miles away, and then to the south of the Calf of Man we could distinctly see on the horizon the summits of two mountains, which we pronounced must be in Ireland. Four years later I was staying at Blackpool with my mother, when we distinctly saw the same blue mountains just appearing above the sea. Being in the Isle of Man later on, I was at Port Erie, to the west of Castletown, and saw the same summits, and was told they were the mountains of Mourne. From there the mountains stood well out of the water, though we could not see the rest of the coast. The Mourne Mountains are 2798 feet high. They are 125 miles from Blackpool.

A. SHAW PAGE

Selsby Vicarage, Gloucestershire, May 28

Museums

THE interest which the readers of NATURE in this country and in America take in the promotion of museums has induced so many of them to inquire of me for a paper recently noticed by yourself that, to spare their time and my own, I shall be glad if you will enable me to refer inquirers to your advertising columns.

. THE AUTHOR OF "MUSEUMS OF NATURAL HISTORY"

A NEW EXAMPLE OF THE USE OF THE INFINITE AND IMAGINARY IN THE SERVICE OF THE FINITE AND REAL

GEOMETERS are wont to speak (it seems to me) somewhat laxly of "the line at infinity" as if there were only one such line in a plane; in a certain but not in the most obvious sense this is true—viz. there is but one right line of which all the points are at an infinite distance from all lines external to them in the finite region of the plane, and except these points there are none others having this property; but in the sense that there is but one line infinitely distant from all points external to it in the finite region, the statement is obviously erroneous, for it need only to be mentioned to be at once perceived to be true by any tyro in geometry that all rays passing through either of the two "circular points at infinity" (Cayley's absolute) are infinitely distant from any external point in the finite region; these two imaginary points may indeed without any reference to the circle be *defined* as the points which radiate out in all directions rays infinitely distant from the finite region; the "absolute" being, so to say, the common depository, *i.e.* the crossing points of all infinitely distant rays as the "line at infinity" is the locus of all infinitely distant points. Similarly in space: there is not one infinitely distant plane, "the plane at infinity," but an infinitely infinite number of such planes—viz. any plane touching "the circle at infinity" (an imaginary circle in the plane at infinity) will at once be recognised to be infinitely distant from any external point in the finite region, or, as we may say more briefly and picturesquely, infinitely distant from the finite region itself. It will give greater vivacity to this conception to imagine an axis through which pass planes in all directions, and to travel in idea this axis round "the circle at infinity" keeping it always tangential thereto; the complex or corolla of planes, so to say, thus formed (infinitely infinite in number) contains only planes of infinite distance from the finite region; and "the plane at infinity" is but one of them—viz. the one which passes through all the axes named, just as the line at infinity in a plane is the line which passes through both the centres of infinite distance. The infinitely infinite series of infinitely distant planes is of course the correlative of the infinitely infinite series of infinitely distant points whose locus is the so-called "plane at infinity."

The above statements have only to be made, to be accepted by the geometer, although I do not remember seeing them * anywhere explicitly given; but what I want to show is that, although supersensuous abstractions, so far from being barren they are capable of immediate application to the world of reality, and afford an instantaneous answer to a very simple practical question which has only just lately been mooted. The question is this: Suppose $a\,b\,c\,d$ to be a given pyramid, and that perpendiculars are drawn from its four vertices, say A, B, C, D, to a variable plane, then it is easy to show that a certain homogeneous quadratic function of A, B, C, D depending on the form of the pyramid or relative lengths of its edges must be constant, and the question arises, What is this constant quadratic function, this quadric in A, B, C, D, expressed in terms of the edges of the pyramid exclusively? † Just so if we take a triangle, $a\,b\,c$, in a plane there will be a constant quadratic homogeneous function of the distances of its three vertices from a variable line; and it is well known in this case that if A, B, C are the distances the constant quadratic function in question will be—

$$(a\,b)^2 (A - C)(B - C) + (b\,c)^2 (B - A)(C - A) + (c\,a)^2 (C - B)(A\,B).$$

But if we had not known this fact it could have been found as follows:—Calling the above function F, when A, B, C all or two of them become infinite the relation between the ratios of $A : B : C$ will be such as would arise from making $F = 0$; on no other supposition will this be the case.

Now, if we use trilinear co-ordinates with $a\,b\,c$ as the triangle of reference, and take as the co-ordinates of any variable point P, the areas $a\,P\,b$, $b\,P\,c$, $c\,P\,a$ instead of the simple distances of P from $a\,b$, $b\,c$, $c\,a$, then every body knows that the line at infinity has for its equation—

$$(1) \quad x + y + z = 0,$$

and will easily see that the circle circumscribing $a\,b\,c$ has for its equation—

$$(2) \quad (a\,b)^2 x\,y + (b\,c)^2 (y\,z) + (c\,a)^2 x\,z = 0.$$

Moreover, when such co-ordinates are employed the distances of any line $A\,x + B\,y + C\,z = 0$ (3) from the three vertices are A, B, C each multiplied by the *same* known quantity.

If then A, B, C become infinite this line must pass through one of the intersections of the line at infinity with the circle, or, in other words, the equations (1), (3), (2) must be capable of being satisfied simultaneously, and accordingly by a well-known algebraical law it follows that the determinant to (2) *bordered* by the coefficients of (1) and (3) must vanish. Consequently this determinant so bordered will represent the sought-for form F, *i.e.* the constant quadratic function will be represented by—

$$\begin{array}{ccccc} \bullet & A & B & C & \bullet \\ A & \bullet & (a\,b)^2 & (a\,c)^2 & 1 \\ B & (b\,a)^2 & \bullet & (b\,c)^2 & 1 \\ C & (c\,a^2) & (c\,b)^2 & \bullet & 1 \\ \bullet & 1 & 1 & 1 & \end{array}$$

On calculating this determinant it will be found to be the function of $A - B$, $B - C$, $C - A$ above given, except that each term is multiplied by the constant factor -2, which may of course be dispensed with.

Now let us apply similar or analogous considerations to the determination of the constant quadratic function of

* The statement concerning the circular point-pair at infinity being centres of pencils of infinitely distant rays I have since met with somewhere in Dr. Salmon's Conics, but stated in quite a casual manner. It may not be unworthy of notice that just as the distance between any two points in a ray passing through either point of the *absolute* in a plane vanishes, so similarly vanishes the area of any triangle drawn in any plane touching "the imaginary circle at infinity" in space.

† If l, m, n, p are the distances of the vertices from the opposite faces, and x, y, z, t from the variable plane, it is well known that

$$\Sigma \left(\frac{x^2}{l^2} - 2\,\frac{y\,z}{m\,n} \cos m, n \right)$$

is constant, in fact is unity.

A, B, C, D, the four distances on a variable plane from the fixed points a, b, c, d. I must promise that using quadriplanar co-ordinates x, y, z, t analogous to those employed just now for the plane—viz. such as will cause

$$x + y + z + t = 0 \quad (1)$$

to become the equation to "the plane at infinity," the sphere circumscribing the fundamental pyramid $a\,b\,c\,a$ takes the analogous form to that given for the circle from which indeed it may be deduced with a stroke of the pen—viz. the equation to this sphere will be—

$$(ab)^2xy + (ac)^2xz + (ad)^2xt + (bc)^2yz + (bd)^2yt + (cd)^2zt = 0 \quad (2).$$

Moreover the distances of a plane whose equation is—

$$Ax + By + Cz + Dt = 0 \quad (3)$$

from the vertices of the pyramid will be A, B, C, D each multiplied by the same known quantity.

The intersection of the plane at infinity with any sphere, and consequently with the circumscribing sphere named, is "the circle at infinity;" hence if F is the constant function required we may find it as the function of A, B, C, D, which becomes zero when the plane (3) is tangential to the intersection of the plane (1) with the sphere (2), or, which is the same thing, when the intersection of the planes (1) and (3) is tangential to the sphere (2), and this function is well known to algebraists to be the determinant formed by bordering the determinant to (2) with the coefficients of (1) and (3), *i.e.* we may take as the constant function F the determinant following:—

$$\begin{array}{cccccc}
\bullet & A & B & C & D & \bullet \\
A & \bullet & (ab)^2 & (ac)^2 & (ad)^2 & 1 \\
B & (ba)^2 & \bullet & (bc)^2 & (bd)^2 & 1 \\
C & (ca)^2 & (cb)^2 & \bullet & (cd)^2 & 1 \\
D & (da)^2 & (db)^2 & (dc)^2 & & 1 \\
\bullet & 1 & 1 & 1 & 1 & \bullet
\end{array}$$

of which the developed value is easily found to be—

$$-\Sigma(ab)^4(C-D)^2 + 2\Sigma(ab)^2(ac)^2(B-D)(C-D) + 2\Sigma(ab)^2(cd)^2\left\{\begin{array}{l}(A-C)(B-D)\\ +(A-D)(B-C)\end{array}\right\}$$

This value of the constant function in its expanded form I some time ago found by a different method, and sent in the shape of a question to the *Educational Times.** In a brief correspondence which ensued with Prof. Cayley, he wrote to me giving the equivalent determinant form which he arrived at by a totally different order of conceptions and in a very beautiful manner, as follows. We may regard the differences between A, B, C, D as equal to the differences between the distances of a, b, c, d from a fifth point, e, at an infinite distance, and may call ae, be, ce, de equal to $A + K$, $B + K$, $C + K$, $D + K$ respectively, where K is infinite. Hence by his own well-known theorem regarding mutual distances of five points we shall have—

$$\left|\begin{array}{cccccc}
\bullet & (ab)^2 & (ac)^2 & (ad)^2 & (A+K)^2 & 1 \\
(ba)^2 & \bullet & (bc)^2 & (bd)^2 & (B+K)^2 & 1 \\
(ca)^2 & (cb)^2 & \bullet & (cd)^2 & (C+K)^2 & 1 \\
(da)^2 & (db)^2 & (dc)^2 & \bullet & (D+K)^2 & 1 \\
(A+K)^2 & (B+K)^2 & (C+K)^2 & (D+K)^2 & \bullet & 1 \\
1 & 1 & 1 & 1 & 1 & \bullet
\end{array}\right| = 0$$

And by the ordinary well-known rules in determinants for combining lines with lines and columns with columns it may easily be shown that the above determinant is of the form $4F_1K^2 + GK + H$, where F_1 represents—

$$\begin{array}{cccccc}
-\frac{1}{2} & A & B & C & D & \bullet \\
A & \bullet & (ab)^2 & (ac)^2 & (ad)^2 & 1 \\
B & (ba)^2 & \bullet & (bc)^2 & (bd)^2 & 1 \\
C & (ca)^2 & (cb)^2 & \bullet & (cd)^2 & 1 \\
D & (da)^2 & (db)^2 & (dc)^2 & \bullet & 1 \\
\bullet & 1 & 1 & 1 & 1 & \bullet
\end{array}$$

Consequently $F_1 = 0$. This equation gives not only the form of the constant function but the value of the constant (F_1, when the element $-\frac{1}{2}$ is suppressed, being identical with my F).

On removing the line and column of capital letters the above determinant equated to zero expresses the condition of the points a, b, c, d lying in a plane—as proved by Cayley in days long past (and still ordinarily so proved) by a very artful manner of multiplying a determinant into a numerical multiple of itself; but this result follows as an instantaneous consequence of the reflexion that if a, b, c, d did not lie in a plane the above equation would mean that the circumscribing sphere was *touched* by the plane at infinity, whereas we know that this plane never touches but has the faculty of always cutting *every* sphere in a constant circle of imaginary points. Hence the existence of this equation implies the coplanarity of the four points a, b, c, d, and the converse proposition may be shown by simple algebraical reasoning to follow from this.*

Postscript.—I have been led by what precedes to a rather interesting observation in universal geometry.

Suppose we form a determinant with the squared distances of one group of n points from another equinumerous group any or all of which may be coincident with those of the former one: and to each line and at the foot of each column of this determinant affix a unit; a determinant so formed we may agree to call the bordered determinant of either group in regard to the other. Thus *ex. gr.*

$$\begin{array}{cccc}
a\alpha^2 & a\beta^2 & a\gamma^2 & 1 \\
b\alpha^2 & b\beta^2 & b\gamma^2 & 1 \\
c\alpha^2 & c\beta^2 & c\gamma^2 & 1 \\
1 & 1 & 1 &
\end{array}$$

is the bordered determinant of a, b, c in regard to $\alpha, \beta\, \gamma$. When the two groups are one group repeated we may call this determinant the bordered *self*-determinant of the groups.

My theorem is that the bordered determinant of two equi-numerous groups in respect to one another is a mean proportional to the bordered self-determinant of one of the groups, and that of the projection upon its *niveau* of the other group. [The *niveau* to a group of points means the homaloid (Clifford's flat) of the lowest number of dimensions which contains the group.]

We may regard a group of n points as the vertices of a figure whose squared content we know by Cayley's theorem above referred to is a sub-multiple of the bordered self-determinant of the group; it is in fact that quantity divided by $(-)^{n+1}2^n(1 \,.\, 2 \,.\, 3 \ldots n)^2$, so that we may vary the statement of the theorem and say that the product of the contents of the figures denoted by two equi-numerous groups into the cosine of the inclination of their *niveaus* is a known numerical sub-multiple of the bordered determinant of one group in respect to the other. Thus, keeping at first within the limits of conceivable space, we see

* If the differences between A, B, C, D be regarded as the minor determinants of the bilinear matrix $\begin{array}{cccc} A & B & C & D \\ 1 & 1 & 1 & 1 \end{array}$ any practised algebraist would at once recognise that my form becomes expressible as a determinant of the 6th order, and I think I could hardly have failed eventually to have made this observation, the more especially as I was aware of the connection of the subject with that of the section of any sphere with the plane at infinity—but as a matter of fact Cayley anticipated me, and was the first to actually write down the function under the form of a determinant.

In each method the concept of infinity appears, but in mine that of the imaginary as well; and although more far-fetched than the other, the latter possesses the advantage of yielding the result as the transcript of a mere mental process without involving the necessity for the performance of any work whatever of algebraical reduction.

* The equation in the text extended to the points $A, B, \ldots L, X$ assumes new importance and rises to philosophic interest when regarded as the *intrinsic equation to the niveau* of $A, B, \ldots L$, in which the co-ordinates of the variable point X in the niveau are the squares of $AX, BX, \ldots LX$; it is of course an equation of the second degree in these co-ordinates. The distances of either of two points from the other are the same in quantity but differ in sign. Hence the *square* of either is the natural measure of the interval *between* the two points.

that the cosine of the angle between abc, abd, the faces of a tetrahedron, will be the determinant—

$$\begin{array}{cccc} \bullet & ab^2 & ad^2 & 1 \\ ab^2 & \bullet & bd^2 & 1 \\ ca^2 & cb^2 & cd^2 & 1 \\ 1 & 1 & 1 & \end{array}$$

divided by sixteen times the product of the faces abc, abd.

Or, again, if ab, cd be any two non-intersecting edges of the tetrahedron, $\pm\, 2ab \,.\, cd \cos(ab, cd)$ ought to be equal to—

$$\begin{vmatrix} ac^2 & ad^2 & 1 \\ bc^2 & bd^2 & 1 \\ 1 & 1 & \bullet \end{vmatrix}$$

and as a matter of fact the cosine between (ab, cd) is equal to $\frac{ad^2 + bc^2 - ac^2 - bd^2}{2ab}$.*

Again, if abc, def are any two triangles in space of 5, 4, or 3 dimensions the product of their areas into the cosine of their inclination will be a numerical multiple of the bordered determinant of the group abc in regard to def, and if they lie in the same plane their product itself will be that numerical multiple.

