THURSDAY, JULY 12, 1900.

A MONOGRAPH ON LAND-PLANARIANS.

Monographie der Turbellarien. II. *Tricladida Terricola* (*Landplanarien*). By Prof. Ludwig von Graff. Pp. i + 574, and an atlas of 58 plates. (Leipzig: W. Engelmann, 1899.)

THE Turbellaria are rapidly becoming one of the most adequately and conveniently described groups of Invertebrates. Practically all that is at present known as to their anatomy, classification and distribution is comprised in three works—the "Monograph," by Prof. von Graff; the special memoir, by the same author, on the "Acœla"; and the masterly work, by Prof. Arnold Lang, on the "Polycladida" in the series of monographs on the fauna and flora of Naples Bay. The work before us, a magnificent folio, completes the author's share in the monographic treatment of the group. The first part was published in 1882, and was reviewed in this journal by Prof. Moseley. It is with great pleasure that we notice the dedication of the second part—jointly to Moseley and Fritz Müller—as only one of the many felicitous ways in which Prof. von Graff expresses his admiration for the work of these his fellow-labourers in the anatomy of planarians. We heartily congratulate Prof. von Graff on the appearance of this volume, the conclusion of a work begun twenty-five years ago.

Apart from all other claims upon our notice, this treatise is remarkable as being the first attempt to deal exhaustively with an essentially tropical group of animals, for nothing can be clearer, after reading this account, than that land-planarians, though not restricted to the tropics, have their headquarters in the equatorial forest belt. Von Graff has himself spent some time in Java, Singapore and Ceylon, and the personal acquaintance made in this way with these animals, and the conditions under which they live, gives a vividness and directness to his descriptions. Other naturalists have notably assisted him. Prof. Dendy, whose admirable and continued researches on the land-planarians of Australia and New Zealand receive full acknowledgment in this work, Spencer, Hamilton, Fletcher and others have sent collections of these animals to von Graff from Australia. Strübell, Max Weber, the Sarasins and others have contributed specimens collected by them in the Oriental region. South America is represented by planarians taken by Darwin, Fritz Müller, von Jhering and Plate. Nearly all the chief museums in Europe have contributed their specimens to von Graff, and in this manner he has been able, not only to more than double the number of species which were recognised when he began this work, but also to personally examine all but a very small percentage. To realise the rapidity of the increase in species of land-planarians during the last twenty years, it will be sufficient to state that Moseley's complete list, made in 1877, comprised only 63 forms, while 125 were known when von Graff began his monograph on the group, during the course of which he has added no less than 200 new species, and this, together with increments from other sources, makes a total of 348.

Of this unexpectedly large number (for it is about equal to all the other Turbellaria put together which have been really adequately described), less than a dozen occur (with the exception of the Manchurian sub-region) in both the Palæarctic and Nearctic regions. The majority come from South America, the Oriental and Australian regions. Even this statement, however, does not represent the richness of the tropics, for Australia is really the only country where land-planarians have been systematically collected and recorded. Our knowledge of the planarian fauna of Africa, India, China, Central and North America is almost a blank. And additions to it will no doubt be made, not only in these countries, but also in places in which naturalists have already sought planarians. The island of Celebes, for example, has been examined by several zoologists, who have searched for land-planarians, but without success. Hickson, and after him Max Weber, searched in vain. More recently, however, the Sarasins have thoroughly explored the island, and have brought to light a most interesting fauna. Von Graff shows that the land-planarians of North Celebes exhibit Oriental characters, those of South Celebes Austro-Malayan features. Altogether twenty-one Celebesian species are now known, and of these all but three are new. We refer to this point particularly as showing that we are only beginning to realise the variety of this element of the tropical fauna, and that years of work are necessary in any one country before the planarian fauna can be fairly estimated. In Ireland a new species has been found near Dublin, and two other additions to the land-planarians of Europe have been made quite recently.

The first part of von Graff's great work is devoted to a full statement of the anatomy and histology of land-planarians. This section must have involved a vast expenditure of labour. Direct observation of the anatomy of living or compressed specimens is impossible, owing to the amount of opaque pigment in the tissues. Even the external apertures are hard to discover. Dissection is precluded by the solidity and tenuity of the body. The only available means in the majority of cases is the laborious one of serial sections, and this method the author has applied to elucidate the structure of no less than eighty-two species.

The chief result obtained in this way is the uniformity of the general anatomical features. Land-planarians form a homogeneous group, and agree closely in structure with the marine Triclad Turbellaria so far as these are at present known. Their distinguishing features appear to be correlated with the terrestrial habit. Among these may be mentioned their greater size and more powerful musculature; the formation of a "keel" to the foot, and the abundance of glands both for lubricating the foot and for enveloping prey; their brilliant, often intensely brilliant, colouring; the presence of sensory thickenings and of sensory pits on the anterior part of the body; and, perhaps their most significant distinction, the presence of elaborate structures accessory to reproduction. The anatomy of some of the simpler land-planarians is, however, an almost exact repetition of an aquatic Triclad, and the retention of cilia in the epidermis points to the conclusion that in land-planarians we have the first stage in the evolution of a terrestrial group from an aquatic one.

The presence of three extreme forms of rod-like secretions and the absence of nematocysts are noteworthy features of the epidermal glands. "Flame-cells" and parts of the canalicular system of excretory vessels have been found. The nervous system exhibits an interesting series of modifications. In the most primitive members of the group—the broad, flattened neotropical Geoplanidæ—the central nervous system consists of a dense plexus forming a horizontal plate lying just above the ventral body-wall. From this plexus nerves are given off, which either at once enter some organ or join with their fellows to form a well-developed cutaneous nerve-plexus right round the body. There is no distinct "brain." In the narrower neotropical and Australian members of the same family, a concentration of this central plexus takes place along two admedian lines, and a marked anterior thickening indicates the "brain." In the other families, as the sense-organs, which are scattered in the Geoplanidæ, become massed in front, so does the individuality of the brain become more and more pronounced. These sense-organs are of four kinds. The tentacles with eyes at their bases, found only in two South American forms. A paired sensory ridge forming a margin to the anterior part of the ventral surface in Geoplanidæ, and to the dorsal and ventral edges of the "cephalic plate" of Bipaliidæ. These ridges are innervated by the cutaneous nerve-plexus. Then the sensory pits which accompany these ridges, but which are supplied direct from the central nervous system. Lastly, the eyes. Of these there are two kinds. One, with the usual Turbellarian type of structure, has the rods directed away from the light, and the nerve entering in front and not, as in most other Invertebrates, from behind. This kind of eye occurs not only down both sides of the whole length of the body in the Geoplanidæ, but also on the dorsal and even the ventral surface. In the Bipaliidæ such eyes are concentrated at the margin and angles of the "cephalic plate." The other type of eye is one common to most Invertebrates, but hitherto unknown in Turbellaria. It consists of a pigment cap with a nerve perforating it behind, and entering the rod-cells, which face outwards towards the light. Such are the large paired eyes of the Rhynchodemidæ, and they are often imbedded in the nervous matter of the "brain."

The most novel and richly illustrated section of the anatomical part of von Graff's volume is, however, that in which the unexpected complexity and variety of the reproductive organs is discussed. This chapter is a most important addition to Turbellarian anatomy, and the results well repay the labour which has been spent on its preparation and illustration.

The next section, a short one, is devoted to the habits of land-planarians. Here, as in the other sections, the author has collected and given *in extenso* all the essentially important information that has been previously obtained. In this section, however, he adds little to the observations of Darwin, Moseley, Dendy, von Kennel and others. Land-planarians, though capable of withstanding considerable variations of temperature, are almost instantly killed by contact with dry objects, and by immersion in water, whether fresh or salt. The majority flourish best in dark, moist places. They are nocturnal, living by day under stones and tree-trunks, under the sheaths of bananas, and on tree-ferns Some are actually subterranean, and live on earth-worms. These are blind. But most land-planarians are content with a diet of snails, woodlice and insects. *Rhynchodemus vejdowskyi* is one of the few diurnal forms. It not only crawls about by daylight, but moves with such grace and rapidity that when von Graff saw it at Buitenzorg he mistook it at first for a Myriapod. A species of *Geoplana* has been found in some numbers creeping on the pavement of Melbourne in broad daylight.

The coloured plates, which show the appearance and bizarre markings of land-planarians, form quite a feature of von Graff's work. The ground colour is usually diversified by mottling or by brilliant longitudinal stripes. Bold transverse bars of colour are comparatively rare, but they occur in a small group of each of the two families, Bipaliidæ and Geoplanidæ. It is an extremely curious fact that all the barred species of the former family are confined to the islands of the Malay Archipelago; all those of the latter to the Chilian sub-region, with a single exception found in Brazil.

With reference to any supposed significance of these colours, von Graff suspends his opinion. Dendy, it is true, has shown that *Geoplana* produces an unpleasant taste on the tongue, and that fowls readily pecked at this planarian, but would not swallow it. A casual experiment of this kind is, however, not sufficient to justify the assertion that the colours of the land-planarians are of the "warning" category. The great difficulty is how to explain the prevalence of such brilliant colours and definite patterns in a group which is almost exclusively nocturnal. Yellow is the commonest colour, then orange, red, green, blue and violet. In young specimens, the pattern is more sharply defined, and the pigment (which is present both in large, richly branched connective-tissue cells and in the parenchymatous matrix) relatively more abundant than in the adult. No experiments appear to have been made to test whether land-planarians possess the power of colour-change. As with many other groups of animals upon which elaborate anatomical monographs have been written, the physiology of land-planarians is practically unknown.

The distribution of this group is very interesting, and is clearly illustrated by von Graff both by tables of every species and by a coloured map. To one of the main facts, their rarity north of the Equator and their abundance in the tropics, I have already adverted. Another interesting and suggestive discovery is the large proportion which occur on islands. More than half of the known species (201 out of 348) are purely insular, and each of almost all these (186) is limited to one island. As showing that this is only one of several indications of the local distribution of many species, von Graff points out that only five land-planarians occur in two geographical regions, only twenty in two subdivisions of the six regions, and but eighteen in two parts of the same region separated by an arm of the sea. The land-planarians afford a striking proof of the value of the Sclater-Wallace regions, which accordingly are adopted by the author.

The Oriental region is, perhaps, the richest, certainly the best characterised. Five-sixths of the family Bipaliidæ are confined to this region, and the remainder occur in Madagascar (most of the species being peculiar to this

island) and Japan. The land-planarians of the Australian and neotropical regions are alike in one striking feature. The family Geoplanidæ is practically divided between them. The neotropical members of the genus *Geoplana* include most of the flattened primitive ones, and also peculiar forms such as *Leimacopsis* and *Polycladus*. Von Graff goes so far as to share the opinion that this geoplanid fauna has arisen on a lost Antarctic continent, and has spread on the one hand to New Zealand and Australia, on the other to South America. The distribution of earthworms lends strong support to this view, as Mr. Beddard has shown.

The concluding section of the work is composed of full systematic descriptions of the families, genera and species. Von Graff makes five families: the Limacopsidæ, with two tentacles; the Cotyloplanidæ (an unnatural family), with suckers; the Geoplanidæ, with scattered eyes; the Bipaliidæ, with the eyes limited to the flattened "head"; and the Rhynchodemidæ, with a pair of large eyes. There are now nineteen genera, many of which are new.

This monograph will be of inestimable value to all naturalists interested in land-planarians, and the author is to be congratulated on having completed such a laborious task with unfailing accuracy. The lithographers and publishers deserve a special word of praise for the beautiful plates and printing which adorn this book.

F. W. GAMBLE.

A SCIENTIFIC ENGINEER.

Papers on Mechanical and Physical Subjects. By Osborne Reynolds, F.R.S. Vol. i. Pp. xv + 416. (Cambridge: University Press, 1900.)

THE Cambridge University Press has during some years past contributed very largely to the progress of physical science by the issue of the collected works of great mathematicians and physicists. The volumes which contain the collected writings of Maxwell, Adams and Cayley form a rich storehouse of knowledge; and the efforts the Press has made to induce living writers, such as Kelvin, Stokes and Rayleigh, to edit their own papers for issue in a collected form deserve the gratitude of all students.

Among the latest of such reprints is the volume before us. Its author, Prof. Osborne Reynolds, has passed a busy life as a teacher in a great commercial and manufacturing city, and his collected papers testify to the breadth of his interests and the wide scope of his work.

The papers included in the present volume, some forty in number, were published between 1869 and 1882. They range over a great variety of subjects, from the tails of comets and the solar corona to problems connected with the steering of ships and the bursting of guns. In so varied a collection the relative importance of the different papers differs greatly, and yet all are interesting; and all have advanced the sum of human knowledge.

Indeed, on reading them, one cannot help regretting that the author's interests have been so widely diffused, and that he has not had the opportunity of concentrating himself on some one or other of the great engineering problems which await solution, applying to it his practical experience and insight and his mathematical skill.

An extract from the author's preface makes the cause of this clear. He writes:

"As affording some explanation of the absence of any connection between many of the subjects in this collection of papers, it may be pointed out that these subjects have not been determined by arbitrary selection, neither have they been the result of following up one line of research. They have for the most part been suggested by the discrepancies between the results obtained in definite mechanical arrangements, such as occur in some parts of the large field of practical mechanics, and the conclusions arrived at as to what those results should be for the same circumstances, by means of geometrical and physical analysis, as far as this analysis was developed at the time."

But to turn to the matter of the papers; it would take too long to attempt to analyse them all; and, indeed, the results of the most important are now classic, *e.g.* those on the refraction of sound, the action of a screw propeller, the steering of screw steamers, and the explanation of the radiometer.