Similarly for two groups of four points lying in one space (as *ex gr.* that in which *we live, move, and have our being* †) the product of their bordered self-determinants will be equal to the bordered determinant of either group in respect of the other, because their *niveaus* coincide, and if we take two groups of five points each in ordinary space it again follows from the theorem that the bordered determinant between them must vanish, a statement which when the two groups coincide reverts to Cayley's condition concerning the mutual squared distances of five points in ordinary space.

Finally, there can be little doubt, I think, of the truth of the following theorem dealing with determinants (but unbordered) ‡ of which the general theorem we have been considering which deals with bordered determinants must needs be a corollary.

By $P : Q$ where P, Q are two groups of n points each, let us understand the determinant formed by taking the cosines of the angles which the n^2 lines connecting P and Q subtend at a point O equidistant, in space of the necessary number of dimensions, from each of the $2n$ given points, and let P', Q' mean the groups P and Q augmented by the addition of O to each of them, the theorem is that—

$$\cos(P', Q') = \frac{P : Q}{\sqrt{(P : P)(Q : Q)}}.§$$

Thus for the case of n equal to 2 if O is the centre of the sphere passing through a, b, c, d, we ought to find the cosine of the angle between the arcs ab, cd equal to

$$\begin{vmatrix} \cos ac & \cos cd \\ \cos bc & \cos bd \end{vmatrix}$$

divided by a square root of

$$\begin{vmatrix} \cos aa & \cos ab \\ \cos ba & \cos bb \end{vmatrix}$$

into a square root of

$$\begin{vmatrix} \cos cc & \cos cd \\ \cos dc & \cos dd \end{vmatrix}$$

i.e. equal to

$$\pm \frac{\cos ac \,.\, \cos bd - \cos ad \cos bc}{\sin ab \,.\, \sin cd}$$

as is the case.

There ought also to exist analogous theorems applicable to non-equi-numerous point groups depending in some way upon the minors of a corresponding rectangular matrix.*

J. J. SYLVESTER

New College, Oxford, April 1885

GRESHAM COLLEGE

THE question of what is to be done with one of the greatest of existing London abuses, Gresham College, has again come up in connection with a letter from a "Londoner" in the *Times*. The *Times*, in a somewhat incomplete leader, animadverts strongly on the abuse, and urges its prompt remedying. Surely when the fact that London has no university in the true sense is attracting so much attention and the movement to supply the want is so powerful, it is absurd to allow the funds to be worse than wasted which represent the wreck of those which were originally intended for the maintenance of a real institution of this class. There were once 20,000 students at Gresham College, and when London does have a university, as it must have some time, even Gresham College will be without *raison d'être*.

"Topographically," the *Times* says, "the lecture-rooms are off the track of students. None of the apparatus of systematic instruction, in the way of examinations, accompanies the courses. Provision does not exist,

* Obviously therefore we can express the squared shortest distance between two non-intersecting edges of a tetrahedron as a rational function of the squares of all six. The formula in the text is well known and easily proved for the case of $abcd$ being in a plane, which is enough to show that it must be true universally, for if we make BCD rotate about BC, the projection of C upon BD does not move, and consequently AC into the cosine of AC, BD is invariable.

† It would perhaps be more correct to say "*which has its being in us.*"

‡ From which it follows that every algebraical theorem regarding square matrices expressed in the umbral notation is immediately convertible into a proposition in universal geometry; the umbræ cease to be mere abstractions, and acquire a *local habitation and a name* as points in extension.

§ $\sqrt{P : P}$ is in fact the factorial of n divided by the nth power of the distance of O from each point in P into the content of (what I call) the *plasm* (of order n) denoted by P'.

A *plasm* of the order 1, 2, 3 means a rectilinear segment, a triangle, a tetrahedron—whence it is easy to deduce and define in exact terms the meaning of a plasm of any order as a figure bounded by plasms of the order next below its own. The squared content of a triangle is equal to the sum of the 3 squared contents of its projections on mutually perpendicular planes in ordinary space: but also to the sum of the 6 squared contents of its projections on 6 such planes in extension of 4 dimensions and so on—and in general the square of the content of a *plasm* denoted by n points is similarly resoluble into a sum of $\frac{n(n-1)\ldots(n-i+1)}{1 \,.\, 2 \ldots i}$, such squares in extension of $(n+i-1)$ dimensions; as these squared contents are all expressible immediately by Cayley's theorem in terms of squared distances, the above statement gives rise to a far from self-evident theorem in determinants. What I have here termed *plasms* might with more exactitude be termed *protoplasms*, as being the elements into which all other figures are capable of being resolved.

* It may be objected that the theorems of the text applied in their full generality beyond the limits of empirical space cease to affirm a relation between two different things and therefore lose their efficacy as such and become mere *definitions* of the meaning of the inclination of two figures in supersensible space. To meet this objection it is sufficient to give a general method for determining algebraically the projection of a point in space of n dimensions on the niveau of ν points where ν is any number not greater than n; this it is easy to see may be effected as follows:—

(α) I observe that the niveau of any μ given points in a space of n dimensions may be expressed in Cartesian co-ordinates by means of equating to zero each of $n - \mu + 1$ independent minors of a rectangular matrix containing $n + 1$ columns and $\mu + 1$ lines, the formation of which is too obvious to need stating in detail.

(β) In order to project orthogonally a point whose n co-ordinates in a space of n dimensions are $x', y', \ldots z'$ upon a niveau (of the $(n-1)$th order) passing through n given points defined by the equation $Ax + By + \ldots Cz + L = 0$, we have only to write $x - x' : y - y' : \ldots : z - z' :: A : B : \ldots : C$, and combining the $(n-1)$ equations contained in this proportion with the given equation, the resulting values of $x, y, \ldots z$ determine the projection of the given point on the given niveau.

If now ν points are given in a space of n dimensions and the projection is required of a given point upon their niveau we may proceed as follows:—

(1) Find the $n - \nu + 1$ equations which define the niveau.

(2) On each of the niveaus of the $(n-1)$th order which correspond thereto respectively find the orthogonal projections of the given point.

(3) Through these $n - \nu + 1$ projections of the given points and the given point itself draw a niveau which will be defined by $(n+1) - (n - \nu + 2)$, *i.e.* $\nu - 1$ equations.

Finally, combining these with the $n - \nu + 1$ original equations we have n equations in all, and these will serve to determine the n co-ordinates of the projection required.

This method is not always the most compendious, but is always sufficient, and enables us to attach a definite meaning to the inclination of two spaces of any the same order to one another: thus *ex. gr.*, the content of the projection of $abcd$ on $efgh$ divided by the content of $abcd$ itself is the cosine of the inclination of the niveaus $abcd$, $efgh$, and the projections of the several points a, b, c, d on $efgh$ (say a', b', c', d') being found by the preceding method, the content of the tetrahedron $a'b'c'd'$ (and therefore the inclination of the two niveaus) is a known quantity.

or, at any rate is not employed, for the contact of the mind of the learner with the mind of the teacher. The lecturer ascends to his chair, recites or reads his stipulated discourse, and disappears with the mechanical routine of an automaton. The professorial staff, it might have been added, has as little internal unity as relationship to its classes. It is a concourse of atoms with no affinity except equality of stipends. To call the foundation a college is to use a manifest misnomer. It is as much a college as one at Oxford or Cambridge would be with the undergraduates and fellows suppressed, and the Master, Dean, Bursar, and Butler left to perpetuate the tradition. The Corporation of the City and the Mercers' Company are Sir Thomas Gresham's trustees, and derive very substantial advantages from his bounty.

"The inutility of the Gresham Lectures was recognised in the days of Dr. Johnson. Johnson lamented as bitterly as our correspondent that the able professors of Gresham College, which was 'intended as a place of instruction for London, contrived to have no scholars.' His explanation was that the professors lectured gratis, and grew indolent from the absence of pecuniary incentives to intellectual exertion. 'We would all,' he exclaimed with conviction, 'be idle if we could.' Permission to charge sixpence a pupil for each lecture would, in his opinion, have infused vitality into the institution; every professor would forthwith have grown 'emulous to have many scholars.' There could be no harm in administering his specific now. The good of a condition such as Gresham College has been reduced to is that any experiments may be tried upon it without excessive risk. But the failure of the foundation arises from deeper sources than those to which Johnson attributed it. Several of the present lecturers are notoriously of a temper and standing not to need a money bribe to urge them to do their duty. The Dean who is the Divinity Professor delights in occasions for ecclesiastical exegesis. He would rejoice to find a way of gathering five hundred receptive hearers to listen to the theological expositions he throws away on a meagre fraction of the number. Another Dean was Senior Wrangler, and is abundantly competent for the geometrical themes he has to discuss. The subject of civil law is committed to a most capable jurist. The Professor of Music is able elsewhere without any endowment to attract to his classes a large paying audience. The blame, as our correspondent concedes, does not lie with the lecturers, who only slumber in concert with their classes and their patrons. It must be imputed to the gross contempt which has been shown for all the conditions of educational success. Their founder intended his seven professors to be professors in a College which he did not survive to create. He died at the age of sixty, still immersed in public affairs, and before attaining the leisure for carrying out his idea of an 'epitome of a University in London.' Accidents for which it would be useless to condemn his trustees would have prevented them, had they otherwise been well disposed, from accomplishing his ambitious programme. His estate, so far as it was appropriated to the purpose, proved insufficient for the complete endowment of a College and its staff. A collection of lectures was left as it were in the air. For a time they appeared to have procured favour in spite of their disadvantages. In the nature of things they could not keep it permanently. They were without soil to take root and sprout in. The error of all concerned has been that the want was not supplied by incorporating either them in something else or something else in them. Last century was a period of educational, though not of intellectual, stagnation. Gresham College only languished in company with many other Colleges better furnished with the gifts of fortune. The present age has witnessed a revival of zeal for instruction by methods in which the Gresham foundation might have been turned to the greatest service, and has been turned to none. While London, and, most of all, the City, was careless of learning, it was no reproach to the managers of Sir Thomas Gresham's bounty that they converted it to no account. The absurdity is that for years the town, from its centre to its outskirts, has been crying out for educational appliances, and that Gresham College is suffered to remain as futile and superfluous as ever. Half-a-dozen institutions have been erected in or by the City to effect the objects for which Sir Thomas designed his foundation. For any one of them it would have been the most admirable nucleus; it would have afforded a starting point, and have bestowed the dignity of old descent. Thus it would have gained at last the reason for existence it has been craving in vain for a couple of centuries.

"Tastes of benefactors in distant ages do not always agree with the popular inclinations of the present. Reluctance on the part of trustees to deviate from the will of the men they represent is to be excused, though it cannot always be allowed to block the road to reform. When, however, a founder has let posterity into his confidence, and the application of his gifts clearly conflicts with his own views, it argues strange perversity or default of mental elasticity not to perceive where genuine respect for his wishes should lead. Without a framework in which they could be set and mutually co-ordinated, the Gresham Lectures cannot possibly do what the founder desired them to do. The public spirit of the City would not refuse to take up and finish the work which Gresham sketched out if it could be secure that his original instalment of beneficence was no longer wasted as now. Already it has been endeavouring to fill up the gap by its own exclusive exertions. The City of London College, the courses of the University Extension Society, lectures at the London Institution, the Technical College, Middle Class Schools, and not a few institutions besides, are spontaneous efforts of the past dozen years to work out the original idea of Sir Thomas Gresham. The proper City of London College is Gresham College. Around it as the centre all the other educational instruments of the City ought naturally to group themselves. Not the most punctilious conservatism could reprobate the Corporation and the Mercers' Company if they would use the authority they possess, and seek fresh authority, to aid in the promotion of that general result. Gresham College, as it is, has been for centuries, and is doomed to be, a burlesque of collegiate life. Its lectures must be equally dead whether delivered in a dead or a living tongue. Its choice is between becoming something more or something less than it is now. If it cannot develop, it had better cease to be."

ELECTRICITY AT THE INVENTIONS EXHIBITION

THE International Inventions Exhibition is intended to illustrate the progress of invention during the period that has elapsed since the last Great International Exhibition in this country in the year 1862. Accordingly we find under Group XIII. electricity ranged under twelve classes, entitled respectively, generators, conductors, testing and measuring apparatus, telegraphic and telephonic apparatus, electric lighting apparatus, electro-metallurgy and electro-chemistry, distribution and utilisation of power, electric signalling, lightning-conductors, electro medical apparatus, electrolytic methods for extracting and purifying metals, electrothermic apparatus. Under such a classification there is no doubt that the Exhibition might have been made thoroughly representative of the wonderful progress that has taken place in this branch of science, both in its theory and practice, during the last twenty-three years. The reason that it is not so is twofold: electricity has had of late years many exhibitions dedicated to itself—those of Paris, Vienna, and Sydenham; and it was quite impossible in such an exhibition as the Inventions, where so much has had to be compressed into so little space, to indicate the progress of invention in each class of each group. If, however, electricity is not represented in this way, it is in another way, and that is through the medium of one of its special applications—that of the electric light. Electricity thus forms the light and life of the whole Exhibition after sunset, and in this connection we would view it on the present occasion.

Those who visited the Health Exhibition last year will not notice any great change in the internal illumination beyond the more extensive use of the electric light and its greater steadiness, but will observe that an alteration has been made in the garden lighting, to a description of which we propose to confine this article. In place of the numerous attendants who, a little before darkness set in, were to be seen last year lighting one by one the little oil lamps which, in their coloured glasses, were scattered all over the trees and lawns, an observer discovers at half-past eight or a little later a gradual diminution in the darkness of the evening, and the eye becomes gradually sensible to the fact that the architectural features of the buildings are becoming clearly defined, and by degrees are actually illuminating surrounding objects, whilst at the same time the lawns and shrubberies, the parterres and trees, and even the ponds of water and waterfalls assist in the general illumination with light of every shade and colour. Where before all was darkness, there is a scene of bewildering enchantment: fountains play and throw up into the air, now high, now low, solid sheets of illumined water and spray of mingled water, dust, and light, at one moment of golden hue, at another of the loveliest magenta; while when the silver light of the electric arc alone illuminates the fountains, broken by some magic power below into waterdrops, all the prismatic colours of the rainbow are observable, and, revelling in the beauty, one wonders how it is all brought about.

In what is known as the tower, Sir Francis Bolton has before him a plan of the gardens with switches on it, enabling him to turn the lights on or off, or to increase or diminish their intensity at his will. One of the switches controls the effects in the upper garden, another those in the lower garden, a third commands the statue of the late Prince Consort, a fourth and fifth the illumination of the east and west quadrants and east and west arcades respectively, whilst a sixth controls the external lighting of the conservatory. Four switches on the lower portion of the switch board enable the operator to raise or lower the intensity of the light; the first altering it from $\frac{1}{4}$ to $\frac{3}{8}$, the second from $\frac{3}{8}$ to $\frac{1}{2}$, the third from $\frac{1}{2}$ to $\frac{3}{4}$, and the fourth from $\frac{3}{4}$ to full power.

One of the most interesting features of the illumination, and that which perhaps causes the most wonder and bewilderment, is the play of the fountains. Below the island in the fountain is a water-tight chamber, about 5 feet in height and 20 feet square, into which one obtains access by first descending a ladder from the diving apparatus-house into a low arched passage, from which one ascends into the chamber. The roof of this is covered with water-pipes which convey the water from the main in all directions, the supply being regulated by screw valves; the five large jets are fitted with plug valves and levers, by the manipulation of which the dancing motion and breaking up into water-drops of the columns of water are effected. The average quantity of water expended per hour during a fountain display is 70,000 gallons. Under the five large water jets are five sky-lights, fitted with thick glass, below each of which is placed a wooden box, containing a powerful arc-light with the carbons set horizontally. Over the top of the lantern is a holophote, such as is used in lighthouses, by means of which the rays of light are concentrated, and projected upwards into and with the column of water, whilst their colours are varied by drawing sheets of stained glass across the lantern. The water is supplied at a pressure of about 70lb. to the square inch, which is sufficient to carry it up to a height of 120 feet.

On one of the walls of the chamber is a board, on which are signalled the instructions from the tower, which are read off by an assistant to the staff. In this manner the various effects which more or less puzzle the spectators are telegraphed from the tower above, and carried out in the concealed chamber below.

The following are the number and distribution of the lamps, all of which are made by the Edison-Swan United Company, most of them being of 5 and 10-candle power, whilst a few of 20-candle power are used on the band stands and verandah of the conservatory:—

	Lamps
Conservatory	1418
E. and W. Quadrants	1584
E. and W. Arcades	1832
Upper Gardens	1550
Lower Gardens	2300
Albert Statue	336
Total	9020

There are fourteen miles of main and branch wires, nine miles of twin wire, and two miles of small connecting wire. On the buildings and on straight lines on the grass specially constructed wooden lamp-holders are used, in other places ordinary spring-holders. The current is generated by three Siemens B 13 self-regulating dynamos, each weighing about 11 tons, and each capable of maintaining 2000 (20-candle) lights at 300 revolutions per minute; the current of each being 500 amperes at an electromotive force of 250 volts, the weight of the armature being 3 tons. The dimensions of the machines are as below:—

	ft.	in.
Height including bed-plate	8	9
Length over all	8	0
Width	4	8
Diameter of armature	2	5
Length of armature	3	2

The four series coils, which are coupled in parallel, are wound with copper-wire 4-10ths of an inch in diameter, and the shunt coils, which are coupled in series, with wire of No. 9 standard gauge; the armature being wound with flat strips instead of wire. Each of the dynamos is coupled to a Goodfellow and Matthew's triplex compound engine of 200-h.p. indicated, two of the machines being easily capable of maintaining all the lights. The main current from the dynamos is led to a switch-board, in connection with which is an electro-dynamometer so arranged that there shall be no break of continuity. In each branch circuit is a fork working in the core of a solenoid, the prongs of the fork dipping into a pair of mercury contact cups. The solenoids are connected by wires with Sir Francis Bolton's room, and by their use he can raise or lower the fork out of or into the contact cups and thus turn the lights off or on as required. The return circuits enter into a single conductor, which is arranged with four sets of mercury cups and solenoids in series; around each set is a bye-pass containing a resistance of determined magnitude, so as to vary the brilliancy of the lamps as desired.

The works for the electric illumination of the gardens and fountains have been carried out by Messrs. Siemens Brothers, to the designs of Sir Francis Bolton. Considering that the instructions for the preparation of the machinery for illuminating the gardens were only given in February last, the result obtained at the Inventions Exhibition is evidence that electric lighting has now advanced to such a stage that orders may be given for very large installations and executed in a perfect manner in a very short space of time.

VESUVIUS

SINCE writing on May 3 Vesuvius has continued to pour forth a continuous stream of lava. From the lowering of the general level of lava in the main chimney no reflection could be seen at its mouth, as is usually the case. This state of things continued till the 6th, when the vapour could only escape in intermittent puff in consequence of the accumulation of *débris* from the crumbling edges of the inner crater edge. As these puffs escaped, they resembled balls of dark grey smoke, from which fell a shower of fine ash, the result of the grinding up of the fine materials that had fallen in as above described, and partially blocked the upper outlet. The crater plain was scattered over with ash and rounded fragments of lava from which that had been ground off. Soon after a faint glimmer was visible, which gradually increased each night until it came to a stationary point, since which little change has taken place. The lava still continues to flow with more or less regularity, but from the small quantity it only gutters and collects on the slope of the great cone. The whole series of events since May 2 is identical with what occurred under similar circumstances in December, 1881, and January, 1882, which I have already described in these pages. The whole sequence of phenomena are easily explicable on the most simple mechanical principles, and do not require that *vulcanological magic* which, even at the present time, is too often employed in describing volcanoes or earthquakes.

I may mention that the above estimate might seem too low as the surface of the streams moved quicker (about 1 m. in 17 seconds), but the lava was particularly viscuous on this occasion, and towards the edges it could not have progressed more than the above distance in two or three minutes. A similar retardation no doubt occurred wherever in contact with its channel, so that I think the estimate of 1 m. per minute is a very fair one. If we allow an average outflow of 5000 cm. during the last twenty-two days (*i.e.* from May 2 to 24), which I am sure many would think under-rated, we have the prodigious output of 110,000 cm.; the product of what would usually be called a very small eruption. But the flow has not stopped, and shows no indication of so doing.

This large amount of material, added to the surface of the great cone, is already making a difference in its outline, and should the outflow continue for nearly three years, as occurred after the December, 1881, outburst, the Vesuvian cone will have another gigantic hump of lava to spoil the graceful curves of its back.

Either as the result of bad writing or of printer's errors some obvious mistakes have crept into my last communication. For "*unattached* pyroxene crystals" read *unattacked*. For "*salbam*" read *salband*. Read for "about one metre per *second*," about one metre per *minute*.

Naples, May 24 H. J. JOHNSTON-LAVIS

THE RUAHINE RANGE, NEW ZEALAND

IN the summer of 1843, Mr. Colenso being at Hawke's Bay, first saw the Ruahine Range, looking sublimely grand under its crest of virgin snow. Hearing at this time of natives living secluded in the interior, in the country lying between this range and the famed central volcanic district, Tongariro, he determined to visit them, and he has lately published a most graphic and interesting account of several visits to and over the range, which were accomplished between the years 1845 and 1847. This narrative is, as would be expected from a botanist like the author, largely interspersed with valuable notes on the flora, and there are also some on the fauna of that region. It is also somewhat interspersed with quotations, for the most part appropriate ones, from the author's favourite poets. It is not necessary that we should make any comments on the fact that this little memoir does not appear in the *Transactions* of the New Zealand Institute, already so full of various important contributions to our knowledge of New Zealand forms from Mr. Colenso's pen, for the publishing Board of that Institute, having declined to publish more than an abstract of it, the memoir was, by request, returned to the Hawke's Bay Philosophical Institute, before which Society it had originally been read, and it has been by them laid before the scientific world with additional and copious notes. The first attempt to cross the range was made under great difficulties in February, 1844: the weather was bad, heavy rain flooded the rivers and mountain streams, and the guide had forgotten the route. Despite all disadvantages, many a rare and several new plants were found. On a Saturday night, after a slender supper amid the deepening gloom of the beech forest, we read: "Here, pendent from some of the trees, hung a most lovely species of Loranthus (*Loranthus flavidus*), while on many other trees that fine species *L. tetrapetalus* formed dense bushes, bearing crimson flowers in profusion, so that in some of the more open spots among the closely-growing trees the whole forest wore a reddish glare." At the very spot where they halted, a fine bushy composite shrub with hydrangea-like leaves was gathered, which has been since named by Sir J. Hooker, *Olearia Colensoi*. Fatigued with the day's work the party slept till 10 o'clock on the Sunday, and then awoke to find themselves completely invaded by a large "blue-bottle fly," which, it appears, inhabited the beech-wood in countless numbers, and was most teasing and audacious: their blankets and woollen clothing had been attacked, and were literally filled with the fly eggs, and the hair of the natives' heads had also similarly suffered. These blue-bottles spoiled the Sabbath day's rest; they had never before been met with by Mr. Colenso. We wonder if the species has been recognised by Baron Osten Sacken, who has recently been engaged in describing New Zealand Diptera. After two days' more fatigue, the party were obliged to descend without crossing the summit, being nearly starved into the bargain. But amid all these troubles, Colenso writes that he at least had some joys, certainly, under the circumstances, unknown to the natives, in that he discovered, on the return, several fine new plants (*Alsophila Colensoi*), several new species of Coprosma, some of which grew so compactly together that in some places it was impossible to get through them, and so they had to walk *upon* them. Here, but only in one spot, that beautiful fern, *Hypolepis millefolium*, was found. Many beautiful and new forms of Veronica, as *V. buxifolia*, *V. nivalis*, and *V. tetragona*, this last species in its barren state resembling much the branch of a Podocarpus. Here we venture to interpose a wish that Mr. Colenso would write an essay on the mimetic resemblances of the species of the genus. But this was not all: a little further up there were found "splendid Celmisias and Ranunculuses in countless numbers, intermixed with elegant Wahlenbergias and beautiful Ourisias, Euphraisias, Gentians, Dracophyllums, Astelias, and Calthas, and many others. Here were plants reminding one of those of our native land, with rare and little known novelties." After the first burst of surprise, the great difficulty of carrying off these prizes presented itself: no collecting materials were at hand. There was no time to lose. "First I pulled off my coat, and made a bag of that; then, driven by necessity, I added thereto my shirt, and, by tying the neck, got an excellent bag. Lastly the crown of my hat held a few. Fortunately the day turned out a fine one, and on returning to the camp the night was spent placing them among spare clothing, bedding, and books." Of this "find" drawings of nearly fifty were published by Sir W. J. Hooker, or Sir J. Hooker, in the "Flora Novæ Zelandiæ" or the "Icones Plantarum." The graphic account of that terrible plant, *Aciphylla Colensoi*, we must content ourselves by thus referring to; it is too long to quote, and too good to condense.

Two solitary tufts of two Alpine plants were also detected on this occasion. One, *Helichrysum Colensoi*, the edelweiss of New Zealand, was found on the edge of the top of a mountain composed entirely of dry shingle of various sizes, from big lumps to dust. The other, *Geum parviflorum*, grew near the former, but, unlike it, has been found on the South Island. This first attempt to cross the range failed, though its summit was reached; but a second attempt, made in February, 1847, was successful. A short sojourn was made at Matuku, the principal of the Patea villages; the route thereto was the long round-about by Taupo. From Matuku, on March 25, the ascent of the Ruahine was made, and the Mission Station at Waitanga was reached on March 3, after many hardships and difficulties. The narrative abounds in numerous records of great interest. The following is an account of one of the largest, we suspect, of flower visitors, honey-seekers, and one unknown to Darwin or Hermann Müller:—

"Close to the village, and even within its fence, were several very large Kewhai trees (*Edwardsia grandiflora*); these were covered with their golden flowers, and mostly without leaves. The sun was shining brightly, and the parrots (*Nestor meridionalis*) flocked screaming from the forests around to the Edwardsia blooms; it was a strange sight to see them, how deftly they managed to go out to the end of a long lithe branch (preferring to walk parrot fashion), and there, swinging back downwards, lick out the honey with their big tongues, without injuring the young fruit . . . For, seeing but very few petals falling (and those only vexillæ), I sent some of the boys to climb the trees and bring me several marked flowering branches, which had been visited by the parrots. I found that all of the fully expanded flowers had had the upper part of their calyces torn open, and the uppermost petal (vexillum) torn out; this the parrots had done to get at the honey. As the flowers are produced in large thick bunches, some are necessarily twisted or turned upside down; still it was always that peculiar petal and that part of the calyx (though often in such cases undermost) which had been torn away. Through this no injury was done to the young fruit inclosed, which would in all probability have been the case if any of the other petals had been bitten off. It cannot be said that it is owing to the vexillum being the largest petal (as it is in many papilionaceous flowers) that it is thus laid hold of and torn away by the parrot, such not being the case in this genus: for the long fruit runs down through the two carinated lowermost petals, that are often quite two inches long, and is further protected by the two side ones (alæ), which four, from their being closely imbricated together, form a much larger and firmer hold for the bird's beak.

"Further, as these parrots are large birds with huge bills, and as the flowers are always produced on the tips of the small branches, which bend and play about under the weight of their bodies, one cannot but suppose that it is no easy matter for the birds to get a bite at them at all, so as to make the proper openings whereby to insert their thick tongues and lick out the sweet contents without injuring the young immature fruits, especially when we further consider that the common practice of this parrot is to take up in its claws whatever it wishes to discuss. Of all the flowers I examined, only the upper part of the calyx and corolla had been torn, and on none was the young fruit wanting, nor did I notice any bunches which had had their flowers wholly torn off. What with the glistening snow, the sun shining, and the golden blossoms of those trees, the numerous parrots diligently and fearlessly at work so close to the village, yet often screaming, it was altogether a peculiar and interesting sight."

What delightful corners for the botanist are to be met with in this range the next paragraph will show. Many of the species are of the greatest interest—quite Alpine gems; and some few of them, or of closely-allied species, grow freely with us. We would be prepared to welcome them all.

"In the open ground, on two or three mound-like hills of peaty-looking soil, and near each other, on the west side, grew that remarkably fine Ranunculus, *R. insignis*. On my discovering it I was astonished at its size—its largest golden flowers being nearly 2 inches in diameter, its flowering stems 3 to 4 feet high, and some of its round crenated leaves measuring 8 to 9 inches across! Both Sir Joseph Hooker and his father were equally surprised and delighted, and as it was (then) by far the largest species known, Sir Joseph Hooker gave it that appropriate specific name—*insignis*. I only found it in that locality, but it was in great plenty; its principal neighbour was the notorious Tamarea plant (*Aciphylla Colensoi*), already fully noticed; and those splendid compositaceous plants *Celmisia spectabilis* and *C. incana*, which generally grew close together, forming large, dark-green, shining patches, and bearing a profusion of fine white flowers—a striking contrast to their leaves. At first sight I saw that this new Ranunculus was closely allied to *R. pinguis*, of Lord Auckland's group and Campbell's Island—then lately described in the "Flora Antarctica," of which work I had received an early part just before I left the station. Other plants of those far-off Antarctic islets were also found here, on the summits—notably *Oreobolis pumilio*, growing in dense tufts in exposed places; while the peculiar straggling *Cyathodes empetrifolia*, and the pretty little flowering-plants *Euphrasia antarctica* and *Myosotis antarctica* flourished in half-sheltered hollows with *Plantago Brownii* and the grass *Catabrosa antarctica*. With these last also grew, very closely intermixed (much as we have seen the daisies and buttercups among low turfy grasses in our English meadows), the curious plant *Drapetes dieffenbachii*; the little elegant *Ourisia cæspitosa*, abounding in flowers; a very small and new species of Plantago (*P. uniflora*); and a similar-sized botanical novelty, *Astelia linearis*, a tiny plant bearing a large orange-coloured fruit; a little Caltha (*C. Novæ Zealandiæ*), having pale, star-like flowers; two graceful Gentians (*G. montana* and *G. pleurogynoides*), and a very small, shrubby, prostrate Coprosma (*C. pumila*), together with several elegant, shrubby little Veronicæ. Two orchideous plants, *Pterostylis foliata* and *Caladenia bifolia* (of which I wished for better specimens), I also detected growing sparingly, and with them a couple of Carices, *C. acicularis* and *C. inversa*, and also two species of Uncinia, *U. divaricata* and *U. filiformis*; and with them several interesting Hepaticæ and Mosses. Only in one or two spots, in shady, sheltered places near the top, and just within the forest, did I meet with that pretty little plant, *Ourisia Colensoi*, but in those spots there were plenty of them, and always beautifully in flower; the plants of this species grew apart, as if they liked room—in this respect differing altogether from the other species of this genus I have seen."

The lover of flowers can easily judge from these extracts how interesting to them would be this memoir of the now venerable explorer; there is much more of the like nature throughout its pages, and we trust the Hawke's Bay Philosophical Institute will send some copies of this "In Memoriam" narrative to this country, on sale for their benefit.

NOTES

THERE will be a *conversazione* at the Royal Society on Wednesday next, June 10.