The two papers on the refraction of sound are numbered 16 and 22. Stokes had, seventeen years before the date of the first of these papers, suggested the reason why sounds are heard less distinctly against the wind than with it. It is due to the fact that the velocity of the wind rises as we ascend; hence when a sound-wave is travelling against the wind, the wave-velocity is less in the upper portion of the wave than in the lower; thus the wave-front is bent upwards, and the sound passes over the head of the observer. The same notion occurred to Reynolds; he verified it by direct experiment, and pointed out, moreover, that in ordinary conditions of the atmosphere the temperature falls as we ascend; hence from this cause also the wave-velocity is reduced, and the path of the sound is no longer straight, but curved, with the convexity of the curve turned downwards. If, however, it should happen that the air is warmer above than it is below, the reverse will be the case—the sound-waves will be bent downwards—the sound will thus be audible at a greater distance than previously.

The papers on the action of the screw propeller form an interesting series. The racing of a screw is proved to be due to the admission of air to the screw; this, it is shown, interferes with the power of the screw to obtain water, and also reduces the resistance which would otherwise be offered by the water the screw would get For consider a vertical plate, totally immersed in water, which is being pushed forward; its speed may be such that the water behind cannot remain continuously in contact with it. A vacuum will tend to form behind the plate; the limiting velocity at which this takes place will depend on the pressure in the water behind the plate; if no air can reach the plate, this pressure will be the atmospheric pressure, together with that due to the depth of water above the plate; if air can reach the space behind the plate, the limiting velocity will depend only on the pressure due to the water, and will be much less than in the first case. The blades of the propeller act like the plate; a stationary screw will be most effective in propelling water when it is turning so fast that a vacuum is just formed behind its floats, and the rate at which the water is driven past depends on the water pressure just close to the floats; if air can reach the floats,

no vacuum can be formed; the pressure will depend only on the height of the column of water above the screw; the limiting velocity will be less than when the screw remained free from air.

The steering of screw steamers is dealt with in several papers laid before the British Association; three of these are reports of a committee appointed in 1875 to investigate the question. Of this committee Prof. Reynolds was secretary. Briefly, their researches confirm the theory he had advanced in a paper published in the *Engineer*, June 4, 1875, explaining the accident to the steamer *Bessemer*, which had failed to enter Calais Harbour on May 8 previously.

Prof. Reynolds pointed out

"when a ship is stopping, the water will be following her stern relatively faster than when she is moving uniformly, and consequently that the effect on the rudder will be diminished; that the longer the ship the greater will be this difference; also that this effect is greatly increased when a ship is stopping herself with her propellers, as was the *Bessemer*, for since not only is the retardation of the vessel much more rapid, but the water has a forward motion imparted to it by the propellers, which motion, if the propellers are near the rudder, may be greater than that of the ship, in which circumstance the effect of her rudder's action will be reversed."

In the paper on the radiometer, "On the Forces caused by Evaporation from, and Condensation at, a Surface," the true explanation of its action is given in the concluding paragraphs. The paper deals in the main with the effects of evaporation and condensation in causing motion, but near the end the author writes:

"Since writing the above paper, it has occurred to me that, according to the kinetic theory, a somewhat similar effect to that of evaporation must result whenever heat is communicated from a hot surface to a gas. The particles which impinge on the surface will rebound with a greater velocity than that with which they approached, and consequently the effect of the blow must be greater than it would have been had the surface been of the same temperature as the gas."

The longest paper in the collection is that on certain dimensional properties of matter in the gaseous state; it contains the results of a number of experiments on the thermal transpiration of gases through porous plates, and an extension of the dynamical theory to account for the phenomena.

Enough has been said, perhaps, to show the interest of the volume and the importance of the scientific results it contains. It is got up in the admirable manner which characterises the Pitt Press productions, and in form leaves nothing to be desired.

COUNT SCHEIBLER'S SPORTING TOUR.

Sette Anni di Caccia Grossa e Note di Viaggio in America, Asia, Africa, Europa. By Count Felice Scheibler. Pp. xv + 525. Illustrated. (Milan: U. Hoepli, 1900.)

ENGLISHMEN are, perhaps, somewhat too inclined to believe that great game shooting is a special prerogative of the Anglo-Saxon; but the publication of the present work, together with the recently issued English translation of Count Potocki's "Sport in Somaliland," should do something to dissipate this mistaken notion. Count Felice Scheibler may, indeed, be said to be a "mighty hunter," and the frequent mention of his name in Mr. Rowland Ward's "Records of Big Game" will suffice to show that many of the animals that fell to his rifle have yielded trophies of more than usual size. As is indicated in the title of the volume before us, the author's seven years' hunting included experiences of the great game of all the four continents of the world although in Asia his travels were limited to India and Ceylon, and in America to the United States and the Dominion of Canada. A well written and well illustrated record of such extensive experiences could not fail to be of interest, not only to his brother sportsmen, but likewise to naturalists; and the present volume may be truthfully said to fulfil both these conditions. The 250 text-figures with which the work is embellished are for the most part reproductions from photographs taken respectively by the author, Prince di Teano, and Mr. Seton Karr, and are remarkable alike for the manner in which they have been executed and the care with which they have been printed. A large number of these illustrations deal with animals which were shot by the Count, and although most of these were taken after death, yet they frequently portray very clearly some of the more striking characteristics of the particular species. The views of scenery and hunting scenes are, moreover, specially good, and will give to stay-at-home readers an excellent idea of the nature of the districts in which sport was obtained, and of the mode in which various animals are hunted. Of especial interest is the photograph, on p. 176, of recently captured elephants crowded into a *kedda*, while those representing the elephant tamers at work are scarcely less attractive. Some of the titles to the illustrations, such as "Il bufalo record," are perhaps a little comic, but Italian, like French, has not yet evolved a sporting language of its own.

Although the author does not appear to have had the good fortune to discover any new species, his accounts of the habits of many of the less known forms will be found of considerable interest to the naturalist. And a gratifying feature is the attention paid to nomenclature, since this is a point in which sporting works are apt to be very deficient. In the employment of names like *Mazama columbiana* for the Columbian black-tailed deer, and *Taurotragus oryx* for the eland, the Count is, indeed, thoroughly up-to-date and ahead of most works on popular natural history.

Whether, however, the author confined his love for shooting within such limits as would meet with the approval of the recent congress on the preservation of great game is a question which may be left for others to answer. But the plate on p. 457, which represents three individuals of the common African rhinoceros, out of a herd of six, already fallen, while aim is being taken by the author at a fourth, is calculated to give rise to misgivings on this point.

Starting from Liverpool in 1889, Count Scheibler sailed for America, where he soon enjoyed excellent sport in the Rocky Mountains with "grizzly" and wapiti; afterwards proceeding to British Columbia, where he was successful in obtaining examples of the Rocky Mountain goat. At San Francisco he embarked for India, where

his first experiences of sport were obtained in the fever-stricken Sandarbans of Lower Bengal. Proceeding northwards, he had the good fortune to be entertained by the Maharaja of Kuch-Behar, whose territories are now the finest sporting-grounds in India; and here he obtained, in addition to tiger, the large Indian rhinoceros, the gaur, and the wild buffalo. After a short sojourn in Gya and Ceylon, the party then crossed to Somaliland, which was at that time in its prime as a sporting country. From the Italian province of Erithræa the Count proceeded by sea to Zanzibar, whence he made a journey of considerable length into the interior of Equatorial Africa, obtaining specimens of Coke's hartebeest (*Bubalis cokei*), and the fringe-eared beisa (*Oryx callotis*). The final stage of the tour was Russia, where elk was added to the list of large game.

Although, as the author himself states, the work lays no claim to having advanced either zoological or geographical science, yet it may be commended as a very interesting account of types of animal life which are only too rapidly disappearing from the face of the earth. In fact, it is so interesting that there would seem a considerable probability that an English translation would be well received. R. L.

OUR BOOK SHELF.

Die Moderne Physiologische Psychologie in Deutschland. By W. Heinrich. Pp. iv + 249. (Zürich: Speidel, 1899.)

Zur Prinzipienfragen der Psychologie. By W. Heinrich. Pp. iv + 74. (Zürich: Speidel, 1899.)

An Outline Sketch, Psychology for Beginners. By Hiram M. Stanley. Pp. 44. (Chicago: The Open Court Publishing Company, 1899. London: Kegan Paul and Co., Ltd., 1899.)

MR. HEINRICH'S two little works demand careful study as well thought-out and consistent expositions of a psychological attitude which is in many ways attractive. The author, who may be described as a disciple of Avenarius *minus* his master's metaphysics, holds strongly the necessity of making the principle of psychophysical parallelism, understood in the most rigid sense, the basis of all psychological inquiry, and would consequently recognise no causes or causal laws other than those of the physical and physiological series. He has little difficulty in showing that Wundt and other contemporary writers, who, while professing the doctrine of parallelism, believe in causal sequences between psychical states as such, are inconsistent with their own professions. That the inconsistency can be avoided, or that an intelligible account of human life can be given in terms of purely physiological sequences, is scarcely so clear. As the author himself admits, it is a necessary consequence of his theory that the only difference between rational and purely reflex reaction on stimulus is one of comparative complexity. Whether an account of human life which reduces all activity to the purely reflex type is not like the play of *Hamlet* with the part of Hamlet left out, he does not discuss. The question is, however, directly suggested by his contention that, in treating of the behaviour of our fellow-men, we have no right to introduce the notion of consciousness, but should confine ourselves to establishing physical relations between changes in their environment and their corresponding outward reactions. He seems to forget that language, for instance, loses half its significance if you neglect to observe that it not merely can be understood by a listener, but is meant by the speaker to be understood. And even if we could agree to take no notice of consciousness in our fellows, it still remains, as the author admits, to examine the relation between the environment, which on his theory all science describes, and ourselves the describers. Thus all the problems about the relation between consciousness and its objects which Mr. Heinrich banishes from our psychological study of our fellows return upon us as soon as we attempt to understand our own relation to our environment. Perhaps the chief value of the author's discussions is that by his insistence on the too often disregarded consequences of the doctrine of parallelism, he compels his readers to ask themselves whether the old belief in the interaction of mind and body is not, with all its difficulties, more satisfactory than the fashionable substitute for it.

It is painful to turn from Mr. Heinrich's able and thoughtful work to such a piece of loose and unsatisfactory popular psychology as Mr. Stanley's essay. If psychology is to be taught in schools at all—in itself a debatable question—it ought, at least, to be taught in a precise and definite form. These scraps of inaccurate chatter are of no more value in psychology than they would be in elementary physics or in any other science. Read, for instance, the light and airy sentences (pp. 8-9) in which Mr. Stanley disposes of the difficult problem of space-perception. What would be thought of a writer on heat or chemistry who should evade all the puzzles of his subject by such loose and flimsy generalisation? In truth, the only way to treat work of this kind with kindness is to say nothing at all about it. The only words one can find in which to characterise it are that, like a good deal of popular writing on psychological topics, it is quite worthless, because the writer has set no serious standard of scientific accuracy before him.

Rural Wealth and Welfare: Economic Principles illustrated and applied in Farm Life. By Geo. T. Fairchild, LL.D. (New York: The Macmillan Company, 1900; London: Macmillan and Co., Ltd.)

THE scope of this treatise is perhaps more accurately indicated by its alternative title: it is primarily a text-book of economics, the concrete illustrations being taken preferably from objects and practices familiar to agriculturists. The book is accordingly addressed to this class of the community, though it may be doubted whether the ordinary farmer, at all events in this country, will be competent to make much practical use of the principles expounded. The position of farming, especially in the older civilised States, has perhaps undergone more change during the last thirty years than that of any other great industry, since it is practically within this period that the cultivator has had to learn to face the competition, not merely of his own countrymen, but of the whole world. It is therefore all the more necessary that he should be thoroughly acquainted with the modern conditions under which he has to work; in this respect, the remarks on the importance, as a factor in prices, of the increased facilities for marketing the enormous quantities of grain and other farm products raised in the United States, are very much to the point.

Lectures on Theoretical and Physical Chemistry. By J. H. van't Hoff. Translated by R. A. Lehfeldt. Part ii. Chemical Statics. Pp. 156. (London: E. Arnold.)

WE welcome the appearance of the English translation of the second part of van't Hoff's lectures. Dr. Lehfeldt has, as before, done his work admirably. It may be regretted, however, that he has adhered so closely to the somewhat uncouth structural formulæ used by the author. We venture to hope that in a future edition a freer use of brackets and points may be made, as the student might have some difficulty in recognising aceto-acetic ether in the formula $H_3CCOCH_2CO_2C_2H_5$.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Eclipse Photography.

THE writer has obtained results in photography which seem to have an important bearing on the work which should be undertaken in future eclipses.

It is well known that photographic plates exposed in some eclipses have developed no trace of an image of the sun. The astronomer has even been subjected to the mortifying suggestion that he had forgotten to uncap his camera. It is not difficult to reproduce such results at any time by simple over-exposure. In eclipse photography, where it is sought to get the most delicate of details in an object of the most delicate character, the methods now used are hedged in by very peculiar limitations. It requires a very appreciable time to secure delicate details, and, nevertheless, if this time is made too great the plate will fog. The developer must then be given restraining properties, which cause a loss of the very details we are seeking to secure.