THE *conversazione* of Sir F. Bramwell, the President of the Institution of Civil Engineers, will be held in the International

Exhibition Buildings, South Kensington, to-morrow evening, from nine to twelve. The Society of Arts *conversazione* will be held in the same place on July 3 next.

A PUBLIC meeting has been held in Birmingham to make preliminary arrangements for the reception of the British Association for the Advancement of Science on its visit to Birmingham in 1886. The mayor, Mr. Alderman Martineau, presided, and there was a large attendance. After referring to the four previous visits of the Association to Birmingham, the last of which was in 1865, the mayor stated that the forthcoming visit would involve a large amount of preliminary work, for which arrangements had to be made by the appointment of local committees. The meeting would probably be under the presidency of Principal Dawson, of Montreal. A large local committee was appointed, together with honorary officers, and the meeting terminated with a vote of thanks to the mayor.

THE statue to Linnæus which was recently unveiled with so much ceremony in Stockholm, stands in the well-known park Humlegården. It represents the "flower-king"—as he is called in Sweden—at the age of sixty in a meditating attitude, holding the "Systema Naturæ" and a bunch of flowers in his left hand. It is surrounded by allegorical female figures representing botany, zoology, medicine, and mineralogy, and is executed by Prof. Kjelberg, the work having occupied five years.

A ZOOLOGICAL garden is being formed in Stockholm, at the well-known pleasure resort of Djurgården, which will be the first of its kind in Scandinavia. Most of the animals are being purchased in Germany.

THE Rede Lecture was delivered on Tuesday in the Senate House at Cambridge by Mr. G. J. Romanes, F.R.S., the subject being "Mind and Motion."

THE *Central News* has received a telegram from Bombay announcing that a fearful earthquake has devastated a portion of Cashmere. The first shocks were experienced on Sunday, and created intense consternation. The oscillation was repeated at intervals of about ten minutes, and the shocks still continued up to the time the despatch was sent off. A wild panic is stated to have seized upon the people, who ran to the rivers and lakes, and sought to escape by embarking upon floating craft of any description. The town of Srinagar seems to have suffered severely. A great portion of the city is stated to have been demolished by the most severe shocks. Later accounts state that although some severe shocks have occurred in Cashmere, the loss has been trifling.

A SMART shock of earthquake was felt in Cape Town and the surrounding districts shortly before midnight on May 10, but no damage was reported.

THE results of a series of observations carried out by the Hydrographical Bureau at Washington, in order to determine the length, depth, and duration of ocean waves, have been published. The largest wave observed is said to have had a length of half a mile, and to have spent itself in 23 seconds. During storms in the North Atlantic waves sometimes extend to a length of 500 and 600 feet, and last from 10 to 11 seconds. The most careful measurements of the heights of waves give from 44 to 48 feet as an extreme limit; the average height of great waves is about 30 feet. These measurements refer to ordinary marine action, and do not relate to earthquake action or other exceptional agencies.

A CORRESPONDENT to *Ausland* makes a communication regarding the present condition of the artesian wells in Sahara. It is well known that such wells have been in operation there from a very remote period, and in the Algerian Sahara additional wells have been opened with considerable success by the French. Between Biskra and Tuggurt the 434 old wells yielded in 1879 64,000 litres of water per minute, the 68 French ones 113,000 litres. The number of palms had increased from 359,000 to 517,000, that of other fruit-trees from 40,000 to 90,000, the population from 6672 to 12,827. In December, 1881, the yield of water from the wells had risen to 209,000 litres per minute. But this success is confined to a narrow zone within which water can be reached within a depth of 100 metres, and even here the borings that have been made since 1881 indicate a diminution in the yield of water, making it appear as if the limit of production of the underground reservoirs had almost been reached. Many of the French borings, too, are getting stopped up by sand, and are of too small calibre to be cleaned out and restored ike the wider Arabic ones. It is believed that it will be absoutely necessary to set about the sinking of new wells with a wider bore.

DR. ANDRÉE, of Leipzig, discussed before a recent meeting of the Anthropological Society of Vienna the question whether iron was known in America in pre-Columbian times. Meteoric iron was certainly in use amongst certain Indian tribes and the Esquimaux, but Dr. Andrée thinks that they were wholly unacquainted with the art of forging iron. This conclusion is based on the fact, among others, that while there is ample proof that the Indians knew how to obtain and employ gold, silver, tin, copper, quicksilver, &c., we hear nothing of iron mines in the history of the civilisation of ancient America. The language itself proves this, for there is no expression for *iron*. Some writers, it is true, speak of the word *panilgue* as that for iron, but it really means metal in general. Moreover, in pre-historic, or rather pre-Columbian, graves, especially in the rainless regions of Peru and Northern Chili, ornaments of all kinds, weapons and implements are found, but no objects in iron have been discovered, although the Indians placed their most valued articles in their tombs. There is no reason, he thinks, to believe that the tools employed in the great masonry works of Peru, such as that at Tiahuanaco, were other than those in use in the rest of Peru, which were of *champi*, a species of bronze. The chisels found in Peruvian graves soon become blunted when used on the hard strut; but it is suggested that there was some method of sharpening them easily. Indians certainly have worked a hard stone like nephrite without iron; and there is no improbability, says the writer, in the theory that these chisels were employed, when we recollect the patient temperament of the Indians, who for generations were accustomed to the repetition of the same work, to indolently pursuing an uniform task, and also that *gutta cavat lapidem*.

BEFORE the last meeting of the Asiatic Society of Japan (reported in the *Japan Weekly Mail*) Mr. H. Pryer read a paper entitled "Notes on the *Mustela itatsi* and on the *Corvus japonensis*, Bonaparte." The paper was largely a criticism of views advanced by Dr. Brauns regarding the generic affinities of these animals, and published in the Society's *Transactions*. A series of comparative measurements of the beak, metatarsus and wing of the *Corvus corax* and *Corvus japonensis* were given, with comparisons of the tail, eggs, and larynx, which proved that they were not identical. It was suggested that Dr. Brauns' specimen of the *Corvus japonensis* was really a specimen of the *Corvus corone*.

THE *Johns Hopkins University Circular* for May contains the abstract of a paper by Mr. Donaldson, entitled "Observations on Temperature-Sense." Blix, of Upsala, and Eulenberg, of Berlin, have observed that there are definite points on the skin at which sensations of cold only are aroused; others, distinct from the first and equally definite, for the sensation of heat, while between these two sets of spots sensations of pressure only are aroused. These reactions were obtained by electrical and thermal stimulation of the skin. Mr. Donaldson, whose attention had previously been attracted to the subject, endeavoured to make accurate maps of these cold and hot spots. It was found that their distribution on corresponding parts differed in different individuals, that the distribution on symmetrical parts of the body was different, that the number of cold spots was greater than the number of hot spots, that the relative abundance of the two kinds varied in different parts of the skin, and that, roughly speaking, there are two grades of spots, viz. those which react almost always and those which react only half the time and with a comparatively faint sensation. The spots, as a rule, are less than a millimetre in diameter, and they are easily exhausted. The sensation roused by a single stimulus often lasts, however, for some minutes after the removal of the stimulus. As the thermally sensitive spots move about as the skin moves, it is clear that they are in the skin and not below. On being cut from the skin and examined, the spots showed no structures with which the sensations could be associated. The spots were found quite as sensitive on scars as on the sound skin. Using the radiant-heat method described by Pollitzer, the hot spots were found to respond from eight to forty times more quickly to a given stimulus than the not-hot ones. The explanation of any sensation of heat on the not-hot spots appears to be that there is conducting heat through the skin, so that the stimulus finally reaches a hot spot.

THE death is announced of Mr. Alexander Croall, Curator of the Smith Institute, Stirling, and a botanist of some reputation.

WE have just received Band v. of the *Verhandlungen des Vereins für naturwissenchaftliche Unterhaltung zu Hamburg*, 1878–1882; the title-page bears the date 1883; it appears to have been published in monthly numbers. Was Band v. actually published until 1885? There is no internal evidence against its appearance in 1883, but we fail to find any reference to certain papers in it in the published records for that year. This ambiguity as to date is awkward. The contents are varied and valuable, and embrace natural history in its broadest sense, as will be seen from the titles of some of the papers, such as "Die Umgestaltung unserer Gegend durch Wasser und Wind und die Abnahme des Wassers in unserem Gebiete;" "Die Variabilität der Schmetterlinge in ihren verschiedenen Entwickelungs-Stadien, und der biologische Werth von Form, Farbe, und Zeichnung;" "Die Entwickelung unserer Kenntnisse der Länder im Süden von Amerika;" "Hammer und Messer in der Sprachgeschichte;" "Haben auch in Deutschland gleichzeitig mit dem Mammuth Menschen gelebt?" "Die Insel Rotumah und ihre Bewohner;" "Mittheilungen über einen Taifun bei Jokohama und Jeddo," &c. Of the papers enumerated that on typhoons seems especially interesting on account of the analyses given of the reports of various ship-captains. There are several zoological and botanical papers, in addition to the one already quoted.

THE new annual report of the Canadian Minister of Agriculture to the Governor-General contains, for the first time, the report of the Dominion entomologist, Mr. James Fletcher. The Minister explains that as an acquaintance with the results of entomological science is a matter of necessity to every tiller of the soil, he took the step of appointing an official entomologist in order that the attention of those whose interests are materially affected might be called to the subject. As Mr. Fletcher was only appointed in June last year, his report is necessarily a preliminary one. He has succeeded in establishing a system of correspondence all over the Dominion, and from extracts of letters which are published in his report it is clear that he has ample work before him. In parts of Nova Scotia, for example, the cultivation of wheat has had to be abandoned, on account of the wheat-midge, or *Diplosis tritici*. In other places, clover, peas, roots, fruit and forest trees have suffered heavily by the ravages of various insects. The position of entomologists, therefore, is one with large possibilities of material benefit to the Dominion and its inhabitants.

A SERIES of photographs of lightning flashes were lately obtained at Berlin by Dr. Kayser, and are the subject of a paper to the Academy there (*Wied. Ann.*, No. 5). The lightning is shown (as previously) to have gone very often from one point to several, the aspect in the photograph being like that of a river with numerous tributaries (only the fluid takes the opposite direction). The weaker flashes did not so branch out. In one remarkable effect the stem consists not of one bright line only, but of four parallel throughout, the second being rather a band, and stratified transversely. The explanation Dr. Kayser offers is, that in this case there was an oscillating discharge. The first spark, in passing from cloud to earth, would leave a channel of heated air, which would be used by the next spark from earth to cloud, only it was meanwhile a little displaced by the wind; and so with the others. Such oscillatory discharges may sometimes be observed with the eye in violent thunderstorms if the oscillation be pretty slow. Dr. Kayser reckons the whole phenomenon in the present case to have occurred in less than half a second. The stratified appearance of the band he is unable to account for.

THE eels of the ponds in the woods of Vincennes leave them every spring in large numbers, making their way to the Seine or the Marne, several kilometres distant. They take advantage of rainy weather, when the herbage is wet, and their instinct guides them directly to their destination. New species have repeatedly been introduced into the lakes, but in vain; all seem to have this disposition to leave. Some have thought that the water of these ponds, having been brought by hydraulic engines, has undergone some change which drives the eels away. But the phenomenon of such migrations by eels and some other fishes is not uncommon. Thus in the marshes of Picardy eels are often found on the grass, going from one pond to another.

THE reports of the Aëronautical Society of Great Britain for the years 1883 and 1884 have just been issued together in a small volume. It is mainly occupied by papers read before the Society. Amongst these is one on the mechanics of flight and their application to flying machines, by Mr. H. Middleton; artificial flight attainable by Mr. Hollands; the possibility of man-flight, by Mr. Barry; on the methods of soaring birds, and the bearing of the facts connected with them, by Mr. J. Lancaster, of Chicago. Amongst the shorter papers are: a visit to the Aëronautical Exhibition at Paris, by Mr. Frost; a memoir of Mr. John Stringfellow, by Mr. Brearey; a light and economical motor for propulsion in air, by Capt. Griffiths; and conjoint gas and mechanical action as applied to flight, by Mr. Brearey.

AN aëronautical exhibition under the patronage of the Aëronautical Society of Great Britain is to be opened during the present month in connection with the International Exhibition at the Alexandra Palace. The objects for exhibition will be models of designs for the accomplishment of aërial navigation by mechanical means only, or partly by buoyancy and partly by mechanical means; objects which are capable of flight and carrying their own motive power; machines constructed upon a scale calculated to carry a weight equal to that of a man upon the principles advocated by the inventors; light motors; balloons, navigable or otherwise; balloon material; kites, or similar aërial appliances, for saving life at sea, or for traction; and other objects of interest connected with aëronautics. The large outdoor space will be made available for various competitions, such as the nearest approach to a given locality. The disputed question of aërial locomotion by the aid of buoyancy will also be conclusively tested.

THE scientific society, Isis, of Dresden, having recently attained the fiftieth year of its existence, has issued a special jubilee or festival number of its *Proceedings*. It was founded in 1834, at the end of which year it had 27 members, and in 1835 it was reorganised and called Isis. During the first thirty years of its existence the Society was fortunate in having in keeping a single president, Dr. Reichenbach, whose lectures were mainly instrumental in the formation of the Society. In 1860 the twenty-fifth anniversary of the founding was celebrated with much ceremony, and as the occasion was also Reichenbach's jubilee, the double event was commemorated by the establishment of a memorial fund which bore his name, and the income from which was to be devoted to the support of a Saxon student travelling for zoological investigation. A record was then issued of the work of the Society so far; the number before us carries on the story for another twenty-five years, thus completing the history of the half century. The 27 members of 1835 have swollen to about 465 in 1885, and progress in other directions has been in proportion. In addition to the secretary's record of the advances of the last quarter of a century, the *Festschrift* contains a paper by Prof. Stelzner on the development of the methods of petrographic investigation during the last fifty years, and one by Herr Töpler on the history of discoveries in electro-magnetism and inductional electricity. Most of the remaining papers deal with local science, such traces of animals in the coal formations of Zwickau, and several others on subjects connected chiefly with Dresden and its neighbourhood. The Society starts on the second half of the first century of its existence with ample vigour and promise of an unlimited lease of existence and activity.

ON May 22, at about 6.30 p.m., a mirage was seen from Visby, on the island of Gothland, in the Baltic. It appeared out at sea, on the western horizon, and represented a town on both sides, surrounded by high forest-clad mountains, which seemed to be within a distance of only a few miles. A large vessel with three masts lay in front of the town. The mirage lasted a couple of minutes, when it suddenly disappeared.

ONE hundred thousand shad have been reared in the United States during the last year, to say nothing of other species of fish, the exact number of which it is impossible to compute. It will be remembered that the shad was once exceedingly prolific in the Thames, but owing to the impure state of the river their numerical proportions have decreased to a very large extent. The Fish Commissioners of America have acted wisely in acclimatising the shad to their own waters, it being a valuable fish and easy of cultivation.

A SHORT time since we commented upon the enormous quantities of rats which infested the Health Exhibition, but which entirely disappeared shortly after it closed. Soon after the present Inventions Exhibition opened, these pests commenced to reappear, and their numbers are daily increasing. The authorities would do well to check their movements before they assume gigantic proportions.

ALTHOUGH the Professorship of Anatomy and Histology at the University of Lund has been twice officially announced vacant no applicant has come forward. It will now have to remain unoccupied till 1886.

THE Mexican Government has at length determined to undertake a geological survey of the whole country, as far as practicable. 10,000 dollars have been assigned for preliminary expenses.