In a paper recently published by the Academy of Science of St. Louis, the writer has shown that a plate which, on account of over-exposure will develop as a zero plate in a dark room, will develop as a positive in a light room. The paper contains a half-tone reproduction of a positive obtained by a camera exposure of one minute, and developed within a few inches of a 16-candle incandescent lamp. The plate was an "instantaneous" Cramer plate. Since that time the same results have been reached by first opening up the plate holder and exposing the film to the lamp light until it is all converted into the zero condition. If covered with an opaque punched stencil, no trace of the design will appear on the film when developed in the illuminated bath. The slide is then closed and the plate afterwards exposed in the camera in the usual way. Such a plate cannot be over-exposed in any reasonable time. It may be exposed for a minute or for four hours to a brilliantly-lighted landscape, and the most superb results can be obtained. There is no restraining developer needed. The tendency to fog when the exposure is too short is corrected by taking the developing bath nearer to the light. It seems probable that on very short exposures it might sometimes be advantageous to use a developer which will yield a positive with an under-exposed plate. In the two eclipses of long totality which are now approaching, this method seems to promise very valuable results, and the attention of those who will have the work in charge is earnestly directed to this matter. The results described have been reached but recently, and there is need of preliminary experimenting by any one who wishes to avail himself of these methods.

St. Louis, Missouri, U.S.A. FRANCIS E. NIPHER.

The Action of Water Upon Glass.

IT is a matter of too frequent observation in India that lenses of optical instruments are liable to serious injury from atmospheric influences. This very often takes the form of injury to the Canada balsam cementing the two lenses of achromatic combinations together; but in other cases, it is due to the solvent action of water on the surface of the glass. As this is a matter of importance necessitating the re-grinding of the lens for its correction, I have thought that the following observations may be of interest and of value to optical instrument-makers, especially as it appears that only particular kinds of glass are attacked in this way. If that is so, it should be possible to avoid using glass of that particular composition; or the edges of the combined lenses may be covered with a coating of cement or varnish so as to prevent moisture getting in between them, and in such a way that it could easily be removed when desired.

My attention was first drawn to some cases of articles of domestic glassware being attacked by water standing in them for some time, and these are recorded to show that a solvent action does take place. The first case that I noticed was that of a cut wine glass which was used—or misused—to hold a few cut flowers. On seeing it dry on one occasion, I noticed it had a dull matt appearance, which I thought was simply a deposit. On examination, however, I found that the surface of the glass had been eaten into up to the level of the water usually put into it.

The next case was that of glass finger-bowls, in which the servants kept water ready for use. These were similarly attacked up to the level of the water. The next was a more remarkable case. A couple of decanters, not required for use, had evidently been washed and drained, more or less, but not dried; possibly during the hot season. The moisture remaining inside had become deposited on the inner surface in droplets, as, indeed, may frequently be seen, and had been standing so for some time. When dried for use the surface was found to be eroded, giving a pattern precisely similar to that formed by condensed moisture: leaving no doubt as to its cause.

Here we have, then, a case of pure water attacking the surface of glass when allowed to stand for some time. Since then, being on the alert, I have met other cases, including some of perfectly new glass articles eroded in like manner, which, without their history, it is impossible to account for.

Now for two instances of physical apparatus being attacked and spoiled by this action. The first noticed was a Newton's Rings apparatus. In this case the two discs of glass were equally attacked, and so much so that the combination was of a dense matt appearance. On opening it out, the discs were found to be firmly adhered, and on inserting a knife edge between the discs and giving a sharp tap on the back to separate them, an irregular piece about 1¼ inch long came from one adhering to the other. The two had thus grown together, and at the junction was actually stronger than in the mass of the glass.

The next was a more serious case, being the object lens of a 3½ inch telescope from a well-known London firm of optical instrument-makers. In this case, the convex lens was badly corroded on its inner surface, though the adjacent face of the concave lens was quite clear. Here we see the difference in action in the case of two different kinds of glass. This, however, would help us little if all kinds of crown glass (of which the convex lens is made) were similarly attacked. But this is not the case, and it is a point of importance to opticians to ascertain what particular kinds of crown glass used in achromatic combinations are liable to this action, and to avoid using them. Of a fairly large number of achromatic combinations I have in the College Laboratory, this is the only one that has been affected, though all are exposed to the same influences, while some belong to old pieces of apparatus. The particular telescope was purchased about six years ago, and the damage took place in one season when it was not much used. Since then I have from time to time opened out the lenses and have frequently found a layer of moisture between them; in one case, of a commoner piece of apparatus in which the lenses did not fit closely, a complete drop of water was collected, the diameter of the lens being only 1½ inch; and in a Soleil's saccharimeter, clear through vision is obscured by moisture collected and condensed on the surfaces of the lenses in one of the adjusting pieces, which it is very difficult to open out to clean.

All this shows that moisture does collect in the form of water between such layers of glass, and the pattern of the eroded portion of the telescope lens, together with the instances of the action of water on the domestic glass goods mentioned above, leave no doubt that it was moisture alone that caused the damage in this case, although it was not actually seen. I need hardly say that, in both the Newton's Rings apparatus and the telescope lens, the exposed surfaces were perfectly clear and unacted upon.

The causes of moisture collecting in this way would appear to be the excessive moisture in the air for many months in the year, the hygroscopic nature of the glass, and capillary action between the surfaces; while the apparently marked action of water on glass here noticed is probably due to the long-continued higher temperature. It is possible, however, that the above phenomena may not be as new or unusual as they appear to be to me, and that many others could give like experiences.

EDMUND F. MONDY.

Dacca College, Dacca, East Bengal, June 16.

THE TOTAL SOLAR ECLIPSE AS OBSERVED BY THE SMITHSONIAN EXPEDITION.

WADESBORO, in Northern Carolina, was the station selected by the Smithsonian Institution for observing the total solar eclipse of May 28 last. The chances of fine weather at eclipse time were about eight to one, and it is satisfactory that on eclipse day the sky was cloudless and the air clearer than on the average.

The main objects of the investigations undertaken were a photographic and visual study of the structure of the lower corona, and a determination by the bolometer of the heat radiated from it, and lastly an examination of the form of its spectrum energy curve.

Prof. Langley, who was in charge of this expedition, observed the eclipse of 1878 from Pike's Peak (14,000 feet), and he was then particularly struck by the remarkable definiteness of filamentary structure close to the sun's limb, a structure which, he remarks, has never been found in any photographs, not even in those beautiful pictures taken by Prof. Campbell at the Indian eclipse of 1898. The eclipse this year afforded him an opportunity of examining this inner corona region with a much more powerful instrument. This instrument was a 12-inch achromatic lens of 135 feet focal length, obtained for the Harvard College Observatory, and lent by Prof. E. C. Pickering. The tube was mounted horizontally in conjunction with a cœlostat of 18-inch aperture, and 30-inch square plates were used, the diameter of the solar image being 15 inches. To supplement this instrument, a 5-inch lens of 38 feet focal length, loaned by Prof. Young, was pointed directly at the sun, and photographs were secured on plates 11 by 14 inches, moved in the focus of the lens by a water clock. For the study of the outer corona and possible intramercurial planets, specially equatorially mounted lenses of 6-, 4- and 3-inch apertures, driven by clock-work, were used.

The accompanying illustration (Fig. 1) shows a small part of the 135-foot telescope. The photographic hut is seen at the end of it, and beyond that the tube containing the lens of 38 feet focal length pointed at the sun. Prof. Langley is seen observing at the 5-inch equatorial.

For the bolometric work a massive siderostat with a mirror of 7 inches was used in conjunction with a large part of the delicate adjuncts employed at the Smithsonian Institution in recent years.

Further work that was attempted, and for which other apparatus had been taken out, was an automatic method of obtaining photographs of the lower chromosphere at about second contact by means of an objective prism working in connection with the 135-foot lens; visual and photographic observations of times of contact; and sketches of the corona, both from telescopic and naked eye observations.

The observers, under the general charge of Prof. Langley, were distributed as follows:—Prof. Langley used the same 5-inch as he observed with in 1878; Messrs. Abbot and Mendenhall were in charge of the bolometer; Mr. T. W. Smillie made exposures at the 135-foot telescope, and Mr. F. E. Fowle, jun., at the 38-foot telescope. Father Searle, assisted by Mr. P. A. Draper and Mr. C. W. B. Smith, employed four telescopes, mounted on a single polar axis and driven by clock-work, for obtaining photographs of the outer corona and the intramercurial planets. Latitude, longitude, time and contact observations were made by Mr. G. R. Putnam, assisted by Mr. Hoxie. Sketches of the inner corona and contacts were made by Mr. R. C. Child with a 6-inch, and by Father Woodman with a 3½-inch.

FIG. 1.—Portion of Smithsonian Astrophysical Observatory Eclipse Camp, showing a part of the large 135-foot telescope (under canvas), the 38-foot coronagraph, and the 5-inch equatorial.

FIG. 2.—Showing prominences at the south-west limb. Taken with a 12-inch lens of 135 feet focal length. Exposure eight seconds. At end of totality. (Natural size of original photograph. Moon, 15 inches diam.).

Among the more general observations made at the time of the eclipse may be mentioned the following:—

Before totality a fall of temperature and a rising breeze were distinctly noticeable. Shadow bands were seen, but their velocity was too rapid and flickering for accurate determination; their size and distance apart (about 5 inches) were also estimated.

During totality the sky to visual observers was notably not dark, and no second magnitude star was seen with the naked eye. Mercury was a conspicuous object

The equatorial streamers were closely observed, and could be followed by the naked eye to 3 or $3\frac{1}{2}$ solar diameters; their structure was likened by Father Woodman to a structure of mother-o'-pearl, and this was generally conceded. Colour estimates, however, varied, and were given as "yellowish green tinge," "straw-coloured" or "golden." (It may be remarked here that the general description of the colour was given by the British observers in Spain and Portugal as "silvery-white.") Prof. Langley's visual telescopic observations gave, as he remarks, "little indication of the finely-divided structure of the inner corona which he had noticed at Pike's Peak. Structure, to be sure, was evident, but not in such minute subdivision as had then been seen; and though one remarkable prominence, as well as several smaller ones, was visible, the coronal streamers did not give to the writer the impression of being connected with these prominences, though the relationship of some of them to the solar poles was abundantly manifest."

The approximate length of totality as observed was 88 seconds, or 4 seconds shorter than the duration as given by the *Nautical Almanac*.

FIG. 3.—North polar coronal region. Taken with a 12-inch lens of 135 feet focal length. Exposure 16 seconds. (Natural size of original photograph. Moon 15 inches diam.)

With regard to the photographs which were found to have been successfully exposed, but of which only a few have as yet been developed, most interesting results will be obtained. During totality six plates were exposed for periods ranging from $\frac{1}{2}$ to 16 seconds, and three others immediately after third contact; these were all secured by the large 135-foot telescope. We are fortunately able to illustrate two portions (natural size) of the large 15-inch disc. Fig. 2 shows one of the principal prominences with the lower filaments near it (exposure 8 seconds), while Fig. 3 is another portion of the north polar region, with a 16 seconds' exposure. The part near the sun has been intentionally over-exposed, to show more clearly the outer portions of the polar structure, which extended to 6 minutes from the sun. The wealth of detail and imposing magnitude of the scale on which these pictures are taken will no doubt give us much needed information about the structure of the corona just above the chromosphere.

The measurement of the heat of the corona appears to have been successfully performed by Mr. Abbot, with the aid of Mr. Mendenhall, and this is probably the first time that it has really been shown to exist. The important result was that the corona gave a positive indication of heat as compared with the moon; this heat though certain, was, we are told, too slight to be subdivided by the dispersion of the prism with the means at hand.

With regard to the negatives depicting the outer corona, these show the extensions reaching to from 3 to 4 solar diameters for the longest streamers.

The plates taken for a search for intramercurial planets have not been carefully examined, but the considerable sky illumination during totality leads Prof. Langley to doubt the possibility of having recorded the images of such faint objects on the plates. Pleione (6·3 magnitude) in the Pleiades, and some fainter stars are, however, recorded on one of the plates.

The expedition seems to have gathered some most valuable data, and to have scored a decided success in every respect; the observations made and the photographs secured promise to be very satisfactory, especially with regard to the primary objects of the expedition.

THE BOARD OF EDUCATION AND ITS CONSULTATIVE COMMITTEE.

IT will be remembered that the Board of Education Act, which received the Royal Assent last year, contained in Section 4 the following provision:

"It shall be lawful for Her Majesty in Council by Order to establish a Consultative Committee, consisting, as to not less than two-thirds, of persons qualified to represent the views of universities and other bodies interested in education, for the purpose of:—

(*a*) framing, with the approval of the Board of Education, regulations for a register of teachers which shall be formed and kept in manner to be provided by the Order in Council; provided that the register so formed shall contain the names of the registered teachers arranged in alphabetical order, with an entry in respect of each teacher showing the date of his registration, and giving a brief record of his qualifications and experience; and

(*b*) advising the Board of Education on any matter referred to the committee by the Board."

The Order in Council nominating the members of the proposed committee and defining its course of procedure, has just been issued, and is a document of considerable public interest and importance. Advisory Boards are not unknown in other departments of the public service, *e.g.* in the India Board and at the Admiralty; but a permanent Consultative Committee of unofficial experts, on the scale and with the powers contemplated in the present Order in Council, is a

novelty in administration; and the working of the new experiment will necessarily be watched with much solicitude by all persons who have at heart the improvement and development of our system of public education.