WE have received from Messrs. Theiler and Sons specimens of their Universal Pocket Microscope and their Demonstration Microscope. The former magnifies 50 diameters, while the latter, intended for "schools and the drawing-room," has three powers—30, 100, and 150 diameters. They are both very admirable contrivances, and should be in the hands of all young people. The definition and achromatism of the Demonstration Microscope are perfect.

THE additions to the Zoological Society's Gardens during the past week include two Javan Cats (*Felis javanensis*), a Marbled Cat (*Felis marmorata*) from Malacca, presented by Mr. Frank Swettenham; a Common Marmoset (*Hapale jacchus*) from Brazil, presented by Dr. L. Morgan; a Slender-billed Cockatoo (*Cacatua tenuirostris*) from Australia, presented by Mrs. E. H. Watson; two Tuatera Lizards (*Sphenodon punctata*) from New Zealand, presented by Prof. T. J. Parker; a Smooth Snake (*Coronella lævis*), a Common Viper (*Vipera berus*), British, presented by Mr. W. H. B. Pain; a Slender-billed Cockatoo (*Cacatua tenuirostris*) from Australia, thirteen Tuatera Lizards (*Sphenodon punctata*) from New Zealand, deposited; an Osprey (*Pandion haliaetus*), caught in the North Sea, purchased; a Darwin's Rhea (*Rhea darwini*) from Patagonia, received in exchange; a Hog Deer (*Cervus porcinus* ♂), two Four-horned Antelopes (*Tetraceros quadricornis*), two Prairie Marmots (*Arctomys ludovicianus*), two Long-fronted Gerbilles (*Gerbillus longifrons*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE OBSERVATORY OF PARIS.—Rear-Admiral Mouchez has issued his report on the work of this establishment during the year 1884. The completion of the re-observation of Lalande's stars has led to a new disposition of the meridian-instruments, one of which, on the proposal of M. Lœwy, is now occupied with the determination of a number of circumpolar stars on his new method; the great meridian-circle and the circle of Gambey are still employed for observations of the minor planets, and of comparison-stars for planets, comets, and nebulæ observed with the equatorials. The great telescope of 0·74 m. is still unmounted, no suitable position being available in the present state of the grounds of the Observatory. M. Mouchez mentions having received communications from the authorities in Algeria, referring to the possibility of obtaining from the local budget the greater part of the sum that would be required to mount the instrument at the Observatory of Algiers on the summit of the Boudjaréah—an exceptionally favourable situation, which might be visited by the astronomers of the Paris Observatory for special observations, but the Council of the latter institution have not availed themselves of the proposition, in the hope that the equatorial may yet be erected at Paris. Amongst the observations made with the instruments in the west tower and the Henry equatorial, are many of the satellites of Uranus and Neptune, the companion of Sirius, the belts of Uranus, nebulæ, and double-stars. MM. Henry have been occupied with astronomical photography during the year, and, as is well known, with great success; various clusters of stars have been photographed, and M. Mouchez appends to his report a reproduction by heliogravure of a plate of the great clusters in Perseus. A trace of the motion of the minor planet Pallas was shown after an exposure of thirty-five minutes. The important results obtained by MM. Henry in photographing very small stars in those crowded parts of the heavens where the Galaxy crosses the ecliptic have been already referred to in this column. Steady progress has been made both with the calculations and printing of the Paris Catalogue of Stars, and it is expected that the first volume of both series (star-positions as observed, and catalogue) will be completed by the end of the year. Vol. xviii. of the *Mémoires* is finished. The Report further details the personal work of the members of the Observatory staff. Amongst the additions to the Museum is a portrait of Pons, presented by M. Tempel.

The Report for the year 1884 is preceded by one which enters specially into the present condition of a scheme for removing the principal instruments in the Observatory to a site where not only greater steadiness can be secured in their mounting but where the objections of being surrounded by a great city will not exist. It appears that the Academy of Sciences have not, so far, favoured this scheme. M. Mouchez states very clearly his view of the question.

THE COMET TEMPEL-SWIFT (1869–80).—M. Bossert, of Paris, is engaged upon the determination of the orbit of this comet, which may be expected to reach perihelion again about May, 1886, the period of revolution being rather less than 5½ years. Since the last perihelion passage on November 8, 1880, the perturbations are not likely to have been material, and should the comet arrive at its least distance from the sun early in May the chances of reobservation will be very small indeed, the longitude of perihelion being in 43°, and the inclination of the orbit to the ecliptic less than 5½°.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, *JUNE* 7-13

(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 June 7

Sun rises, 3h. 47m. ; souths, 11h. 58m. 35·5s. ; sets, 20h. 10m. ; decl. on meridian, 22° 48′ N. : Sidereal Time at Sunset, 13h. 15m.

Moon (New on June 12, 23h.) rises, 0h. 56m. ; souths, 7h. 3m. ; sets, 13h. 22m. ; decl. on meridian, 0° 41′ N.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	2 59	10 34	18 9	17 10 N.
Venus	4 17	12 38	20 59	23 57 N.
Mars	2 34	10 14	17 54	17 58 N.
Jupiter	9 51	17 1	0 11*	12 52 N.
Saturn	4 31	12 40	20 49	22 26 N.

* Indicates that the setting is that of the following day.

Phenomena of Jupiter's Satellites

June	h. m.		June	h. m.	
7	20 42	I. ecl. reap.	11	20 36	II. occ. disap.
8	0 2	IV. tr. ing.	13	22 0	I. tr. ing.

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

June	h.	
11	1	Mars in conjunction with and 3° 51′ north of the Moon.
11	16	Mercury in conjunction with and 2° 47′ north of the Moon.
13	6	Saturn in conjunction with and 4° 3′ north of the Moon.
13	17	Venus in conjunction with and 5° 48′ north of the Moon.

GEOGRAPHICAL NOTES

THE Pamir is the subject of another contribution, by M. Ivanoff, to the last issue of the *Izvestia* of the Russian Geographical Society. Several objections having been made to his views on the Pamir, already mentioned in NATURE, and especially to his tendency of limiting the name of Pamir to the eastern part of the great Central Asian mountain mass. M. Ivanoff answers by a paper accompanied by a map of the Pamir, on which the whole of the region is represented ; the chains of mountains being drawn, however, merely schematically, which circumstance is a great obstacle to catching on the map their real characters. He insists on the fact that the denominations "Great" and "Little Pamir," introduced by Messrs. Gordon and Trotter, are not known to those natives who are best acquainted with the region, and they lay altogether too much stress upon the names in use among Kirghizes. He thus limits the discussion as to what must be considered as the Pamir, which discussion had been so very well put by his former orographical papers on its proper ground—that of physical geography—where it obviously must remain. We notice in the same issue a paper by M. Wolter on the Prussian Lithuanians ; and a preliminary report, by M. Sorokin, on his journey in Russian Tian-Shan.

THE new and promising route to Central Asia from the Mortvyi Kultuk Gulf of the Caspian viâ the Ust-Urt to Kungrad is the subject of an interesting paper read by M. Belavskiy before the Russian Geographical Society, and analysed in the last issue of the *Izvestia* (xxi. 2). Until lately the Mortvyi Kultuk was considered too shallow for navigation, east winds being said to reduce its depth to 3·5 feet. Recent soundings proved, however, that, the usual depth being about 9 feet, no winds reduce it more than to 4½ feet ; in fact, flat steamers freely navigate the gulf. Those which do not take more than 4½ feet of water approach the shores for 60 to 230 yards at Ayrakly. From that port, which has sweet-water wells, the route goes on to the Ust-Urt plateau. The Ust-Urt was formerly considered as quite dry, and as having a very severe climate. But this belief was exaggerated. Water is found at each 10 to 13 miles ; there are also pasture-grounds, and neither the cold in winter nor the heat in summer is excessive. This last is moderated by winds. The *saksaoul*, brushes, and the excrement of camels give the necessary fuel. On the whole stretch, 270 miles long, from the Mortvyi Kultuk to Kungrad, there is no difficulty in crossing the Ust-Urt in carriages, and want of water is felt only near Kungrad. From this town steamers may ply on the Amu-daria ; a steamer has already gone up the river to Khodja-Sala. Moreover, a route, available for carriages, runs along the left bank of the river. On the whole this new route has already proved to be more advantageous for the transport of merchandise from Bokhara to Russia than he old one viâ Orenburg.

FROM a communication to the Russian Geographical Society, made by Dr. Dybovskiy, it appears that the Commodore Islands —Behring, Copper, and two smaller ones—situated 300 miles east of Kamschatka, ought to be regarded in a better light than they have been hitherto. Behring Island is covered with excellent prairies, and Dr. Dybovskiy is sure that agriculture could be carried on it. The southern part of this island is hilly, and reminds one of the alpine regions of Kamstchatka. No forests, but only shrubs of the *Rhododendron Sorbus*, and so on, grow on the islands ; but the explorer's experiments of planting forest-trees proved quite successful. The higher tracts offering excellent grazing grounds for reindeer, a number of these last were imported in 1882, and the experiment of acclimatising them on the island proved also quite successful. The narrow valleys of Copper Island are also considered quite suitable for agriculture. The islands are formed of crystalline rocks covered with Tertiary deposits ; they contain copper ore and brown coal, of course unworked. Fuel is brought from Kamtschatka. The climate is far milder than on the peninsula, and while in May snow a yard thick lay at Petropavlovsk, vegetables are freely grown on the islands. Snow is altogether so scanty that horses brought on to Behring Island were feeding throughout the winter on the prairies. The fauna of the islands has been well explored by M. Dybovskiy. The flora is much like that of the alpine regions of Kamtschatka. The inhabitants, all Aleutes, 514 in number, live in wooden houses. They are all Christians, and can read.

THE attention of geographers and men of science ought to be called to several numbers of the *Archiv für die naturwissenschaftliche Landesdurchforschung von Böhmen*, which have recently been issued (Prague : Franz Rzuonatz). The numbers of most interest to geographers pure and simple are those forming the first division of the third volume, and containing a list of the heights in Bohemia trigonometrically determined by the Imperial Institute of Military Geography in the years 1877–79. Numbers 2 to 6 of the fourth volume deal with the geology and botany of Bohemia, and numbers 1 to 3 of the fifth volume are also devoted to geology. The monographs composing this work are said to constitute a real treasury of information concerning the physical conditions and natural resources of the Austrian Crownland of which it treats.

AT the last meeting of the Paris Geographical Society a communication was read from Capt. Sorensen respecting his visit last year to Spitzbergen. It contained numerous observations on climatology and the configuration of the coasts (especially in correction of the English charts). His remarks with regard to the state of the ice during the spring are of special interest. He found the ice around Spitzbergen very different from what he had observed in previous years. Usually the western side is accessible at the commencement of the season, viz., May and June. *Drifts* are to be met with, but they disappear about the middle of June, or, at the latest, in the beginning of July. Last year, on the other hand, the west coast was blocked by ice the whole summer through. No captain can recollect having ever encountered such a mass of ice on this coast. The Norwegians have observed that for three years past the melting of the ice has grown later year by year. On the east coast the sea is generally full of icebergs, but it was wholly free from them last year. Off Barentz Island also the sea was free from ice, and one of the captains who penetrated farther to the east discovered two islands. Capt. Sorensen suggests, therefore, that Spitzbergen and Franz-Josef Land form parts of a vast archipelago, and not two wholly distinct territories, as has hitherto been believed. He promises during coming years to continue his meteorological observations in his annual visits to these regions.

THE last number of the Royal Geographical Society of Antwerp (tome ix. 5e fascicule) contains a paper by M. van den Gheyn on the European origin of the Aryas, a discussion of recent researches on this subject, especially of the works of Schrader, Penka, von Löher, Roth, Geiger, and Ujfalvy. The author, while regarding the subject as open to discussion, thinks that the probabilities are in favour of an Asiatic origin. Dr. Haine writes on the manners of the Californian Indians, amongst whom he passed some time about 1850. M. August Thys contributes a brief account of an early Flemish navigator, Dietrich Paesschen, who made several voyages to the Levant about 1511; and M. Baguet describes Steinen's late journey on the Xingu. An instalment of the report of the commission to study the Scheldt concludes the number.

THE expedition which the Norwegian Government dispatches this summer to the coast of Finmarken, to which we have previously referred, has for its chief object to ascertain whether there are banks or fishing grounds far from the coast, a circumstance which has never been ascertained, but which would be of great value if proved. Hitherto all fishing has been confined to the shore, but, judging from what is the case further south in Norway, such a discovery is very likely.

ON May 27 the Arctic steamer *Alert* sailed from Halifax with a scientific expedition for Hudson's Bay, to examine its harbours and the facilities that exist for a trade route from the Western Territory to Europe.

ARTIFICIAL EARTHQUAKES

QUITE recently we noticed a paper by Prof. Milne, of Japan, which contained exhaustive records of nearly 250 earthquakes that occurred in that country in two years, and which was an earthquake history of Northern Japan during that period. We have now before us another paper from the same indefatigable investigator, also on earthquakes, but on a totally different branch, viz. seismic experiments—in other words, on artificial earthquakes. These experiments are so original in their inception, and in some respects so unexpected in their results, that they are worth describing at some length. The paper, which was read before two successive meetings of the Seismological Society of Japan towards the close of last year, covers over eighty octavo pages, and contains several illustrations; but it will be possible to extract its principal results in a comparatively short space. There were in all ten series of experiments, carried on over three years. The object was to study phenomena connected with earth-vibrations produced either by some explosive like dynamite, or by allowing a heavy weight to fall from a height. Each set of experiments involved several weeks' preparation; amongst the chief difficulties to be overcome were the procuring, transporting, and storing dynamite, putting the observing-stations in telegraphic connection, arranging the firing apparatus, making electric fuses, and the like, and doing all this in the midst of a populous city. These initial difficulties could never have been overcome but for the assistance of various departments of the Japanese administration, and it is pleasing to notice the help which Japanese officials freely render Prof. Milne in his interesting and important work in the field of seismic science. Nevertheless, he warns his readers at the outset that his experiments were such that it is hardly just to expect them to be carried out satisfactorily by a private individual; the trouble, expense, danger, and magnitude of the arrangements which they involve make them fitter undertakings for an army corps.

The only guiding data which he had when he commenced were the results obtained by the late Mr. Robert Mallet and by Gen. Abbot. These referred only to the velocity with which earth-vibrations were propagated, and in taking diagrams of earth-motion he was therefore entering upon new ground, and therefore continually encountered new results. Sometimes it was found that the instruments employed required modification before satisfactory records could be obtained; at other times the records which were obtained gave indications of new lines of investigation, to pursue which new apparatus would be needed, and so on. Hence many of his results, he observes, can only be regarded as provisional; for example, those which relate to the velocities of normal and transverse vibrations. The experiments were carried out, as far as circumstances would permit, in different soils, the chief agents employed being heavy weights of 1700 lbs. and upwards dropped from heights up to 40 feet, and different quantities of dynamite exploded in cavities of varying depths. The effects of these were observed with different seismographs. The observations thus made in the ten series of experiments are described with the utmost detail, illustrated by numerous plans and tables, under their appropriate heads. Prof. Milne sums up his results under a succession of heads, and the most important of them are given below. He observes, however, that in reading these conclusions it must be remembered that they only refer to experiments performed in certain kinds of ground.

Effect of Ground on Vibration.—Hills have but little effect in stopping vibrations, but excavations exert considerable influence on them. In soft, damp ground it is easy to produce vibrations of large amplitude and considerable duration; in loose, dry ground an explosion of dynamite yields a disturbance of large amplitude but of short duration, while in soft rock it is difficult to produce a disturbance the amplitude of which is sufficiently great to be recorded on an ordinary seismograph.

General Character of the Motion.—The pointer of a seismograph with a single index first moves in a normal direction, after which it is suddenly deflected, and the resulting diagram yields a figure partially dependent on the relative phases of the normal and transverse motion, which phases are in turn dependent upon the distance of the seismograph from the origin of the disturbance. A bracket seismograph indicating normal motion at a given station commences its indications before a similar seismograph arranged to write transverse motion. If the diagrams yielded by two such seismographs be compounded, they yield figures containing loops and other irregularities not unlike the figures yielded by the seismograph with the single index. Near to an origin the first movement will be in a straight line outwards from the origin; subsequently the motion may be elliptical, like the figure 8, and irregular. The general direction of the motion is, however, normal. Two points of ground only a few feet apart may not synchronise in their motions, and earthquake motion is probably not a simple harmonic one.

Normal Motion.—Near to an origin the first motion is outwards; at a distance from the origin the first motion may be inwards, the nature of the movement being dependent probably on the intensity of the initial disturbance and on the distance of the observing station from the origin. At a station near the origin the second or third wave is usually the largest, after which the motion dies down very rapidly in its amplitude, the motion inwards decreasing more rapidly than the motion outwards. Roughly speaking, the amplitude of normal motion is inversely as the distance from the origin. As a disturbance radiates, the period of oscillation increases, until finally it becomes equal to the period of the transverse motion. It may thus be inferred that the greater the initial disturbance the greater the frequency of the waves. A wave which appeared single at one observing station had split up into two by the time it reached the second. At stations near the origin the motion inwards is greater than the motion outwards; but at a distance the two motions are practically equal. At a station near the origin the period of the waves is at first short, but it becomes longer as the disturbance dies out. The semi-oscillations inwards are described more rapidly than those outwards.

Transverse Motion.—The laws governing the transverse motion are practically identical with those which govern the normal motion, the only difference being that in the case of normal motion they are more clearly pronounced. Near to an origin the transverse motion commences definitely but irregularly; the first two or three movements are decided, and their amplitude slightly exceeds that of those which follow, but it decreases as the disturbance radiates at a slower rate than that of the normal motion. The period increases as the disturbance radiates, and decreases as the latter begins to die out.

Relation of Normal to Transverse Motion.—Near to an origin the amplitude of normal is much greater than that of transverse motion, and as a disturbance radiates the amplitude of the latter decreases at a slower rate than that of the former, so that at a certain distance they may be equal.

Maximum Velocity and Intensity of Movements.—An earth-particle usually reaches its maximum velocity during the first inward movement, but a high velocity is sometimes attained in the first outward semi-oscillation. The value

$$V^2 = \tfrac{4}{3} g \sqrt{a^2 + b^2} \times \left(\frac{1 - \cos\theta}{\cos^2\theta}\right)$$

used by Mallet and other seismologists to express the velocity of shock, as determined from the dimensions of a body which it has overturned, is a quantity not obtainable from an earthquake diagram. It represents the effect of a sudden impulse. In an earthquake a body is overturned or shattered by an acceleration, f, which is calculable for a body of definite dimensions. As obtained from an earthquake diagram f lies between $\frac{V}{t}$ and $\frac{V^2}{a}$, where V is the maximum velocity, t is the quarter period, and a is the amplitude. The initial velocity given in the formula $V^2 = \frac{2a^2}{b}$ for horizontal projection used by Mallet as identical with V^2 in the first formula, are not identical quantities. The velocity calculated from the range of projection, when projection occurs, is identical with the maximum velocity as measured directly or calculated from a diagram. The values $\frac{V^2}{a}$ are those used by Prof. Milne in discussing the intensity of movement. The intensity of an earthquake at first decreases rapidly as the disturbance radiates, subsequently it decreases more slowly. A curve of intensities deduced from observations at a sufficient number of stations would furnish the means of approximately calculating an absolute value for the intensity of an earthquake.

Vertical Motion.—In soft ground vertical motion appears to be a free surface-wave which advances more rapidly than the horizontal component of motion. It commences with small, rapid vibrations, and ends with vibrations which are long and slow. High velocities of transit may be obtained by the observation of this component of motion, and this is possibly an explanation of the preliminary tremors of an earthquake and the sound phenomenon.

Velocity.—The velocity of transit decreases as a disturbance radiates; near to an origin it varies with the intensity of the initial disturbance. In different kinds of ground, with different intensities of initial disturbance, and with different systems of observation, velocities lying between 630 feet and 200 feet per second were determined. Mr. Mallet determined a velocity in sand of 824 feet, and in granite of 1664 feet per second. Gen. Abbot observed velocities of 8800 feet. These various determinations may all be strictly correct, the great difference between them being due partly to the nature of the rock, the intensity of the initial disturbance, and the kind of wave which was observed. In Prof. Milne's experiments the vertical free surface wave had the quickest rate of transit, the normal being next, and the transverse motion being the slowest; but the rate at which the normal motion exceeds the transverse is not constant. As the amplitude and period of the normal motion approach in value those of the transverse motion, so do the velocities of transit of these motions approach each other.

In stating the results, of which those given above are the principal, Prof. Milne refers to the particular experiments which support them, thus giving chapter and verse for his conclusions; but he thinks that if the investigations were repeated by himself or by any other investigator, although much of what he has recorded would be substantiated, more accurate results might be obtained by taking advantage of his experience. Finally he gives examples of investigations which have yet to be undertaken, and as these are valuable for others working in the same field, we append them here:—(1) An accurate determination of the rate at which the velocity of transit decreases as a disturbance radiates from its origin; (2) the relation between the velocity of transit and the intensity of the initial disturbance; (3) the determination of the rate at which the intensity of a disturbance decreases as measured at different distances from the origin. This might perhaps lead to the construction of a curve of intensities from which the absolute intensity of the initial disturbance could be learnt; (4) a more complete investigation of the vertical motion and of free surface waves; (5) an investigation of the inward motion of shocks. In Prof. Milne's experiments the movement of the ground from its neutral position *in* towards the origin of the disturbance has been performed so rapidly that he has been unable with the instruments at his disposal to measure its velocity accurately. As this is probably the most destructive element of motion, he regards its investigation as exceedingly important; (6) further investigations on the relationship between earthquake diagrams, and the overturning and projecting of various bodies; (7) a repetition of these and of all other experiments, on different kinds of ground.

THE INFLUENCE OF FORESTS ON CLIMATE

THE third number of *Petermann's Mittheilungen* for this year contains an article by Herr A. Woeikof on the influence of forests on climate. The commencement of a scientific investigation of this subject was made when the Bavarian forest meteorological stations were established, and when Prussia, Alsace-Lorraine, France, Switzerland, and Italy followed the example. As a general rule it may be laid down that in the warm seasons, as between forests and places close at hand which are treeless (1) the temperatures of the earth and air are lower in the former, (2) their variations are less, (3) the relative humidity is greater. After examining observations as to evaporations, Herr Woeikof states that the influence of forests in diminishing evaporation from water and the soil is so great that it cannot be accounted for alone by the lower temperature of the hot months, the greater humidity, or even by the shade. An important influence, which has hitherto been but little appreciated, is the protection from the wind afforded by the trees, and this the writer regards as more important than all the others together in reducing the degree of evaporation. With regard to the influence of forests on rain and snowfall, there is as yet only a single series of observations supplying comparative statistics, and extending over a sufficiently long period. These were taken in the neighbourhood of Nancy, and they show an important influence of forests in increasing the rainfall. It might appear that the effect of forests on rain in the climate of Central Europe in winter would be small, for the difference between the temperature and humidity of the forest and the open is very little, and the quantity of moisture in the atmosphere is small. But the observations show that it is at this time of the year that forests get much more rain. This the writer attributes to the clouds being lower, the resistance which the forest offers to the movement of the air, and to the moist west wind. Forests retain rain by the undergrowths of grass, moss, &c., much better than open ground, and let water off superficially only after a heavy rainfall; the remainder filters upwards slowly, and much of it is used for the evaporation of the trees. Although forests, especially thick, luxuriant forests, cannot exist without certain supplies of moisture, yet it is the same to them when the supplies come, for they retain what they get and use it over a long period. One example of this is the Lenkoran forest on the west coast of the Caspian, where the vegetation is more luxuriant than in any other part of Europe, yet very little rain falls in summer, but the rainfall in autumn and winter is great. The water is stored up by the forest, and is used in evaporation during the heat of summer. Humidity of the atmosphere, however, is not inconsistent with a high temperature, as the Red Sea shows; but in forests the humidity is due to the evaporation of the leaves—in other words, to a process by which heat is converted into work, and hence the coolness. Herr Woeikof then endeavours to ascertain the influence of forests on the climatic conditions of their neighbourhoods in the western parts of the Old World, between the 38th and 52nd degrees N. latitude, the places selected being in all cases in the open. Thus for the 52nd degree eight stations are taken between Valentia in Ireland on the west and the Kirghiz steppes on the east; for the 50th, Guernsey on the west, Semipalatinsk on the east, and thirteen stations, and so on for each two degrees of latitude to 38°. The general result of the observations in fifty-stations in six different degrees of latitude is that in Western Europe and Asia large forests have a great influence on the temperature of places near them, and that by their influence the normal increase of temperature as we travel eastward from the Atlantic Ocean to the interior of the continent is not merely interrupted, but they give places far removed from the coast a cooler summer than those actually on the sea. A striking example of this is Bosnia. An examination of the statistics shows (1) that in Bosnia the summer is 2°·5 to 4°·5 cooler than in Herzegovina; (2) even on the island of Lissa, in the full influence of the Adriatic Sea, the summer temperature is more than a degree higher than that of Bosnia, which is separated by lofty mountain ranges from the sea. Bosnia owes this comparatively cool summer to its great forests, while Herzegovina is almost disafforested. To sum up: forests exercise an influence on climate which does not cease on their borders, but extends over a larger or smaller adjacent region according to the size, kind, and position of forest. Hence man by afforestation and disafforestation can modify the climate around him; but it is an extreme position to hold that by afforestation the waste places of the earth can be made fertile. There are places incapable of being afforested, which would not give the necessary nourishment to trees.

ORIGIN OF THE CEREALS

RECENT numbers of *Naturen* contain interesting papers, by Prof. Schübeler, on the original habitat of some of the cereals, and the subsequent cultivation in the Scandinavian lands and Iceland of barley and rye more especially. It would appear that barley was cultivated before other cereals in Scandinavia, and that the generic term "corn" was applied among Northmen to this grain only from the oldest times, and that in the Norwegian laws of the seventeenth and eighteenth centuries wherever reference was made to the "*Kornskat*"—or standard by which land in the Northern lands was, and still is, rated in accordance with the corn it is capable of yielding—the term was understood to apply to barley. Proof of the high latitude to which the cultivation was carried in early ages is afforded by the Egil's Saga, where mention is made of a barn in Helgeland (65° N. lat.) used for the storing of corn, and which was so large that tables could be spread within it for the entertainment of 800 guests. In Iceland barley was cultivated from the time of its colonisation, in 870, till the middle of the fourteenth century, or, according to Jón Storrason, as lately as 1400. From that period down to our own times barley has not been grown in Iceland with any systematic attention, the islanders being dependent on the home country for their supplies of corn. In the last century, however, various attempts were made both by the Danish Government and private individuals to obtain home-grown corn in Iceland, and the success with which these endeavours were attended gives additional importance to the systematic undertaking, which has been set on foot by Dr. Schübeler and others, within the last three years, for the introduction into the island of the hardier cereals, vegetables, and fruits. As many as 382 samples of seeds of ornamental and useful plants, most of which were collected from the neighbourhood of Christiania, are now being cultivated at Reykjavik under the special direction of the local government doctor, Herr Schierbeck, who succeeded in 1883 in cutting barley ninety-eight days after the sowing of the seed, which had come from Alten (70° N. lat.). And here it may be observed that this seems the polar limit in Norway for anything like good barley crops. The seed is generally sown at the end of May, and in favourable seasons it may be cut at the end of August; the growth of the stalk being often 2½ inches in twenty-four hours. North of 60° or 61° barley cannot be successfully grown in Norway at more than from 1800 to 2000 feet above the sea-level. In Sweden the polar limit is about 68° or 66°, but even there, as in Finland, night-frosts prove very destructive to the young barley. In some of the fjeld valleys of Norway, on the other hand, barley may in favourable seasons be cut eight or nine weeks after its sowing, and thus two crops may be reaped in one summer. According even to a tradition current in Thelemarken, a farm there owes its name *Triset* to the *three* crops reaped in the land in one year! Rye early came into use as a bread-stuff in Scandinavia, and in 1490 the Norwegian Council of State issued an ordinance making it obligatory on every peasant to lay down a certain proportion of his land in rye. In Norway the polar limit of summer rye is about 69°, and that of winter rye about 61°; but in Sweden it has been carried along the coast as far north as 65°. The summer rye crops are generally sown and fit for cutting about the same time as barley, although occasionally in Southern Norway less than ninety days are required for their full maturity.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE Gilchrist Trustees have instituted a Scholarship of the annual value of 50*l.*, for three years, tenable at either Girton or Newnham College, Cambridge, to be awarded in connection with the Cambridge Higher Local Examination. The first award will be made on the results of the examination to be held in June. Further information may be obtained from the secretaries of the two colleges.

AT a recent meeting of the Senate of the Royal University of Ireland, two Fellows in the Department of Natural Science were elected. The successful competitors were the Rev. Marshal L. Klein, of the Catholic University College, and Mr. Marcus M. Hartog, Professor of Natural History, Queen's College, Cork. The salary attached to each of the Fellowships is 400*l.* a year.

SCIENTIFIC SERIALS

The Quarterly Journal of Microscopical Science, April, contains:—On the urinary organs of the Amphipoda, by W. B. Spencer, B.A. (plate 13).—The skin and nervous system of Priapulus and Halicryptus, by R. Scharff, Ph.D. (plate 14).—The eye and optic tract of insects, by S. J. Hickson, B.A. (plates 15–17).—A peculiar sense organ in *Scutigera coleoptrata*, one of the Myriopoda, by F. G. Heathcote, B.A. (plate 18).—The structure and development of Loxosoma, by S. F. Harmer, B.Sc. (plates 19–21).—A new hypothesis as to the relationship of the lung-book of Scorpio to the gill-book of Limulus, by E. R. Lankester, M.A.—A supplement number is announced to be published during May.

The Journal of the Royal Microscopical Society for April contains:—The Rev. W. H. Dallinger's address as President (plates 4–6).—The Lantern Microscope, by L. Wright.—On some unusual forms of lactic ferment; *Bacterium lactis*, by R. L. Maddox, M.D.—On a cata-dioptric immersion illuminator, by J. W. Stephenson.—With the usual summary of current researches in zoology and botany.

American Journal of Science, May.—Experiments undertaken to determine the modulus of elasticity of ice and the velocity of sound in ice, by John Trowbridge and Austin L. McRae. The average of all the observations was found to be 72×10^9 as compared with Bevan's absolute modulus 54×10^9. The velocity was determined at 2900 m. per second, or about nine times the velocity of sound in air.—Contributions from the Agricultural Experiment Station of the University of Wisconsin: digestion experiments, by H. P. Armsby. These experiments, made on sheep fed with hay, clover, malt-sprouts, and cotton seed-meal, yielded so many uncertain results that no satisfactory averages could be determined. Such averages may be made the basis of the calculation of rations in practice; but neither they nor the single results upon any given fodder can properly enter into any scientific calculation of the nutritive effect of a ration.—Chemical analysis of massive safflorite, by Le Roy W. McCay.—Application of photography to the study of electrical measurements (two illustrations), by John Trowbridge and Hammond Vinton Hayes.—On the production of alternating currents by means of a direct-current dynamo-electric machine, by John Trowbridge and Hammond Vinton Hayes.—Chemical analysis of a variety of topaz discovered in 1882 by Mr. N. H. Perry in the Stoneham district, State of Maine (two illustrations), by F. W. Clarke and J. S. Diller.—A notice of the relation observed by Dr. Weber between the residual elasticity and the chemical constitution of glass, by O. T. Sherman.—On the meridional deflection of ice-streams, as shown in the *moraines* of the extinct glaciers in the Mono Lake Valley, Eastern California (two illustrations), by W. J. McGee.—The pre-Glacial channel of Eagle River, Keweenaw Point, Lake Superior (one illustration), by Charles Whittlesey.—Note on the age of the slaty and arenaceous rocks in the vicinity of Schenectady, Schenectady County, New York, by S. W. Ford. These formations, usually referred to the epoch of the Lorraine shales, are regarded by the author as belonging to the Utica age. From them were obtained various fossils, including a species of Lingula which he considers to be the Utica species, *L. curta*.