The following are the names of the eighteen persons who are nominated as the first members of the Consultative Committee:—

Right Hon. Arthur Herbert Dyke Acland.
Sir William Reynell Anson, Bart., M.P.
Professor Henry Armstrong.
Mrs. Sophie Bryant.
Right Hon. Sir William Hart-Dyke, Bart., M.P.
Sir Michael Foster, K.C.B., M.P.
Mr. James Gow, Litt.D.
Mr. Ernest Gray, M.P.
Mr. Henry Hobhouse, M.P.
Mr. Arthur Charles Humphreys-Owen, M.P.
Sir Richard Claverhouse Jebb, M.P.
Hon. and Rev. Edward Lyttelton.
Very Rev. Edward Craig Maclure, D.D., Dean of Manchester.
Miss Lydia Manley.
The Ven Ernest Grey Sandford, Archdeacon of Exeter.
Mrs. Eleanor Mildred Sidgwick.
Professor Bertram Coghill Alan Windle, M.D.
Rev. David James Waller, D.D.

It will be noticed that with the exception of the two former Vice-presidents of the Council, and of Mr. Hobhouse, all the persons named in this list may be regarded as representatives of "bodies interested in education." Oxford, Cambridge and London are most appropriately represented by their respective Members of Parliament; two of the proposed members are head-masters of public schools, one has been a teacher in a public elementary school, one is a High School mistress, another lady is the head of Newnham College, a third is the mistress of a training college for schoolmistresses, and may also be reckoned as a representative of the British and Foreign School Society. Science and technology have their advocates in Prof. Armstrong and Sir Michael Foster; the Established Church and the National Schools are represented by Archdeacon Sandford the Roman Catholics by Prof. Windle, and the Nonconformists by Dr. Waller, Wales and the Welsh Intermediate Schools by Mr. Humphreys-Owen, and the School Boards of England by Dean Maclure, the chairman of the Manchester School Board. There can be no doubt that an excellent selection of names, typical of various classes, and likely to command the public confidence, has been made by the Lord President and his advisers.

Nevertheless, it was generally hoped and expected that, while two-thirds of the number were very rightly and in fulfilment of the express intentions of the Act to be composed of persons able to express the views of different academic and professional bodies, the remaining third would consist of persons detached from sectional interests, and specially qualified by breadth of view, by large acquaintance with schools and institutions of various classes, both here and in foreign countries, and by a disinterested concern for the interests of national education as a whole, to render service in consultation with the Board of Education. No such proportion has, however, been observed in the composition of this committee. Like some recent Royal Commissions, to which have been entrusted duties especially demanding wide knowledge and judicial impartiality, the chief ingredients in the committee are advocates and partisans specially charged to look after the interests of particular institutions, creeds, or professional bodies. It appears to be assumed that the resultant of all these opposing forces will be a satisfactory conclusion. But when it is considered that one of the first duties of the committee will be to determine the conditions on which teachers shall be admitted to the official register, and that it will be the task of that committee to determine the kind of qualification which should be recognised, and the relative claims of a great number of different institutions, both public and private, it becomes evident that the list of the proposed committee is seriously incomplete. One of the most important questions which will in due course inevitably demand its attention is the examination and inspection of secondary schools, and it is quite conceivable that on this point professional interests may not prove to be precisely identical with the public interests. It may be hoped that attention will be given to these considerations before October, when the committee is for the first time to be summoned. It is indispensable that a body charged with such novel and weighty responsibilities should from the first command the full confidence of all those who are conscious of the defects in our present system, and who are concerned more with its due expansion and its fulfilment of high national ideals than with the conservation of any traditions and interests, however important and deserving of respect, which belong to particular classes or institutions.

THE INTERNATIONAL ASSOCIATION OF ACADEMIES.[1]

THE Academy will recall the fact that at the conclusion of the mission entrusted to M. Moissan and myself, consent was given to the "Projet de Statuts pour l'Association internationale des Académies," drawn up by the delegates of the nine Academies represented at the Conference held at Wiesbaden early in October last, at the invitation of the Academy of Berlin.

The International Association is now constituted; and it includes the eighteen following Academies:

1.	Academy of Sciences	*Amsterdam.*
2.	Prussian Academy of Sciences	*Berlin.*
3.	Academy of Sciences, Literature and the Fine Arts	*Brussels.*
4.	Hungarian Academy of Science ...	*Budapest.*
5.	Academy of Sciences	*Christiania.*
6.	Society of Sciences	*Göttingen.*
7.	Academy of Sciences of Denmark ...	*Copenhagen.*
8.	Academy of Sciences of Saxony ...	*Leipzig.*
9.	Royal Society	*London.*
10.	Academy of Sciences of Bavaria ...	*Munich.*
11.	Academy of Inscriptions and Literature	*Paris.*
12.	Academy of Sciences	*Paris.*
13.	Academy of Moral and Political Sciences	*Paris.*
14.	Academy of Sciences	*St. Petersburg.*
15.	Academy dei Lincei	*Rome.*
16.	Swedish Academy of Sciences	*Stockholm.*
17.	Academy of Sciences	*Washington.*
18.	Academy of Sciences	*Vienna.*

Amongst the Academies invited to join, one only, the Royal Academy of History of Madrid, has as yet not replied to the request of the Wiesbaden Conference.

The provisional rules take into consideration the possibility of the addition of other learned societies, and in § 2 the conditions and formalities are indicated which will be necessary for the admission of a new Academy.

The Association comprises two Sections, the Section of Literature and the Section of Science. The work will be carried out by general meeting and committee. In principle, the general meeting will be held every three years, and each Academy will send as many delegates as it may deem necessary, but each Academy will have only one vote, which should be given by one of the members of the delegation.

In the interval between two general meetings, the Association is represented by the committee, each

[1] Translation of a report made to the Paris Academy of Sciences on July 2, by M. Darboun, permanent secretary of the Academy.

Academy being represented on this by one member only, if it concerns itself with only one of the Sections of Literature or Science; it will send two delegates when it is concerned with both Sections. Amongst the eighteen Academies, twelve belong to both Sections and consequently will send two delegates to the committee. Of the other six, four, namely the Royal Society of London, the Academy of Sciences of Paris, the Academy of Stockholm, and the National Academy of Washington, belong to the Section of Science alone, and two, the Academy of Inscriptions and Literature, and the Academy of Moral and Political Sciences, belong to the Section of Literature. Hence the committee will consist of thirty delegates, of which sixteen will belong to the Section of Science, and fourteen to that of Literature. In full committee the two delegates of one Academy will have only a single vote. After delay, inevitable in such cases, all the Academies, with the exception of two or three, have sent in the names of their delegates. The delegate of the principal Academy will take the chair at the committee of the Association, the principal Academy being that of the place in which it is proposed to hold the next general meeting.

The Conference of Wiesbaden having decided on a resolution to which we can here only draw attention, that the first general meeting of the International Association should be held in Paris this year, a difficulty has arisen not foreseen when the provisional rules were drawn up. Three Parisian Academies having joined the Association, it is necessary to decide to which shall be assigned the Presidency on this occasion. The delegates of the three Academies of the Institute of France have met, and have unanimously decided to confer for this year the presidency of the Association upon the Academy of Sciences, which was the first to join the Association, and, moreover, has taken an active part in the discussions, at the conclusion of which the Association was constituted.

It has been further decided that the first Session of the committee shall be held in Paris towards the end of July, the first meeting being fixed for Tuesday, July 31, at 9.30 a.m., at the Palais de l'Institut.

The agenda for the first meeting will include the preparation of a scheme of government for the committee, the settlement of the exact date and the order of the day for the next general meeting. The Royal Society of London, which has taken so active a part in the formation of the Association, has already announced a scheme which it proposes to submit for approval to this next general meeting; it concerns the measurement of an extended arc of a meridian in the interior of Africa.

The Academy, by the act of joining, has subscribed to the rules of the new Association. There is no occasion to recall here with what prudence and moderation they have been drawn up. The object of the Association is to prepare and promote scientific work of general interest which may be proposed by one of the constituent Academies, and generally to facilitate scientific relations between different countries. In any particular case, each Academy reserves to itself the right to give or refuse its support, or decide the choice of methods and the means to be employed.

If these principles are followed, the Association will become a powerful instrument of study, of concord and of scientific progress; it will rapidly take its place in the front rank of those international scientific associations, the *rôle* of which must necessarily be satisfactory.

Faithful to the principles which they have always followed, the three Academies of the Institute of France, called by the nature of their studies into the Association, will strive to assure it the success and influence which have been desired for it by its promoters.

Finally, attention may be directed to a particular clause in the rules which will interest some of our colleagues. For taking into consideration the study or preparation of scientific enterprises or researches of international interest, upon the proposition of one or more of the associated Academies, special international commissions may be instituted either by the general meeting or one of its two Sections, or, in the interval between two general meetings, by the committee or one of its two Sections.

THE NEW PHYSICAL LABORATORY AT OWENS COLLEGE.

OWENS COLLEGE recently held high festival on the occasion of the opening, by Lord Rayleigh, of the new physics laboratories. Of these, a preliminary account was given in NATURE of October 27, 1898, on the occasion of the laying of the foundation-stone. As the size of the new building surpasses that of any other physical laboratory in this country, it was fitting that the occasion should be marked by a ceremony of some importance, and dignified by the presence of a number of leading physicists from all parts of the country.

The main features of the new laboratories, as planned by Prof. Schuster, were described in our former article; but it remains to state how they have been carried out. The new building is separated by Coupland Street from the main quadrangle of buildings of which Owens College consists, though it is joined to the older buildings by an underground passage. It is a commodious structure, having three complete storeys above the basement, with simple but effective decorative features both internal and external. The frontage is about 110 feet wide, and the main building extends about 90 feet back. The ground floor is devoted to rooms for electrical measurement, the magnetic testing of iron, electrochemistry, a workshop and a private laboratory. The first floor contains a large laboratory for elementary teaching (36 feet by 44 feet in dimensions), a balance room, a room for chemical physics, two laboratories for electricity and one for optics. On the second floor is a fine lecture theatre with raised auditorium, preparation room, museum and apparatus room, a class-room and two smaller laboratories, and a special room fitted up for physical optics; its special feature being the equipment, designed by Sir Howard Grubb, necessary for working with a 6-inch Rowland grating. From this floor an upper staircase leads to a small astronomical observatory containing an excellent 10-inch equatorial by Cooke, the gift of Sir Thomas Bazley. In the basement are rooms for spectroscopic and photographic work, a cryogenic laboratory and a room for researches at constant temperature. The arrangements for heating, ventilating, and for the supply of gas, electricity, water, steam and compressed air are exceedingly complete. In the ventilation system, the air supplied through a fan and warmed by passage through a flue heated by the gases of the boiler-furnaces, is passed over a surface of oil to deprive it of its dust and prevent blackening effects.

A very important adjunct to this fine building is the John Hopkinson memorial wing for electrotechnics. This consists of two large rooms on the ground floor: one (27 feet by 50 feet) to serve as a dynamo room, the other an electrochemical laboratory (36 feet by 37 feet), together with basement rooms for gas engine, counter-shaft for dynamo-driving, photometers, and heating apparatus. In the dynamo room, where already are placed several of Wilde's dynamos and some more recent types, there is a fine bronze portrait tablet of the late Dr. Hopkinson. The cost of this wing has been defrayed by the parents and relations of the lamented Dr. Hopkinson, who was himself an alumnus of Owens College.

The opening ceremony on the 29th ultimo began with

an academic procession from the Christie library to the lecture theatre of the new laboratories, where the chair was taken by the Treasurer of Owens College, Mr. Alderman Thompson. Amongst those present were Lord Rayleigh, Prof. Schuster, Sir Henry Roscoe, Principal Hopkinson, Prof. Oliver J. Lodge, Prof. Bodington (Vice-Chancellor of Victoria University), Prof. Rücker, Prof. Pickering of Harvard College, Prof. Osborne Reynolds, Prof. Stroud, Prof. J. J. Thomson, Prof. Poynting, Prof. Ramsay, Prof. Core, Archdeacon Wilson, Mr. Wimshurst, Prof. Perry, Mr. W. Mather, M.P., and many others. Lord Rayleigh delivered a short address upon physical laboratory work and research, and formally pronounced the building open. Prof. Schuster gave an account of the aims of the building, and of the various stages in their realisation. Prof. Pickering likened a physical laboratory to a battleship, and enlarged upon the uses of its equipment. The company then adjourned, some to visit the various rooms, others to attend the opening ceremony in the John Hopkinson memorial wing, which was presented in a touching speech by Mr. Alderman Hopkinson on behalf of the family.

A garden-party held in the afternoon in the house of Prof. Schuster was followed in the evening by a reception and conversazione in the new building. In one of the rooms was a very interesting exhibit of some of the apparatus used by Joule, including two "current weighers," a tangent galvanometer, and a mercury pump. These have been presented to the Owens College by Mr. B. A. Joule. In another room Mr. T. Thorp showed his celluloid gratings and celluloid reproductions of Rowland's grating and of his own echelon grating. Mr. Wilde exhibited his magnetarium and a number of lunar photographs. The large electro-magnet presented by him was also shown in operation.

On the morning of the 30th was the annual ceremony of conferring of degrees of the Victoria University. This took place in the Manchester Free Trade Hall, which was crowded with undergraduates and visitors. The Chancellor, Earl Spencer, presided with great dignity. Honorary degrees were conferred on Lord Rayleigh, Sir William Huggins, Sir William Abney, Sir William Roberts-Austen, Dr. T. E. Thorpe, Prof. Dewar, Prof. Forsyth, Mr. R. T. Glazebrook, Mr. Sidney Lee, Prof. E. Pickering, Prof. J. J. Thomson, and last on the father of the profession of electrical engineering, Mr. Henry Wilde. The ordinary degrees were then conferred upon the successful candidates of the year from the three constituent colleges—Owens College, Liverpool University College, and the Yorkshire College. A luncheon in the Town Hall, given by the Lord Mayor, was subsequently partaken of by the Chancellor, the new Honorary Doctors, the University Professors, and a large number of distinguished visitors.

It has been mentioned that the new physics laboratory exceeds in size any other similar building in England. It is, however, smaller than the physics laboratories of Baltimore, Darmstadt and Strassburg. Its cost has been defrayed by the generosity of private individuals.

NOTES.

TWO deputations have recently waited upon Mr. Hanbury to put before him the two sides of the question referring to the proposed establishment of the National Physical Laboratory in the Old Deer Park at Richmond. On one side are some naturalists and inhabitants of the neighbourhood, who protest against the proposed buildings as an interference with the amenities of the neighbourhood of Kew Gardens; on the other are the physicists and the members of the Committee, which, after giving great attention to the question of site, decided that Kew was most suitable. It is a little unfortunate that this difficulty should have arisen, and it could probably have been avoided by the exercise of a little tact and consideration when selecting the site for the laboratory. Much of the misapprehension which at present exists as to the character of a physical laboratory might thus have been removed. Some people seem to think that the fifteen acres required will be covered with buildings in which noisy operations comparable with those of large engineering workshops will be carried on. This, of course, is entirely incorrect. In the first place, the actual area to be covered by buildings is only a quarter of an acre, or the sixtieth part of the whole area proposed to be taken, and secondly, quiet and freedom from all the perturbing characteristics of towns and manufactories are essential for the investigations to be carried on in the laboratories. When this is kept in mind, the alarm of a certain portion of the public, especially those who appreciate the beauties of Kew Gardens, that the buildings would break the present charm, seems a trifle unnecessary. The Observatory being already in the Old Deer Park, it is natural and proper that the laboratory, which is under the same administration, should be there too. As, however, the Park is over 350 acres in extent, it ought not to be difficult to find another suitable site if there is a persistent opposition to the one already selected. In any case, we are convinced that a *modus vivendi* could be arrived at if the representatives of the opposing interests were to meet one another in a conciliatory spirit.

M. ZAMBACO has been elected a correspondant of the Paris Academy of Sciences, in the section of medicine and surgery.

DR. CORFIELD, professor of hygiene and public health at University College, has been elected a Foreign Corresponding Member of the Royal Academy of Medicine of Belgium.

MR. J. H. MAIDEN, director of the Botanic Gardens, Sydney, is expected to arrive in London at the end of the present month, and will be in the United Kingdom and on the Continent for about three months, engaged in special investigations in botany and agriculture.

THE Duke of Northumberland has been elected a trustee of the British Museum.

THE annual meeting of the Victoria Institute will be held on Monday next, July 16, when an address will be delivered by Prof. Hull, F.R.S.

IT is announced in the *Athenaeum* that Baron von Richthofen has been nominated Director of the newly founded Museum für Meereskunde of the University of Berlin.

A BOTANIC GARDEN has been established by the Belgian Government at Coquilhautville, Congo Free State. It will be called the Kew Gardens, and is expected to be of great importance to the rubber and other tropical industries.

THE Council of the Royal Geographical Society have decided to award the Murchison Grant for next year to Mr. John Coles, late Map Curator and Instructor to the Society, as an acknowledgment of his services to geography.

THE annual meeting of the Society of Chemical Industry will be held in the lecture theatre of the Royal Institution, Albemarle Street, on Wednesday, July 18, when the presidential address will be delivered, and the officers for the ensuing year appointed. The president-elect is Mr. J. W. Swan, F.R.S.

THE Council of the Sanitary Institute have arranged to hold a meeting in Paris from August 7 to 9, which will immediately precede the meeting of the International Congress of Hygiene and Demography, also to be held in Paris. The Société Française d'Hygiène have offered to the members of the Institute

a cordial reception, and are providing a reception room, and making arrangements for special visits and excursions for the benefit of members attending.

A PUBLIC HEALTH CONGRESS will be held at Aberdeen from August 2 to 7, under the auspices of the Royal Institute of Public Health. Among the papers promised may be mentioned the following:—"Disinfection," by Prof. Delépine; "Sewage," by Prof. Percy Frankland, F.R.S.; and "The Origin and Treatment of Malarial Fever," by Dr. Patrick Manson. There will also be submitted and discussed a report on the inquiry made into the chemical and bacteriological condition of the air in the London Board Schools.

THE Home Secretary has appointed a committee to inquire into the working of the method of identification of criminals by measurements and finger prints, and the administrative arrangements for carrying on the same, and to report whether any and what changes are desirable. The members of the committee are Lord Belper (Chairman), Mr. F. A. Bosanquet, Q.C., Common Serjeant, Mr. A. De Rutzen, Metropolitan Police Magistrate, and Mr. C. S. Murdoch, C.B., and Mr. C. E. Troup, C.B., of the Home Office, with Mr. C. Lubbock, of the Home Office, as secretary.

AMONG the Civil List pensions granted during the year ended on June 20, we notice the following:—Mr. Benjamin Harrison, in consideration of his researches in the subject of pre-historic flint implements, 26*l.*; Mr. Thomas Whittaker, in consideration of his philosophical writings, 50*l.*; Mr. Charles James Wollaston, in recognition of his services in connection with the introduction of submarine telegraphy, 100*l.*; Mr. Robert Tucker, in consideration of his services in promoting the study of mathematics, 40*l.*; Mrs. Eliza Arlidge, in consideration of the labours of her late husband, Dr. John Thomas Arlidge, in the cause of industrial hygiene, 50*l.*; Miss Emily Victoria Biscoe, in consideration of the services rendered to Antarctic exploration by her late father, Captain John Biscoe, 30*l.*

SOME molluscan remains found in a sandstone from the Malay Peninsula were described by Mr. R. Bullen Newton at the May meeting of the Malacological Society of London. The shells consist of Lamellibranch casts and impressions, many of them being sufficiently well defined to point conclusively to their Triassic origin. The most abundant genus represented is *myophoria*, so characteristic of the Trias period. *Chlamys valoniensis* also occurs, together with other bivalves. These fossils, the first recorded from this area of south-eastern Asia, were collected by Mr. H. F. Bellamy, and subsequently presented by him to the Geological Department of the British Museum. They were obtained from the Pahang Trunk Road, on the Lipis River.

THE annual meeting of the Museums Association was opened at Canterbury on Monday. In an address, Dr. Henry Woodward, F.R.S., the president-elect, referred to his forty-two years' association with the British Museum and to the many changes and improvements which had taken place there during that period. He advocated the publication by the association of a handbook giving an account of every provincial museum throughout the country, with full particulars as to each, not only as to its officers, organisation, and its plan of arrangement, but also what were the chief features of its exhibits and especially any records concerning types and figured specimens preserved in its collections and any other particulars of general public interest. Papers upon museums and related subjects were subsequently read.

A NEW medical institute, having for its object the placing at the disposal of doctors the aids to diagnosis required in many forms of disease, has just been opened in Berlin. The institute will place at the disposal of the medical profession its laboratories, instruments and apparatus, and its officers will undertake the carrying out of special researches and examinations. It has departments devoted to the study of bacteriology, chemical microscopy, pathological anatomy, and physiology. To the last-named is attached a Röntgen ray room.

GENERAL SIR R. MURDOCH SMITH, K.C.M.G., Director-General of the Museum of Science and Art, Edinburgh, since 1885, died on July 3, after a brief illness. He was born in 1835, and was the executive officer with Sir Charles Newton's archæological expedition in Asia Minor in 1856-59. He explored the Cyrenaice and made successful explanations at Cyrene in 1860-61. Subsequently he became director-in-chief of the Government Indo-European Telegraph Department. He was the author of a "History of the Recent Discoveries at Cyrene," and of a "Handbook of Persian Art."

A PERMANENT committee for the study of tuberculosis as a national scourge has been formed in Russia. The president is Prof. W. D. Scherwinsky, of Moscow. The committee, which has met twice a month since the beginning of April, has, says the *British Medical Journal*, drawn up for itself the following programme of work: (1) Reports on the communications made on tuberculosis to the Pirogoff Congress and other medical societies in Russia; (2) reports of foreign congresses on tuberculosis; (3) reports on tuberculosis as an infectious disease (diagnosis, etiology—heredity, individual predisposition, external influences, mode of diffusion, economic and social factors); (4) statistical data respecting tuberculosis in Russia; (5) legislative measures and ordinances in regard to tuberculosis of human beings and beasts; (6) sanatoria, koumiss establishments, &c.; (7) the means actually in use, and which should be used, for the prevention of tuberculosis in the different provinces of Russia; (8) tuberculosis in animals and its relation to the disease in human beings.

THE new number of the *Geographical Journal* gives further particulars as to the preparations that have been made for the forthcoming National Antarctic Expedition. An executive officer, Lieut. Charles Royds, R.N., of H.M.S. *Crescent*, has been appointed; and Mr. T. V. Hodgson (of the Marine Biological Station of Plymouth) and Dr. R. Koettlitz (of the Jackson-Harmsworth Expedition) will form part of the scientific staff, which Prof. Pollock (the holder of the chair of physics in the University of Sydney) will, it is stated, be invited to join. The name of the vessel used will be the *Discovery*. As was mentioned in our issue of May 31, the commanding officer of the expedition will be Lieut. R. F. Scott, R.N., and the leader of the scientific staff will be Prof. J. W. Gregory.

FROM information that has reached us from Mr. Rotch's Blue Hill Meteorological Observatory we learn that a kite used in the exploration of the air was on June 19 sent up to the height of 14,000 feet, thus exceeding the greatest height previously obtained there by 1440 feet. The temperature at this height was fifteen degrees below freezing point, the wind velocity was about twenty-five miles an hour from the north-east, and the air was extremely dry, although clouds floated above and below that level. The kites remained near the highest point from 5 to 8 p.m. On the way down the kites passed through a stratum of thin ragged clouds at the height of 1½ miles. These were moving with a velocity of about 30 miles an hour. At this time the wind at the observatory, about 600 feet above the general level of the surrounding country, had fallen to a calm. The highest point was reached with 4½ miles of music wire as a flying line supported by five kites attached to the line at intervals of about ¾ miles. The kites were Hargrave or box kites of the improved form devised at the

observatory. They have curved flying surfaces modelled after the wings of a bird. The three kites nearest the top of the line had an area of between 60 and 70 square feet each, and the two others about 25 feet each. The total weight lifted into the air, including wire, instruments and kites, was about 130 lbs.

MR. E. G. GREEN, Government entomologist at the Botanic Gardens at Peradeniya, Ceylon, has recently been able to confirm by personal observation the web-spinning habits of the red ant (*Œcophila smaragdina*). He has seen ants actually holding larvæ in their mouths and utilising them as spinning machines. To find what would be done, some leaves which had been newly fastened together by the ants were purposely separated by Mr. Green. The edges of the leaves were quickly drawn together by the ants, and, about an hour later, small white grubs were seen being passed backwards and forwards across the gaps made in the walls of the shelter. Each grub (there were apparently only two of them) was held in the jaws of one of the worker ants, and its movements directed as required. A continuous thread of silk proceeded from the mouth of the larva, and was used to repair the damage. There were no larvæ amongst the occupants of the disturbed inclosures, and the grubs used for spinning were apparently obtained from a nest a short distance away, which probably accounts for the considerable time that elapsed before the rent was repaired.

THE temperature of the free air is the title of a paper communicated by Dr. Hergesell to Part V. of *Petermann's Geographische Mitteilungen*. We have frequently referred to the great importance of this subject and to the valuable work performed by Dr. Hergesell in organising ascents of manned and free (or unmanned) balloons, and in discussing the results of the observations obtained. In the present paper he collects and discusses the most recent materials, and deals especially with the daily range and the vertical decrease of temperature in the upper strata of the atmosphere. The observations show that even at a height of a few hundred metres, there is a very small diurnal range; at night-time it amounts, in some ascents, to only a few tenths of a degree, and in the day-time, at about 800 metres, to some 3° or 4° Centigrade, when solar radiation is unobstructed. On cloudy days, and in the mean values, the daily amplitude is much less. With respect to the vertical decrease of temperature, the results of thirty sets of observations show that in all levels up to 10,000 metres an extremely varying temperature obtains, according to the season of the year and the conditions of weather. The decrease at that height reached or exceeded 40° C. in all cases, but no fixed rule could be laid down as to the *regular* decrease with altitude.

A RECENT number of the *Scientific American* contains a very interesting account of the use of a diver for the collection of zoological specimens that has been made in the Bay of Avalon, California. A large double-ended surf boat, in which the pump was placed, was towed to the scene of operations and anchored securely, bow and stern. Besides this, a number of observation boats, with glass bottoms, were used, and through these every movement of the diver could be observed. As soon as the diver was ready to descend, a scoop-net and a spike were handed to him. Stepping down, round by round, he finally pushed off and slowly sank to the bottom in about twenty-five feet of water. Through the glass bottom of the observation boats every movement could be plainly seen, as the diver walked through the weed, parting it on each side with ease, and collecting such specimens as seemed desirable. In one walk he brought up angel fishes, star fishes, holothurians, echini, a number of large univalve shells, a living shark, and numbers of small shells. The result of two days' work demonstrated the value of this method of collecting specimens, as in using a dredge many of the most delicate forms were injured. Where a diver is used it is not necessary to take them from the water, the specimens being transferred in the water from the wire collecting-basket to a glass jar. The experiments are stated to have proved beyond question the value of the diver in work of this kind, as the ground covered was a veritable forest of macrosystis, in which groups of rocks were scattered, making work with a dredge impossible.