The American Naturalist, March, contains:—Indian corn and the Indians, by E. L. Sturtevant.—The evolution of the Vertebrata, progressive and retrogressive, by E. D. Cope.—On the larval forms of *Spirorbis borealis*, by J. W. Fewkes.—Pennsylvania, before and after the elevation of the Appalachian Mountains; a study in dynamical geology, by E. W. Claypole.—Life and nature in Southern Labrador, by A. S. Packard.

April.—Why certain kinds of timber prevail in certain localities, by J. T. Campbell.—The evolution of the Vertebrata, by E. D. Cope.—Progress of North American Invertebrate palæontology for 1884, by J. B. Marcou.—The clam-worm, by S. Lockwood.—Life and nature in Southern Labrador, by A. S. Packard.

May.—Some new Infusoria (with illustrations), by A. C. Stokes.—Kitchen-garden esculents of American origin (I.), by E. L. Sturtevant.—The Lemuroidea and the Insectivora of the

Eocene period of North America (illustrated), by E. D. Cope.—On the Labrador Eskimo and their former range southward, by A. S. Packard.

Rendiconti del Reale Istituto Lombardo, April 23.—Some formulas for the calculation of the momenta of inertia in plain polygons, by Prof. G. Bardelli.—Some remarks on the functions which satisfy the differential equation $\Delta^2 u = 0$, by Prof. Giulio Ascoli.—Note on the morphological distinction between the various homologous and analogous organs of the different orders in the animal kingdom, by E. L. Maggi.—On a generalisation of the involute properties of complete squares and quadrilateral figures, by Gino Loria.—On a method of plain representation for the descriptive geometry of ordinary space, by Prof. F. Aschieri.—On the discontinuities in the secondary derived forms of the potential functions of a surface, by Dr. Paolo Paci.—Meteorological observations made in the Royal Brera Observatory, Milan, during the month of April.

Rivista Scientifico-Industriale, April 15-30.—Remarks on the velocity of the wind in connection with Prof. Archibald's experiments with Biram's anemometers, by the Editor.—Variations in the electric resistance of solid and pure metallic wires, according to the temperature (continued), by Prof. Angelo Emo.—Description of a new steam generator based on the principle of vortex circulation, by Prof. Annibale Riccò.—Note on the *Emberiza intermedia* discovered by Dr. Michaellis in Dalmatia; is it a distinct species in this family of birds? by Dante Roster

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 7.—"Contributions to the Chemistry of Chlorophyll. Part I.," by Edward Schunck, F.R.S.

The paper treats of the products formed by the action of acids on chlorophyll. All who have worked with chlorophyll are familiar with the peculiar effects produced in solutions of chlorophyll by the action of acids. The colour is changed, and an absorption spectrum makes its appearance, which differs from that of chlorophyll. According to some, these changes are due to a simple modification of the chlorophyll, others consider they are caused by the formation of products of decomposition. The latter view seems the more probable.

On passing a current of hydrochloric acid gas into an alcoholic solution of chlorophyll, a dark green, almost black, precipitate is formed at once. The greenish-yellow liquid contains substances extracted along with chlorophyll by the alcohol, and not connected with the latter. The precipitate consists essentially of two colouring matters, phyllocyanin and phylloxanthin, bodies that had been previously observed and so named by Fremy, who, however, did not obtain them in a state of purity. They are best separated by Fremy's method, which consists in dissolving the mixture in ether, and then adding concentrated hydrochloric acid, when the liquid separates into two layers, a lower blue one containing phyllocyanin and an upper yellowish-green one containing phylloxanthin. It is immaterial what kind of leaves are taken for extraction, the products are always the same.

The paper deals only with the properties of phyllocyanin, which are very peculiar. After being purified in the manner described, it is obtained as a dark blue mass resembling indigo, and consisting of microscopic crystals which are generally opaque, but sometimes when very thin are translucent, and then appear olive-coloured. It stands heating to 160° without decomposition, but between that temperature and 180° it is decomposed without previously fusing, leaving a charred mass which, on further heating, burns away without residue. It contains nitrogen, but is free from sulphur.

Phyllocyanin is insoluble in water, petroleum ether, and ligroin, but dissolves in alcohol, ether, chloroform, glacial acetic acid, benzol, aniline, and carbon disulphide. The best solvent is chloroform. A minute quantity of the substance imparts an intense colour to any one of these solvents. It is only on diluting largely that the solutions lose their opacity. They then appear of a dull green or olive colour, and show the well-known and often described spectrum of so-called "acid chlorophyll," consisting of five bands, three of which are very dark, one of moderate intensity, and the fifth very faint.

By oxidising agents, such as nitric or chromic acid, phyllocyanin is easily decomposed, yielding yellow amorphous products, the solutions of which show no absorption bands. It shows a remarkable degree of permanence as compared with chlorophyll, when exposed to the combined action of air and light. A chloroformic solution contained in a loosely-stoppered bottle may be exposed for weeks, or even months, to alternate sunlight and diffused daylight before its peculiar colour and all trace of absorption bands have disappeared. When the process is complete a yellow liquid results, which contains several products, all of them amorphous, one being easily soluble in water, and exceedingly bitter to the taste. The decoloration of a chlorophyll solution under the same circumstances would take place in a day or two.

Phyllocyanin dissolves easily in concentrated sulphuric, hydrochloric, and hydrobromic acids, yielding dark blue solutions, which show spectra differing from that of phyllocyanin, and no doubt contain compounds of the latter with acids. These compounds, however, are unstable; for, on the addition of water to the solutions, phyllocyanin is precipitated unchanged. Phyllocyanin shows no tendency to combine with weaker acids, such as phosphoric, oxalic, tartaric, or citric acid.

Phyllocyanin dissolves easily in dilute caustic potash or soda lye. The solution gives precipitates of various shades of green with earthy and metallic salts, such as barium chloride, calcium chloride, lead acetate, and cupric acetate, and these might be called phyllocyanates. It seems, however, that by mere solution in alkali, phyllocyanin undergoes some change, for if acetic acid in excess be added to the solution, and it be then shaken up with ether, the precipitate dissolves in the ether, giving a solution which shows the bands of phyllocyanin; but if the whole be left to stand some time, the colour of the ethereal solution changes from green to brown, and it now shows a distinct and peculiar spectrum, characterised by two bands in the red and two fine but well-marked bands in the green, the third and fourth bands of phyllocyanin having disappeared, while the fifth still remains. The body yielding this spectrum has been prepared and found to yield microscopic crystals like phyllocyanin. A different product is formed when hot alkaline lye, or, what is better, boiling alcoholic potash or soda, is employed. It crystallises in small rosettes, which are green by transmitted, of a fine purple by reflected, light. Its solutions have a dull purple colour, and exhibit a distinct spectrum characterised by a broad, very dark band in the green. It may be identical with one of the products obtained by Hoppe-Seyler from his chlorophyllan with alkalis.

The concluding part of the paper treats of what may be called double compounds of phyllocyanin, into which metals and acids, especially organic acids, enter as constituents. Phyllocyanin seems to act the part of a weak base, uniting with strong acids and forming unstable compounds. In acetic acid it merely dissolves without yielding any compound. In like manner, when freshly precipitated cupric oxide or zinc oxide is added to a solution of phyllocyanin in boiling alcohol no combination takes place. A very different effect is observed when either of the two oxides is employed along with acetic acid. When cupric oxide is added to a solution of phyllocyanin in boiling acetic acid the solution acquires at once a deep greenish blue colour, and it no longer contains uncombined phyllocyanin, for its spectrum is different, and, on standing, it deposits lustrous crystals, which doubtless consist of a compound containing phyllocyanin, acetic acid, and copper. If zinc oxide be employed, a similar effect is observed: the liquid acquires an intense green colour like that of a chlorophyll solution, and now contains the corresponding acetate of phyllocyanin and zinc. The same phenomenon is seen when ferrous oxide, manganese oxide, or silver oxide is taken, liquids of various shades of green being obtained which contain phyllocyanin compounds; but no similar compounds are formed when potassium, sodium, barium, calcium, magnesium, or lead acetate is employed. Acetic acid is, however, not the only acid which yields the reaction. If palmitic, stearic, oleic, tartaric, citric, malic, or phosphoric acid be employed, it takes place just as with acetic acid, but in some cases time is required for its completion. Oxalic acid, however, seems to be without effect, and tartaric acid fails in some cases.

The behaviour of phyllocyanin towards zinc oxide in the presence of acids may serve to explain a peculiar phenomenon first observed by Prof. Church, and subsequently described by Tschirch. The former took chlorophyll that had become brown on standing, and, acting on it with zinc powder, obtained a body yielding green solutions, which he took to be regenerated chlorophyll. Tschirch acted on Hoppe-Seyler's chlorophyllan with zinc powder and observed the same phenomena, the conclusion at which he arrived being the same, viz. that chlorophyll is reproduced from chlorophyllan by reduction. It is probable, however, that what they obtained was in reality a zinc compound of phyllocyanin, and would have been formed just as well by using zinc oxide. Chlorophyllan is probably an impure substance containing some fatty acid along with phyllocyanin, so that by the action of zinc oxide it may yield a compound similar to those above mentioned. The experiment was tried with the crude product obtained by passing hydrochloric acid gas into a solution of chlorophyll. Some of this was dissolved in alcohol, and the solution was boiled with zinc oxide, when it gradually became of a bright green like a solution of chlorophyll, but its spectrum differed, being identical with that of the zinc compounds obtained directly from phyllocyanin.

May 21.—"Contributions to the History of the Pleiocene and Pleistocene Deer. Part I. *Cervus verticornis*, *Cervus savini*." By W. Boyd Dawkins, M.A., F.R.S., F.G.S., Professor of Geology and Palæontology in the Victoria University.

The numerous cervine remains which occur in the various collections in Britain and on the Continent have been studied by the author for the last twenty-five years, and in this communication two species, the one hitherto ill-defined, and the other new to science, have been described.

The first, or *Cervus verticornis*, Dawkins, remarkable for the singular forward and downward curvature of the first tine, is represented by a large series of skulls and antlers, which enable the author to define the changes in antler-form from youth to old age, as well as to relegate it to the division of deer with palmated antlers, and to establish its geological age to be Pleiocene and early Pleistocene in Norfolk and Suffolk.

The second, or *Cervus savini*, is represented by several skulls and many antlers, which present considerable modifications in form at varying ages. It also belongs to the section of deer with palmated antlers, and is probably the ancestral form of the extinct (*Cervus browni*, Dawkins) and living (*C. dama*) types of fallow deer. It has hitherto only been met with in the early Pleistocene forest-bed series of Norfolk and Suffolk.

Mathematical Society, May 14.—J. W. L. Glaisher, F.R.S., President, in the chair.—B. Hanumanta Rau, Madras, was elected a member.—Papers were read by Rev. T. C. Simmons, on an application of determinants to the solution of certain types of simultaneous equations; and by H. M. Jeffery, F.R.S., on binodal quartics, on the latter of which the President, S. Roberts, F.R.S., and the author made further remarks.—Mr. Tucker read part of a paper by Prof. J. Larmon on the flow of electricity in a system of linear conductors.

Zoological Society, May 19.—F. Du Cane Godman, F.R.S., in the chair.—A letter was read from the Rev. G. H. R. Fisk, C.M.Z.S., respecting the capture of a Sea-snake among the rocks at the entrance to Table Bay, which he believed to be referable to *Pelamis bicolor*.—A letter was read from Mr. B. Crowther, stating that he was about to send the Society a pair of Duckbills (*Ornithorhynchus paradoxus*), and giving some instructions as to the treatment of these animals in captivity.—Mr. F. Day exhibited and made remarks on a curious specimen illustrative of an extensive injury to the intestines of a Trout and its subsequent recovery therefrom. Mr. Day also exhibited a piece of the sifting-apparatus of the Basking-Shark, together with specimens of the food upon which it lives; and an example of the Vendace taken in Derwentwater Lake.—Mr. Osbert H. Howarth exhibited a specimen of coral of the genus *Dendrophyllia* attached to a brown stoneware bottle, which had been dredged up in the Atlantic, off Madeira, at a depth of about fifteen fathoms.—A communication was read from Prof. J. von Haast, C.M.Z.S., on *Dinornis oweni*, in which the author gave a detailed description of the bones of this recently-discovered new species of the extinct wingless birds of New Zealand, which was remarkable for its small size.—A communication was read from Dr. St. George Mivart, F.R.S., containing notes on the genetic affinities of the group of Pinnipeds.—Dr. F. H. H. Guillemard read the third part of his report on the collection of birds formed during the voyage of the yacht *Marchesa*. The paper dealt with the birds obtained on the island of Sumbawa, a locality hitherto almost unknown to ornithologists. During the *Marchesa's* short visit examples of thirty-nine species were collected. Of these, two (*Turnix powelli* and *Zosterops sumbavensis*) were new to science. The remaining species had been previously recorded from islands to the eastward or westward in the same group.—A communication was read from Dr. Hubrecht, C.M.Z.S., containing a description of a Pennatulid obtained by Capt. St. John in the Japanese Sea at a depth of seventy-one fathoms. A careful examination of the specimen in question induced the author to assign it to a new genus and species, which he proposed to name *Echinoptilum mackintoshii*.—Mr. Herbert Druce, F.Z.S., read a paper on some new species of Lepidoptera-Heterocera, founded on specimens obtained by the late Mr. C. Buckley in Ecuador, to which were added descriptions of some recent acquisitions of the same group from various other localities.—Mr. F. D. Godman, F.R.S., read descriptions of the Lepidoptera collected by Mr. H. H. Johnstone on Kilimanjaro. The collection contained examples of twenty-one species of the Rhopalocera and six of Heterocera. Of the Rhopalocera the author described three species as new.