THE Russian steamer *Rurik* has arrived at Tromsö, from Spitsbergen, bringing news from the Russian expedition, which had wintered on the island for the measurement of an arc of the meridian. No news could be sent until now, because the carrier-pigeons which the expedition set free on Spitsbergen refused to fly southwards and obstinately returned to the wintering place. The *Rurik* probably brings in a full report from the chief of the expedition, Prof. Th. Tchernysheff, but from a telegram of the learned geologist, which was sent to the Academy of Sciences from Tromsö, we already learn that all members of the expedition were well. During the winter astronomical and physical observations were made according to the programme. Photographs were taken of auroræ and their spectra, and in the spring observations were made on Mount Keilhaus, at the signal-pillar of the meridian arc. South Spitsbergen was crossed several times. Akhmatoff made pendulum measurements on Mount Keilhaus. The state of ice was still unfavourable in Storfjord, and Prof. Tchernysheff's intention was to make more excursions and, leaving the "ice-breaker" at Storfjord, to try to reach the Swedish party at Seven Islands.

THE Transbaikalian Railway will be opened for traffic this month. It begins at Irkutsk, wherefrom a line, forty miles long, goes to Lake Baikal. There the train is placed on an ice-breaker-ferry and is transported to the Mysovskaya Station on the eastern shore of the lake, whence it runs 665 miles pas Verkhneudinsk, Chitá, and Nerchinsk (the town—not the mines) to Sryétensk. Steamers ply regularly during the summer from this little town down the Shilka and the Amur to its mouth. At the station Kaidalóva, near Chitá, begins the railway across Southern Transbaikalia, Mongolia, the Great Khingan Mountains and Manchuria, *viâ* Tsitsikar (on the Nonni) and Mukden, to Port Arthur. Work is busily carried on along this last line, building going on on several sections at once: in Transbaikalia, at Tsitsikar, and at the southern end of the line.

MESSRS. CADETT AND NEALL have sent us a sample of their X-ray paper. It is claimed for this material that a great reduction in exposure is effected as compared with the most rapid dry plates, about one-eighth of the usual exposure being all that is required. The paper has also the advantage over glass plates of freedom from risk of breakage, flexibility and consequent adaptability to the object to be photographed, and portability. The reason for paper of this description requiring so much less length of exposure than ordinary dry plates, is because less density is required for a reflecting surface to show structure than is required for a plate from which prints are required; consequently, with the X-ray paper, and using a 10-inch coil with a good tube, a good print of a hand can be obtained with about two seconds exposure; or, using an electrolytic break with the coil, with less than one second exposure.

AN ingenious machine for solving any algebraic equation of the form $px^n + px^{n_1} + p_2x^{n_2} + \&c. = A$, by an application of the principle of Archimedes, is described by M. Georges Meslin in the *Journal de Physique* for June. It consists of a beam balanced on a knife-blade from any point of which may be suspended a solid of revolution, and a series of such solids is provided, constructed in such a manner that in the solid of order n the volume cut off by a horizontal plane is proportional to the nth power of the distance of the horizontal plane from

the lowest point. Thus for orders 1, 2, 3, the forms of the solids are a cylinder ; a paraboloid of revolution, a cone. If the solid of order n is suspended at a distance p from the knife-blade, then when it is immersed to a depth x in liquid, the moment of he resultant upward thrust of the fluid about the knife-edge is proportional to px^n. The operation of solving the equation consists in adjusting the weights at suitable distances, p, p_1, p_2 from the axis, and balancing them, then running water into a trough containing the solids until the fluid thrusts balance a weight A fixed at unit distance from the axis of the beam ; when this is done the equation of moments takes the form of the given algebraic equation and x, the root of the equation is equal to the depth of immersion of the solids.

IN the *Rendiconto del R. Istituto Lombardo*, xxxiii. 11, 12, Prof. Luigi Berzolari considers a generalisation of the problem enunciated by Tanturri, of discovering the number of conics meeting a given algebraic gauche curve in eight points. The generalisation consists in the problem of finding the number of conics meeting one or more given algebraic curves in a points, passing through b given points and touching c given planes, where $a+2b+c=8$, and a number of results are given referring to the particular cases when one or more of the algebraic curves are straight lines.

ALTHOUGH it is now about sixty years since Moser published the results of his experiments on the action of light upon various surfaces as revealed by the condensation of vapours upon them, the character of the change produced by light still remains a mystery. Theories have been suggested, guesses have been made, but little or nothing has been proved. Major-General J. Waterhouse, I.S.C., has, during the last year, accumulated some additional interesting facts in connection with this subject. He fully confirms Moser's results as to the production of a change on the surface of metallic silver by exposure to light that can be demonstrated by the condensation of a vapour, such as mercury upon it. But he has gone further, and demonstrated the change by the deposition of silver from solution, after the manner of the development of an exposed wet collodion photographic plate. By some half hour's exposure in bright sunshine "printed out" images were obtained, that is, images visible without any subsequent application of a developer. General Waterhouse shows that these results are not due to pressure against the mask or stencil plate used, nor to the emanation of vapours from it, nor to heat. Usually blue light gives a much stronger effect than red, but in one experiment when the exposure was for three hours to bright sunshine, the effect was reversed, and the patches under red, orange and yellow glasses were developable, while those under the blue and violet glasses were not. But when the silver plate was heated to redness, quenched in dilute sulphuric acid, washed and dried, and the cut out design was also warmed before use, the effect produced by light was so small that it seems doubtful whether there was any effect at all. On the other hand, if the silver plate was exposed to the fumes of certain substances, especially nitric acid, it was rendered very much more sensitive. General Waterhouse, in his communication to the Royal Society, states that he hopes to continue the investigation this summer, and invites others to extend the observations that he has described.

IN the course of the Cavendish Lecture on the "Application of Pathology to Surgery," recently delivered by Mr. H. T. Butlin, of St. Bartholomew's Hospital, to the West London Medico-Chirurgical Society, a good deal was said with reference to research work, especially in relation to pathology. In the course of the lecture the need was pointed out of two species of pathological laboratories for research—one for research in pure pathology, without any reference to its application, which "need not be attached, so far as its site is concerned, to any hospital. The other for research in applied pathology, the laboratory for inventors, must needs be attached to the hospital ; and those who work in it should have the freest access to the wards, even if they are not in charge of special wards, and should have every opportunity of observing what is done there and in the operating rooms. In order that they may be thoroughly instructed in the science of pathology, they should be taken from among the workers in the laboratory of pure pathology, and should be selected on account of their special aptitude for the work of research and for the originality they have exhibited. They leave the school of discoverers and the science of pure pathology for the school of inventors and the science of applied pathology." After alluding to the advance that has been made during the last few years, the lecturer said : "Money and organisation are necessary if great results are to be secured. The laboratories for research in pure pathology are too small and too scattered, and insufficiently endowed. The laboratories in the hospitals, which ought to be devoted to applied pathology, are used for every kind of microscopical and bacteriological examination and for teaching, so that research is crowded out. And pathological chemistry, from which vast things are to be hoped in future, has taken no proper hold upon the town." An investment of funds for the advancement of medicine and surgery, something like the provisions made in certain industrial establishments in Germany for research, was needed, in the opinion of the lecturer, who had no doubt as to the advantage which would accrue from such a movement.

IN No. 6 of the *Tufts College Studies* appears an important paper, by Mr. J. S. Kingsley, on the ossicles of the ear, which concludes with a suggestive discussion on the origin of mammals. In regard to the latter part of the subject, the author, as might be expected, attaches much importance to the fate of the quadrate bone of the lower vertebrates in mammals. And he arrives at the conclusion that the incus is mainly the representation of that element, although a portion of the latter may be included in the tympanic ring. It is further urged that the articulation of the lower jaw with the skull in mammals does not correspond with the same articulation in the lower vertebrates, but is entirely a new formation.

AS regards the origin of mammals, Mr. Kingsley urges that the ancestral type must certainly have possessed a freely movable quadrate bone ; from which he is led to conclude that the fixed suspensory arrangement of the lower jaw found in the chimæroid fishes, *Ceratodus*, and amphibians, is an acquired, and not a primitive, feature. Hence the fringe-finned fishes like *Polypterus* indicate the ancestral stock of the higher vertebrates. Reverting to mammals, it is shown that the anomodont reptiles of South Africa are far too specialised to have been the parent stock. From this and other inferences it is concluded that "no reptile has yet been found which will in any way fit the requirements for the ancestor of the mammalia ; but that all known facts point rather to a line of descent from forms allied to the amphibia." There is, however, no amphibian type which conforms to the necessities of the situation, and it is accordingly necessary to go back to the common ancestor of the existing salamanders and cœcilians, and of the extinct labyrinthodonts or stegocephalians. In conclusion, it is stated that the ear-bones negative the view advanced by Mivart as to the egg-laying mammals having developed from a separate stock to that which gave origin to the other members of the class.

MEMOIR 4 of the Australian Museum, Sydney, deals with some of the Crustacea obtained during the trawling expedition of H.M.C.S. *Thetis* off the coast of New South Wales in the early part of 1898. Mr. T. Whitelegge, who has been entrusted with

the description of this group, states that the collection of Crustaceans obtained during the cruise is remarkably rich in forms either new to science or to the fauna of New South Wales. Of the forty-five species recorded, twenty come under the latter category and nine under the former. But the present fasciculus applies only to the higher groups of the class, and when the lower forms are worked out a still larger proportion of novelties may be expected. The new types are figured in a well-executed series of plates.

IN its *Bulletin*, No. 180, the Michigan State Agricultural College Experiment Station sets an excellent example by calling attention to the noxious insects which have been most numerous during the past year in that district, and the best means for their destruction.

THE North London Natural History Society's syllabus for the period July to December has just reached us, and gives promise of an interesting session.

THE *Bibliotheca Mathematica*, iii. 1, contains a heliogravure portrait of the late Sophus Lie, together with a descriptive list of his papers by F. Engel, of Leipzig.

MESSRS. WILLIAMS AND NORGATE'S "Book Circular" for June has reached us. In it are to be found notes on new and forthcoming scientific publications, and a list of works on medicine, natural history, chemistry, physics, mathematics, &c.

WE have received Nos. 7 and 9 of *Scientia*. The former, by Dr. Denis Courtade, is entitled "L'Irritabilité dans la Série Animale," while the latter, by Dr. Pierre Bonnier, is called "L'Orientation," and deals with the notion and perception of space by animals, and the localisation of external objects.

THE conclusion of the series of articles on "South African Lepidoptera," by F. Barrett, in the *Entomologist's Monthly Magazine*, appears in the current issue of that periodical, and in it is contained the first instalment of an account of "An Excursion to Egypt, Palestine, Asia Minor, &c., in search of Aculeate Hymenoptera," from the pen of Rev. T. D. Morice.

THE July issue of "Climate, a quarterly journal of Health and Travel" contains several interesting articles, such as "The Art of Travelling" (an interview with Mrs. Bishop, the traveller), and "The Malaria Question," by the editor, in which a good deal of information is given in a compressed form.

IN the new number of "The Journal of the Royal Agricultural Society of England," Mr. W. E. Bear, in an article on "Fumigation for Insect Pests," passes in review the methods of fumigation that are or have been in use in various parts of the world, and the measure of success they have met with.

THE July number of *Knowledge* has as its leading article an account of the recent total solar eclipse, by Mr. E. W. Maunder. It is accompanied by a "process" reproduction of a full-page drawing of the corona, the work of Miss C. O. Stevens. Dr. W. Stanley Smith has commenced in the same periodical an interesting series of articles on Early Theories of Fermentation.

THE current number of *Science Gossip* contains the first of a series of "Geological Notes in Orange River Colony," from the pen of Mayor B. M. Skinner, which probably will appeal to a wider circle of readers just now than would have been the case had war not broken out. The present instalment deals with the country lying between Enslin and Bloemfontein.

THE *Agricultural Journal*, published by the Department of Agriculture, Cape of Good Hope, always contains many items of interest and value to the student of agriculture. The issue for May 10, which has just come to hand, contains, among other things, a good portion of the inaugural address on "The Bearings of Education and Science on Practical Agriculture," which was delivered by Prof. Somerville at Cambridge in November last.

THE Commissioner of Agriculture for the West Indies has issued a handy and useful pamphlet, entitled "Hints and Suggestions on Planting in Tobago." The greater portion deals with the subject of cacao culture, and is written by Mr. E. R. Smart, and revised by Mr. J. H. Hart and others. Short notes on other plants are from the pen of Sir R. B. Llewelyn, formerly Administrator of Tobago.

THE Yorkshire College, Leeds, on behalf of the East and West Ridings Joint Agricultural Council, will provide courses of instruction in the following subjects throughout the ensuing year:—Results of the Garforth and other experiments in the East and West Ridings; agriculture; veterinary hygiene; horticulture; and poultry keeping. A guide has been issued by the two bodies to experiments at the Manor Farm, Garforth, for the year 1900.

THE *Zambesi Mission Record* is a well-edited quarterly periodical, which contains not only reports of the religious and educational work done by the Catholic Mission under the auspices of which it is brought out, but also from time to time notes and articles on the natural history, botany and meteorology of the area traversed by the society; thus the issue for July contains notes on the weather and climate from observations taken at Bulawayo during 1899, and a lengthy contribution, entitled "By an African Pool," in which there is a good deal of popular science, appealing for the most part to the ornithologist. The latter article is illustrated by well-executed "process" blocks of photographs of specimens from the Albany Museum, Grahamstown.

RECENT successful attempts to prepare tubes and bulbs of fused quartz have led to a more detailed study of the thermal properties of this material. Its low coefficient of expansion and absolute unalterability at high temperatures would point to fused silica as an ideal material for air thermometry, and hence the observation by M. P. Villard in the current number of the *Comptes rendus*, that it resembles platinum in being permeable to hydrogen at high temperatures, is a disappointing one. A manometer connected to a pump and quartz tube, the latter being heated in a Bunsen burner to about 1000° C., shows a slowly increasing pressure, amounting in the course of a day to several centimetres of mercury, and on examination the gas proved to be nearly pure hydrogen. The same number contains a so a note by M. Dufour on the resistance of fused silica to sudden changes of temperature in which it is stated that quartz tubes, even although badly made, may be heated to any temperature and plunged into cold water without showing any signs or breaking.

IN the current number of the *Berichte* is a note by Dr. Vaubel on the phenyl derivative of diimide, NH : NH. This has been isolated in a simple manner from the products of reduction of diazoamidobenzene with zinc dust in alkaline solution. Phenyldiimide $C_6H_5.N : NH$ is an oily liquid of a pale yellowish colour, which can be distilled in steam, and possesses a strong odour of almond oil. Since it cannot be distilled with steam from an alkaline solution, it would appear to possess acid properties; it is very poisonous, and has no reducing action upon Fehling's solution. Contrary to expectation, it explodes neither on

heating nor by shock. On account of its great stability towards oxidising agents, the author suggests the formula $C_6H_5.N \dagger NH$ as being the most probable.

THE additions to the Zoological Society's Gardens during the past week include two Tigers (*Felis tigris*, ♂, ♀) from India, presented by H.H. the Maharani Regent of Mysore; a Black-eared Marmoset (*Hapale jacchus*) from South-east Brazil, presented by Mrs. G. L. Bagnell; a Pine Marten (*Mustela martes*), British, presented by Mr. C. G. Beale; a Common Squirrel (*Sciurus vulgaris*), British, presented by Mr. Cecil Slade; a Yellow-cheeked Amazon (*Chrysotis autumnalis*) from Honduras, presented by Mr. S. Hankings; two Crimson-crowned Weaver Birds (*Euplectes flammiceps*) from West Africa, presented by Mrs. Charles Green; a Sharp-nosed Crocodile (*Crocodilus cataphractus*) from West Africa, presented by Mr. J. A. Robb; a Four-lined Snake (*Coluber quatuorlineatus*), European, presented by Mr. W. R. Temple; four Natterjack Toads (*Bufo calamita*), European, presented by Mr. Stanley S. Flower; two Great Wallaroos (*Macropus robustus*, ♂, ♀) from South Australia, three Wrinkled Terrapins (*Chrysemys scripta rugosa*) from the West Indies, deposited; an Adanson's Sternothere (*Sternothoerus adansoni*), a Common Chamæleon (*Chamaeleon vulgaris*) from the Soudan, received in exchange; a Burrhel Wild Sheep (*Ovis burrhel*), two Black-backed Gulls (*Larus marinus*), a Herring Gull (*Larus argentatus*), bred in the Gardens.

ERRATUM.—We are asked to state that in the report of Prof. S. Young's paper, read before the Physical Society on June 22, on the Law of Cailletet and Mathias, the words "1 per cent." (p. 215, col. 1, line 3) should be "0·1 per cent." The 0 was omitted from the report sent to us.

OUR ASTRONOMICAL COLUMN.

COMET GIACOBINI (1900 *a*).—Several observations have been made of this comet since its conjunction with the sun, but it is reported as faint. The following positions are an abridgment from the Ephemeris by Herr Ristenpart in *Astronomische Nachrichten*, No. 3636.

Ephemeris for 12h. Berlin Mean Time.

1900.	R.A. h. m. s.	Decl. °
July 12 ...	22 29 5 ...	+46 25·9
14 ...	12 29 ...	46 50·9
16 ..	21 55 5 ...	47 5·1
18 ...	37 4 ...	47 7·1
20 ...	18 42 ...	46 55 9
22 ...	21 0 16 ...	46 30·8
24 ...	20 42 2 ...	45 51·8
26 ..	24 19 ...	45 0·0
28 ...	20 7 20 ...	43 56·4
30 ...	19 51 16 ...	+42 42·4

The comet attains its maximum north declination on the 18th, to the north-west of α Cygni, afterwards travelling in a south-westerly direction through Cygnus and Lyra.

WALTER PERCY SLADEN.

BY the death of Walter Percy Sladen, the world has lost one of the most lovable of men, and science an earnest devotee—a worker content to spare no effort could he but discover the truth.

Sladen was born on June 30, 1849, at Meerelough House, near Halifax, Yorkshire, and was educated at Hipperholme Grammar School, and afterwards at Marlborough under Dean Bradley. He came of an old Yorkshire family, who have been much respected for many generations; and ease and refinement of manner were among his marked characteristics, while the charm of his address endeared him to all with whom he came in contact.

He never attended a regular academic course of instruction in the branch of science in which he became eminent; his elementary training was self-acquired, and his leaning towards zoology innate. The definitive choice of the Echinoderma as the object of his life's work was of his own seeking, after much consideration; and in this he showed great force of character and a power of self-reliance which there was reason earlier to believe he possessed, for even before he entered Marlborough he evinced an unusual predisposition towards science, in founding for his boy friends a scientific society devoted more especially to the study of astronomy, in connection with which he became known among them as the "Astronomer Royal." Little did he think that he would in later life become for ten years a secretary of a leading scientific society, and that for eighteen he would conduct the affairs of a zoological research committee, as he did in his capacity as Secretary to the British Association Table of the Naples Station.

Sladen's scientific work, so far as his published memoirs and papers are concerned, extended over a period of seventeen years, 1877 to 1893. Of these there are thirty-four in all—twenty-one from his own hand, thirteen in conjunction with his intimate friend and adviser, the late Prof. Martin Duncan. Beyond these there stand to his record certain bibliographical notices and miscellanea. Of the thirty-four published works, fifteen of which he was sole, and four of which he was joint author, deal with the starfishes; and of the remaining fifteen, nine were conjoint, and devoted, with the exception of two, to fossil forms. Conspicuous among these are reports upon the collections made by the Geological Survey of India; and among those which he alone produced are Parts i. and ii. of the second volume of the Palæontographical Society's Memoirs on the Fossil Echinodermata, which were his last published works. They deal with the Cretaceous Asteroids, and appeared in the Society's volumes for 1890 and 1893. His first three papers deal with the remarkable creature *Astrophiura*, whose generic name is self-explanatory. The first, a brief description, was published in the *Proceedings of the Royal Society* for 1878; the other two, each containing a Latin diagnosis, in the *Zoologischer Anzeiger* and *Annals and Magazine of Natural History*, the year following. His remaining papers appeared in the *Annals* and the *Journal of the Linnean Society*, the publications of the Royal Society of Edinburgh, and elsewhere. They mostly deal with whole collections, and include reports on those made in the Arctic Region in 1875–1876, on those of the *Alert*, *Knight Errant* and *Triton*, as also those made in the Faroe Channel, the Korean Sea, and the Mergui Archipelago. In each Sladen produced good results, as in the discovery of genera such as *Micraster* and *Rhegaster*; and what more natural, therefore, than that he should have been entrusted with the working out of the Asteroids collected by H.M.S. *Challenger*, the report upon which was the crowning achievement of his life.

This magnificent work of 900 pp., with its accompanying atlas of 118 plates, ranks among the most masterly and exhaustive of the *Challenger* volumes. Before taking it seriously in hand, Sladen visited every museum in Europe (with one exception) which was known to contain starfishes of importance; and, as pointed out by the editor in its preface, it is a monograph of the whole group. The labour involved in its production was prodigious; and its interest is enhanced by the fact that the bulk of it was written between the hours of 9 p.m. and those of early morning, often after a day's occupation with other affairs. The extension of the family Pterasteridæ and the great addition to our knowledge of the deep-sea forms are its most salient characters; but we know not which to admire most, the body of the work, with its laborious descriptions of individual forms, or the supplemental part, in which there is given a list of every known species, with a record of its bathymetric distribution. Elementary student and expert stand alike indebted to him for this monumental work, indispensable to progress in the knowledge of the subject with which it deals. Generic names like *Benthaster* and *Marsipaster* are sufficiently significant in themselves. Proceeding to classification, Sladen made good use of the marginal and ambulacral plates, and his subdivision into the sub-classes *Euasteroidea* and *Palaeasteroidea*, with the ordinal divisions to which he was led, has withstood the test of time and become the adopted classification of the better text-books, as for example those of Lang and Gregory. In this his influence on the progress of science will live, and it is a matter of profound gratification that only a short time before his death

he gave expression to the satisfaction this recognition afforded him.

Beyond this magnificent work and those papers more or less immediately associated with it, wholly taxonomic, Sladen produced others of a physiological and developmental order, as for example his Naples Station paper, on the structure and functions of the pedicellariæ, and that announcing his discovery of the "cribriform organ," and his papers on the apical plates of the Astrophiuroids, in which he was obviously in agreement with his friend, the late Dr. Herbert Carpenter, in the belief in a stalked ancestry of these. It has been said of his taxonomic work that his descriptions are protracted, and that he deals with specimens as species. There is, however, no reason to believe that he was using the term species in any but a purely conventional sense, without necessarily implying any fixed inter-relationships; and his painstaking accuracy of description was the outcome of an excessive honesty of purpose and desire for thoroughness, in which he was altogether exemplary. There never lived a man with a truer sense of honour.

Some ten years ago Sladen had a bad attack of influenza, followed at intervals by several similar visitations, which unfitted him for serious scientific work, but he always hoped to get better and to take it up again. The last winter was passed in Devonshire with very beneficial results, and he might be said to have been in his usual health when two months ago he started with his wife for Rome. But the wish to return to work was not to be fulfilled; after spending six weeks in Rome he journeyed to Florence, and there after a week of rather active sightseeing, on June 11, he was taken with a fainting fit, and though he quickly recovered consciousness and declared his intention of going to Como that very night, within half an hour he passed away by failure of the heart's action.

He was a Fellow of the Linnean, Zoological, and Geological Societies; for ten years Zoologic Secretary, and later a Vice-President of the former. In his secretarial capacity his genial nature found full sway, and his encouraging attitude to the younger men with whom he came in contact will ever be remembered. As a boy at school he was the captain wrestler. He was a good shot, though never a sportsman or member of a rifle corps, but he belonged to a private Guerilla Club in Yorkshire, of which he was sometime secretary.

In 1890 Sladen married Constance, elder daughter of the late Dr. W. C. Anderson, of York; and about two years ago he inherited from an uncle the estate of Northbrook, near Exeter, and there he has been laid to rest. It will be remembered that he recently gave the sum of 2000*l.* to insure the lives of the Yeomanry and Volunteers of his county going to the front in the Boer campaign; and this is but one among many of his generous acts, the majority of which are known only to the recipients. A loving husband, a trustworthy friend, whose advice was always sound, a keen sympathiser with suffering humanity, he has passed from us; but his memory and tender-loving influence for good will endure.

Among his scientific effects are a large library and some zoological collections of great value. Sladen had always a taste for old books, and one of his last expeditions was to a monastery at Subiaco, to examine some ninth century MSS. there preserved, and he had collected a goodly number of ancient MSS. and examples of early printing. His collection of Echinoderm literature is very complete; while, as to material, he leaves the collections of his friend, the late Herbert Carpenter, rich in Crinoids and other rare animal forms, which include, as a separate historic possession, the materials which formed the basis of the elder Carpenter's book on the microscope. These he purchased. There were also in his possession at the time of death a large series of Cretaceous Echinoderms, upon which he was contemplating a renewal of his Palæontographical Society's work; and the collection of Astrophiuroids of the *Albatross*, entrusted to his hands by Prof. A. Agassiz. There accompanied these a series of superb coloured drawings from the life, like those already published for the Holothuroidea of the expedition; and the very day of his death there reached him a letter from the same distinguished explorer, offering him the materials of his recent Australian cruise. It was Sladen's intention to have returned to these rich possessions; and we could desire no more fitting memorial to his work than that it might be possible to find and train a competent zoologist to continue that which he has left thus unfinished, on the lines on which he would have laboured, and to hand it down to posterity a completed record in his name. G. B. H.

JEREMIAH HORROCKS AND THE TRANSIT OF VENUS.

WE are indebted to the *Journal* of the Leeds Astronomical Society for 1899, which contains an interesting paper by Mr. A. Dodgson, on the life and work of the illustrious young astronomer, Jeremiah Horrocks. This worthy was born in 1619, 281 years ago, in the reign of James I., at Toxteth, three miles from Liverpool. He received his early education there, but on reaching the age of fourteen, he entered as "sizar" at Emmanuel College, Cambridge. At seventeen he was enabled to become tutor at Toxteth, and two years later, *i.e.* in his nineteenth year, he was appointed curate at Hoole, near Preston. Soon after this he made his memorable astronomical observation of Venus, and only two years later was dead. The life of the young man at Cambridge, as traced by Mr. Dodgson, was one of persistent industry. Imbued at an early age with a love of studying natural phenomena, he was hampered at the outset

by the absence of instruction in mathematics and the scarcity of books. This difficulty of getting philosophical and scientific works is clearly shown by the fact that of the thirty-two volumes he possessed later, not one was published in England or written by an Englishman. Lansberg's works he could not make agree with his own observations, and later, having obtained those of Kepler through the advice of his friend Crabtree, of Manchester, he found that even they needed many corrections. His first results in astronomical research were in elucidation of the lunar theory. Sir Isaac Newton confirms that he was the first to state the ellipticity of the moon's orbit; he also stated the causes of "evection" and "annual equation." The experiment of the circular pendulum for illustrating the action of a central force is also due to him. Most interesting, however, is his successful prediction of the transit of Venus in November, 1639. Kepler had stated that the two next transits would occur in 1631 and 1761, but Horrocks found, during his revision of the tables he had in use, that another would take place, the slight

errors in Kepler's tables probably accounting for his omitting it. Horrocks made all preparations for observing the phenomenon, arranging the image projected from his telescope (which had cost him half-a-crown) on a sheet of white paper having a circle six inches in diameter traced on it, the circumference being divided into degrees. He watched from sunrise to nine o'clock, and from ten until noon. Resuming his labour again shortly after three, he was overjoyed to find a round black spot just within the limb of the sun, at the internal contact. During some thirty minutes he was enabled to make many observations, which he considered very successful. Besides these definite scientific achievements, he wrote upon many different phenomena connected with the solar system, including the motions of Jupiter, Saturn, and various comets. The illustration on p. 257, reproduced from Mr. Dodgson's paper, shows Carr's house at Hoole, where Horrocks made his transit observation, and also the monumental tablet erected in 1826 to his memory in Hoole Church.