Geological Society, May 13.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the chair.—William Horton Ellis and Prof. J. Hoyes Panton, M.A., were elected Fellows; and Prof. J. Gosselet, of Lille, a Foregn Member of the Society.—The following communications were read:—On the Ostracoda of the Purbeck formation, with notes on the Wealden species, by Prof. T. Rupert Jones, F.R.S., F.G.S.—Evidence of the action of land-ice at Great Crosby, Lancashire, by T. Mellard Reade, F.R.S.—The North Wales and Shrewsbury coal-fields, by D. C. Davies, F.G.S. After discussing the origin of coal-beds, and the causes of their variation in structure and quality, the author proceeded to describe the North Wales and Shrewsbury coal-field, which consists of three parts: (1) The Shrewsbury field south of the Severn, exclusively composed of Upper Coal-measures; (2) the tracts north of the Severn, extending from near Oswestry to north of Wrexham; and (3) the Flintshire coal-field. The first and second are separated from each other by the alluvial plain of the Severn and Vyrmoy, and the second and third by the Great Bala and Yule faults. Some remarks on the scenery of the Welsh border-land followed, and then a general section of the Carboniferous system, as developed in the country described, was given, the Permian beds being included, as the author considered them the upper portion of one great division of Palæozoic time. The section was as follows, with the maximum thickness of each subdivision:—

	Thickness in yards	
1. Dark red Sandstone	210	Permian, 590 yards.
2. Ifton or St. Martin's Coal-measures	75	
3. Red marls with calcareous matter...	180	
4. Green rocks and Conglomerates ...	125	
5. Upper Coal-measures	80	Coal-measures, 665 yards.
6. Cefn rock to Cefn coal	100	
7. Cefn coal to Lower yard-coal... ...	270	
8. Lower yard-coal to Chwarcle coal...	80	
9. Chwarcle coal to Millstone Grit ...	135	
	1255 yards	

A detailed description of the strata was next given, beginning with the lowest, together with details of each coal-seam as worked in various parts of the field. After describing the beds from the Millstone Grit to the Cefn rock in the North Wales coal-field, the author proceeded to notice the Upper Coal-measures and Permian strata in the Shrewsbury area, and showed that no break exists between the two, the former passing gradually into the latter. He then discussed the probability of Lower Coal-measures existing beneath the upper beds near Shrewsbury, and showed from sections that the existence of the lower measures might be anticipated. A similar inquiry as to the presence of the Coal-measures beneath the New Red Sandstone of the Vale of Clwyd should also, in the author's opinion, be answered in the affirmative. The organic remains found in the different beds were briefly noticed, and then the faults of the district were discussed at some length. The principal faults run north and south, with an upthrow to the east, but are crossed by lines of fracture running east and west. In conclusion, the correlation of the strata in the North Wales and Shrewsbury coal-fields, and especially of the coal-seams, with the beds found in other parts of Great Britain, was discussed, and a section was given to show the representation of the different measures in various coal-basins. The author was disposed to adopt four subdivisions rather than three only, as usually accepted, and pointed out some of the characteristics of each subdivision.

Royal Meteorological Society, May 20.—Mr. R. H. Scott, F.R.S., President, in the chair.—Dr. H. Dobell and Mr. J. N. Longden were elected Fellows of the Society.—The following papers were read:—The temperature zones of the earth considered in relation to the duration of the hot, temperate, and cold period, and to the effect of temperature upon the organic world, by Dr. W. Koppen, Hon.Mem.R.Met.Soc.—Velocities of winds and their measurement, by Lieut.-Col. H. S. Knight, F.R.Met.Soc. The author, after describing the various ways of ascertaining the direction and velocity of the wind, makes several suggestions for the improvement of Robinson's anemometer.—On the equivalent of Beaufort's scale in absolute velocity of wind, by Dr. W. Koppen, Hon.Mem.R.Met.Soc. The author refers to Mr. C. Harding's paper read before the Society in December last on the anomalies in the various wind velocities given by different authors as equivalents for the numbers in Beaufort's scale, and, as illustrating the point, calls special attention to the want of agreement between the velocities obtained by Mr. Scott and those subsequently obtained by Dr. Sprung, and confirmed by himself.—Note on a peculiar form of auroral cloud seen in Northamptonshire, March 1, 1885, by the Rev. James Davis.

EDINBURGH

Royal Physical Society, May 20.—Prof. Duns, D.D., F.R.S.E., President, in the chair.—The following communications were read, viz. :—On new Selachian remains from the Calciferous Sandstone series, by Ramsay H. Traquair, M.D., F.R.S., L. and E.—Observations on living Cephalopoda, and note on *Loligo forbesii* (Steenstrup), by W. E. Hoyle, M.A., F.R.S.E.—Note on ulceration of the skin of a fish, by G. Sims Woodhead, M.D., F.R.C.P.E.—Note on the presence of a double dorsal vessel in certain earthworms, by Frank E. Beddard, M.A., F.R.S.E., F.Z.S.—The north-west coasts of Sutherland and their bird-life, by John A. Harvie-Brown, F.Z.S., F.R.S.E.—Note on the contents of two bits of clay from the elephant bed at Kilmaurs in 1817, by James Bennie, H.M. Geological Survey. The Secretary (Mr. Robert Gray, V.P.R.S.E.) drew attention to several interesting birds that had been taken during the present month on the Island of May by Mr. Agnew, lighthouse-keeper, and forwarded to Mr. J. A. Harvie Brown, in whose collection they had since been placed. These were two specimens of the Ortolan bunting (*Embariza hortulana*) and others of the pied flycatcher (*Muscicapa atricapilla*), red-backed shrike (*Lanius collurio*). The Secretary remarked that these birds had occurred during their spring migration, and that in the case of the Ortolan bunting the captures proved that any Scottish specimens of the bird that had been recorded could not be said to be escaped birds, seeing that they had been in company with well-known migratory species, and were in all likelihood on their way to Scandinavia, where they were known to breed.

SYDNEY

Linnean Society of New South Wales, March 25.—Prof. W. J. Stephens, M.A., F.G.S., President, in the chair.—The following papers were read :—On a Devonian fossil, allied to *Worthenia* (de Koninck), from New South Wales, by F. Ratte.—On the Phoriaspongiæ (Marshall), by Dr. R. von Lendenfeld. Both species described by Marshall have been found by the author, who considers them, together with some new species discovered by himself, to be Ceraospongiæ, with flesh-spicules, and not, as Marshall had supposed, Desmacidanidæ, or Cianidæ, living in sand. There exist many sponges on the Australian shores with a skeleton consisting of arenaceous fibres, which form an irregular network, thus connecting the Phoriaspongiæ with the ordinary horny sponges. Eleven species of horny sponges, with fleshspicules, have been found in Australian waters. Their spicules are described and their relative position to other sponges discussed. The author upholds his previously published views on the relationship between Ceraospongia and Monactinellidæ, and discusses the hypothesis recently put forward by Vosmaer.—Synonymy of, and remarks upon, four species of shells, originally described by Dr. J. E. Gray, by John Brazier, C.M.Z.S., &c.—Notes on the Australian Amphipoda, by William A. Haswell, M.A., B.Sc., &c.—On the Toxoglossate Mollusca of New Zealand, by Capt. F. W. Hutton, F.G.S.—Notes descriptive of some rare Port Jackson fishes, by J. Douglas Ogilby, Assistant in Zoology, Australian Museum, Sydney.

PARIS

Academy of Sciences, May 25.—M. Bouley, President, in the chair.—After the formal proceedings, the President referred in the following terms to the late Victor Hugo :—"France is to-day widowed of one of her great writers, a man by whose works of genius the glory of our land has been spread furthest and widest during the present century. Victor Hugo is about to descend into the grave, but by the greatness of his writings he is himself saved from death. Years may henceforth roll on until they are reckoned by hundreds and thousands ; but in the series of future ages there never will be a time when André Chénier's lines on Homer will not also be applicable to our great poet :—

> "Trois mille ans ont passé sur la cendre d'Homère,
> Et depuis trois mille ans Homère respecté
> Est jeune encor de gloire et d'immortalité."

For the work of Victor Hugo belongs to that class which defies years and for everlasting ages secures the youth of glory and immortality to those by whom it has been accomplished. And now the five Academies of the French Institute must consider it a sacred duty to render like homage to this great memory. Our Bureau has the honour of asking you, in sign of mourning, to suspend your proceedings for to-day." The proposal having received general assent, the public meeting of the Academy was adjourned.—Account of an elliptical halo of unusual brilliancy, and evidently connected with the halo of 22° so frequently noticed for some weeks past, observed during the afternoon of Tuesday, May 19, by M. A. Cornu.—A contribution to the history of sulphur and quicksilver, by M. Berthelot.—Note on the algebraic integers of linear equations, by M. E. Goursat.—Demonstration of a particular property of geometrical curves of double curvature, by M. V. Jamet.—On the verification of the laws of vibration of circular plaques, second note, by M. E. Mercadier.—Remarks on the peculiar properties of the electric current generated by the rheostatic machine, by M. Gaston Planté.—On a method of determining and recording the charge of electric accumulators, by MM. A. Crova and P. Garbe. The authors claim to have discovered a means of determining and automatically recording the exact amount of energy stored in accumulators, and so regulating the discharge as to be able to ascertain the quantity still held in reserve at any given moment. The machines used in their experiments were of the Planté type modified by Faure.—Note on the phenomenon of crystalline superfusion of sulphur, and on the velocity of transformation from prismatic to octahedric sulphur, by M. D. Gernez.—Remarks on the composition of the persulphuret of hydrogen, and on the nacreous variety of sulphur, by M. P. Sabatier.—Note on the product of addition $PhFl^3Br^2$ obtained by the action of bromine on the trifluoride of phosphorus, by M. H. Moissan.—A synthesis of some specimens of anorthite recently obtained from the gas-works of Vaugirard, by M. Stanislaus Meunier.—Note on the microscopic anatomy of *Dentalium entale* from the Roscoff coast, by M. H. Fol.—On the Penian formations (red sandstones associated with clay-stone and felspar grit) prevalent in the secondary ranges of the Vosges Mountains, by M. Ch. Vélain.—The election of M. Laguerre as member of the section for geometry in the place of the late M. Serret was confirmed by the President of the Republic.

BERLIN

Physiological Society, May 1.—Dr. Raudnitz had subjected to examination, by new experiments, a statement advanced by Profs. Eulenberg and Landois, and which was controverted by several investigators, namely, that there was a vasomotor centre having its seat in the cortex of the cerebrum. For the measurement of the peripherical temperature he made use of mercurial thermometers, which he fastened into the paw of the animal. It was found, by preliminary experiments, that subcutaneously inserted thermometers, on stimulation of the nerves or of the central organs, yielded variations of temperature essentially different from, often opposite to, those fixed into the paw—a circumstance referable, no doubt, to the influence of the contraction of the muscles. Thermo-electric piles, again, were not suitable for application, for the reason that it was not possible to find for the second contact a medium that remained constant as far as 0°·04 C. Dr. Raudnitz had investigated a large number of conditions influencing the temperature of the skin, such as motion, the muscular rhythm, paralytic poisons, the situation of the paralysed animal, &c. Of the phenomena observed in the course of such investigation, the fact was specially striking that the difference in the situation of the investigated extremity was able to give rise to differences of temperature as great as 13° C. The results of the whole investigation went to show that it was not possible to demonstrate with certainty the existence of a vaso-motor centre in the cortex of the cerebrum. In the case of each epileptic attack resulting from stimulation of the membrane the change of temperature in the skin was induced in large part by the muscular movement, and in part also otherwise. Whether, however, the influence of the stimulation of the brain on the vaso-motor system was direct or indirect was a question not to be determined either by experiments of stimulation or by extirpation of the part of the cerebral cortex concerned. — Dr. Leo communicated his experiments on the formation of fat and conveyance of fat in the case of phosphorus-poisoning. Seeing that some physiologists ranged themselves on the side of the view that fat, and especially in fatty liver after phosphorus-poisoning, was formed in the body through decomposition of albumen, but others, on the contrary, held that the fat of the internal organs was derived from the alimentary fat, either directly conveyed to these organs, or transported from the skin, where it had been deposited, the speaker instituted the following experiments: two young guinea-pigs of the same litter, of very similar constitution, and of almost the same dry weight, were kept in a state of hunger for a considerable time; then one was poisoned with phosphorus, and after three days both were killed. On determining the fatty contents of each of the animals, it was found that the poisoned animal showed a very considerably larger percentage of fat than the other. It had now to be ascertained what amount of fat an animal experimented on had before, and what amount it had after the phosphorus-poisoning. For this purpose two rats were employed, living under precisely the same conditions. One of them, accordingly, was killed on the same day on which the poisoning of the second begun. After three days the latter was likewise killed, and an essentially smaller quantity of fat was found in the poisoned animal than in the former. Finally, experiments were made with eighteen frogs, of which six were killed before the poisoning, six after the poisoning, and at the same time with these, six control frogs were killed. The result was that the six poisoned frogs contained a larger per cent. of fat than the six killed before the poisoning, and than the six unpoisoned and in other respects similar frogs. In all experiments the fatty contents of the liver after the phosphorus-poisoning were considerably greater than in the case of the unpoisoned animals. The increase per cent. of the liver fat, in comparison with the dry substance, tended to show with great probability that fat was not only formed anew, but was conveyed to the liver from other quarters. According to present views fat was formed in the body of the animal only by decomposition of the albumen, and it was conjectured that the lecithin was an intermediate product of this transformation. The quantitative determination of the lecithin in the animals poisoned with phosphorus, and in the control animals yielded, however in both, like percentages, so that this conjecture was not confirmed by the experiment.

Rome

Reale Accademia dei Lincei, March 15.—The unthinkable; a logico-psychological note by Signor Bonatelli. In this note the author proposed to show that what is called the impossibility of thinking a thing is not really an impossibility on the part of the thinking subject to form any given thought, but rather either the absolute impossibility of imagining or the impossibility of the existence of the object. And in this fact there is found a confirmation of that philosophical doctrine which maintains the existence of the ideal. That which is absolutely unthinkable is out of all relation to our thought, and we can say nothing about it.—Concerning a vase found at Metapontum with a Greek alphabet of the Achæan colonies of South Italy. Signor Barnabei exhibited a vase found in a burying-place during the excavations now being carried on at Metapontum, and which may be considered one of the most important discoveries that have been made in recent times. The vase is in perfect preservation and shows by its form that it belongs to about 300 B.C. In the annular space surrounding the raised rim the letters of the entire alphabet are inscribed. Signor Barnabei, after citing the opinions of various authors on the origin of writing, showed that it could not be attributed to the Phœnicians, but that the art of writing was actually introduced into Italy by the Greeks.—On the distribution in latitude of the solar maculæ, faculæ, protuberances, and eruptions observed in 1884 in the Royal Observatory of the College of Rome. In this note Signor Tacchini explained at length the methods by which his observations on the solar maculæ, faculæ, and protuberances were made, and the tables relating to them drawn up, as well as the means taken to insure the accuracy of both. He defended, against the criticisms of Prof. Respighi, the conclusions which he had laid before the last meeting of the Academy on the strength of his own observations and those of other astronomers.—Resumption of the observations of red glows. Prof. Riccò communicated the conclusion of his previous note, in which he gave an account of all the observations made by him on red glows from December, 1883, to April, 1884. As some features of the phenomenon would induce us to admit the presence of an extremely fine dust at a great height in the atmosphere, Prof. Riccò wished to ascertain the fact as to whether fresh dust had fallen during and after the glows. But the examination of the dust collected at those times in rain-water or water long exposed to the air, showed no traces of fresh dust in the atmospheric deposits, and, in particular, no recognisable traces of volcanic dust.—Other communications:—Prof. Millosevich communicated the observations made by him on a new planetoid between Mars and Jupiter (245), discovered by Signor Borelly.—Drs. Ciamician and Silber explained the reactions by means of which they had succeeded in obtaining acetyl-pyrrol in a state of perfect purity without any trace of pyrrol-methyl-ketone. They also stated the result of their experiments with a view to obtain a sulphur acid from pyrrol-methyl-ketone: experiments which show clearly the analogy between pyrrol, pyrridin, and benzol.—Prof. Besso communicated a note by himself on trinomial equations, and in particular on those of the seventh degree.—Dr. Bianchi communicated a note by himself on the triple orthogonal systems of Weingarten.

Christiania

Society of Science, May 4.—The President, Prof. Guldberg, in giving an account of the working of the Society last year, stated that there had been eighteen meetings, and that fifty-two articles and papers had been presented by members.—The number of members is at present 112.—Prof. Lochman gave a lecture on biology in relation to life.

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