JUBILEE OF THE IMPERIAL GEOLOGICAL INSTITUTE OF VIENNA.

TO celebrate the fiftieth anniversary of the foundation of the Imperial Geological Institute of Vienna, a jubilee meeting was held on June 9 in the Great Hall of the Institute under the presidency of its present director, Hofrath Guido Stache. The meeting was attended by a number of high Government officials, geologists, and representatives of national industries and scientific associations.

The director having welcomed the guests, speeches of congratulation were delivered by his Excellency the Minister for Spiritual and Educational Affairs, Dr. W. Ritter von Hartel, his Excellency the Minister for Railways, Dr. H. Ritter von Wittek, and the Mayor of Vienna, Dr. C. Lueger. These were succeeded by the following representatives of scientific institutions and industries, who presented addresses: Geheimrath von Richthofen, conveying the good wishes of the Prussian Royal Academy of Sciences, the Gesellschaft für Erdkunde, and the German Geological Society; Prof. Dr. Beyschlag, for the Royal Prussian Geological Institution and the Berg Akademie of Berlin; Geheimrath Dr. Lepsius, for the Grand-ducal Institute of Hesse and the Upper Rhine Geological Society at Darmstadt; Prof. Dr. E. Naumann, for the Senckenberg Natural Science Society of Frankfurt a-M.; Sectionsrath Boeck, for the Hungarian Geological Institution and the Hungarian Geological Society; and Chief Geologist Pethö, for the Natural Science Association of Buda-Pesth.

Among Austrian representatives there were: Prof. E. Suess, as President of the Imperial Academy of Sciences; Prof. L. Szajnocha, for the Cracow Academy; Prof. Woldrich, for the Bohemian Francis Joseph Academy; Hofrath Steindachner, for the Court Museum of Natural History; his Excellency Field-Marshal Ritter von Steeb, as Commandant of the Military Geographical Institute; Rector Zeisel, for the Agricultural College; Hofrath Juraschek, for the Central Statistical Commission; Prof. Doelter, for the Steiermark Scientific Society; and Vice-President Straberger, for the Francisco-Carolineum at Linz.

The good wishes of the Lower Austrian Chamber of Commerce were presented by the President of the Northern Railway, Hofrath Jeitteles, and the congratulations of societies for the advancement of allied sciences were tendered by Custos Marenzeller, Freiherr von Poche, Hofrath Toula, Freiherr von Andrian, and Councillor Karrer. In conclusion, the Chairman read those parts of the Jubilee Report which referred to the advancement of the Institute by the Emperor and the Government.

Among the 264 messages of congratulation received the following are specially mentioned: from the Geological Survey of Great Britain and Ireland, the Geological Society and the Iron and Steel Institute in London, the Smithsonian Institution and the United States Coast and Geodetic Survey in Washington, the American Philosophical Society in Philadelphia, and the Cincinnati Society of Natural History. Also those of the Imperial Russian Academy of Sciences, the Russian Geological Committee, and the Imperial Russian Mineralogical Society at St. Petersburg; the Naturalists' Society of Moscow, the Royal Swedish Academies at Stockholm and Upsala, the Academia dei Lincei and the Ufficio Geologico in Rome, the Science Academies of Naples and Turin, the Belgian Geological Society, the Royal Academy of Amsterdam, and scientific associations and institutions at Hallé, Dresden, Leipzig, Breslau and Göttingen.

The Institute, or Geologische Reichsanstalt, was founded in 1849 by the then Minister of Mines and Agriculture, von Thinnfeld, with the object of working out the geology of the whole empire, collecting and arranging the material, and publishing the results in maps and memoirs. Haidinger was its first director, and his chief geologist was Freiherr von Hauer, who was appointed director on Haidinger's death in 1866. In those early days the position of the Institute was not by any means secure. In 1859 an attempt was made to abolish it as a separate institution and to incorporate it with the mathematical and natural science section of the Imperial Academy of Sciences. But the proposed change failed to obtain the approval of the Reichsrath.

Between 1867 and 1871, under von Hauer's direction, a geological map of the Austro-Hungarian Monarchy was published, to a scale of 1 in 576,000. Under the supervision of the present director, Hofrath G. Stache, the publication of a series of detail maps has been commenced. The publications of the Institute comprise the annual *Jahrbuch*, which has now reached its fiftieth volume, the *Verhandlungen*, and the *Abhandlungen*. The latter are in 4to, and up to the present they have an aggregate of 7000 pages and 950 lithographic plates. Besides, explanatory letterpress is issued with each section of the new detailed geological map drawn to a scale of 1 in 75,000.

A chemical laboratory is attached to the Institute, which undertakes geological and industrial analyses. This laboratory was suppressed for several years, owing, it is said, to the overshadowing influence of another laboratory connected with the Vienna Academy of Sciences (see Dr. Tietze's "Life of Franz von Hauer," Vienna, 1900).

The Institute possesses extensive geological and mineralogical collections, chiefly from Austrian and Hungarian districts. These are exhibited in twenty-one rooms, some of which are really halls of great architectural beauty. The library contains over 40,000 volumes.

The Reichsanstalt is under the supervision of the Minister for Spiritual and Educational Affairs. Its annual income is 18,000*l*. Its staff numbers twenty persons, twelve of whom are employed in the Geological Survey.

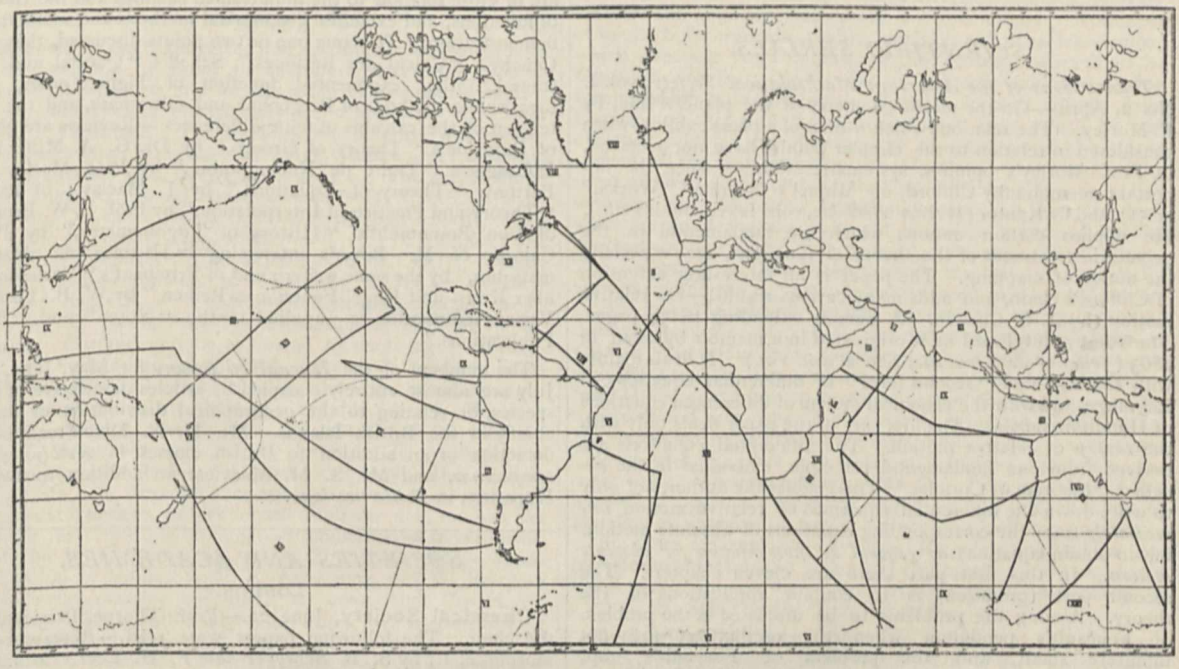
A PARTIAL EXPLANATION OF SOME OF THE PRINCIPAL OCEAN TIDES.

AT the meeting of the U.S. National Academy of Sciences on April 19, a paper bearing the above title was read by Mr. R. A. Harris, of the United States Coast and Geodetic Survey. An abstract summarising the chief results arrived at has been published by the Academy: the full memoir is to be issued as an Appendix to the Annual Report of the Survey for 1899-1900. The abstract is too short to allow of critical examination of the methods employed in these inquiries, but some of the conclusions stated are very significant and important.

Mr. Harris enunciates the fundamental proposition of his investigation in the following terms: "Considering the actual distribution of land and water, a few computations upon hypothetical cases will suffice to convince one that as a rule the ocean tides, as we know them, are so great that they can be produced only by successive actions of the tidal forces upon oscillating systems, each having, as free period, approximately the period of the forces, and each perfect enough to preserve the general character of its motion during several such periods were the forces to cease their action . . . having once for all constructed a set of force diagrams for the various latitudes, we have only to discover those regions which have a free period of oscillation about equal to the period of the forces, and to then ascertain at what time the particles should be at elongation in their nearly rectilinear paths."

The main idea underlying this proposition is not altogether new, the novelty in the present paper is rather an attempt to locate and define areas which seem to account for the principal ocean tides, due regard being had to the difficulties arising from irregularities in the natural boundaries of such areas where such exist, or from the absence of natural boundaries. Each *oscillating area* is one of comparatively simple form, of which

the free period of oscillation, supposing its boundaries all rigid, would not differ much from twelve lunar hours, and the forces are connected with the dominant ocean tides by applying to such an area, or to a system of such areas, the rule that "if to the particles of water in a given oscillating system, each area of uniform depth, and wherein the resistances are proportional to the velocities of the particles, a series of simple harmonic forces having for period the free period of the body of water be applied and a permanent state established, then must the time of elongation be simultaneous with the time when the virtual work of the external periodic forces upon the system becomes zero." Applying this rule, by means of the tidal-force diagrams the time can be found when "the aggregate of the elementary masses, each multiplied by the intensity of the tidal force in the direction of the displacement of the element, and again by a quantity proportional to the value of the maximum displacement (since the oscillation is harmonic), is zero": this is the time of high or low water. The results of this method appear at once in a few simple cases: thus in an east-and-west canal half a wave-length long it is high water at the east end at the component hour 0 or 12, the time meridian being understood to be the meridian of the middle point of the canal; in a meridional canal one wave-length long, whose centre lies



between 45° south and 45° north latitude, it is high water at both ends at the component hour 9; if the centre lies beyond these limits, the component hour of high water at the ends is 3.

Before laying down the oscillating areas, Mr. Harris gives a number of lemmas which have to be borne in mind as modifying the motions discussed. To quote one example: "Suppose a stationary oscillation to exist in a canal communicating with a tided sea; let the length of the canal lie between 0 and $\frac{1}{4}\lambda$, then at the time of high water outside it is high water throughout the canal (*e.g.* many Alaskan canals). If the length lie between $\frac{1}{4}\lambda$ and $\frac{3}{4}\lambda$, it is low water for a distance of $\frac{1}{4}\lambda$ from the head at the time it is high water outside (*e.g.* Irish Sea, node at Courtown; English Channel, node at Christchurch). If the length be equal, or nearly equal, to $\frac{1}{4}\lambda$, then the horizontal motion at the mouth, instead of the vertical motion, determines the time of tide within; this tide will be three hours later than the tide outside (*e.g.* the Gulf of Maine).

The systems supposed to account for the principal semi-daily movements of the oceans are outlined on the chart which we reproduce in a reduced form; the Roman numerals indicate the cotidal hours. The main systems are seven in number: (1) North Atlantic, (2) South Atlantic, (3) North Pacific, (4) South Pacific, (5) North Indian, (6) South Indian, (7) South Australian (solar).

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Applications are invited for the new Wykeham professorship of physics, referred to in a note on May 24 (p. 91). The election will take place in November, and applications must reach the Registrar not later than October 24. The following particulars are given in the *University Gazette*:—The subjects on which the professor will chiefly lecture and give instruction will be electricity and magnetism. The professor will have the charge of any laboratory which the University may assign to him. It is expected that rooms, now otherwise occupied, will be assigned to the professor for a laboratory in the course of the year 1901; 700*l.* will be appropriated to fitting up the laboratory, and provision has been made for spending 250*l.* a year for the first two years on assistance and maintenance. As soon as the professor is elected, he will be entitled to be admitted to a Fellowship at New College of the annual value of 200*l.* In addition, from January 1, 1901, he will receive from New College (1) an annual payment of 200*l.*; and (2) a further annual payment of 100*l.* so long as the College has funds available for the purpose. It is anticipated that this further payment will be paid for not less than twelve or thirteen years.

PROF. MCCALL ANDERSON, Professor of Clinical Medicine in the University of Glasgow, has been appointed to the chair of Systematic Medicine in the same University, in place of Sir W. Gairdner, resigned.

THE war in South Africa has raised many questions of great national importance which are fortunately receiving the attention of many thoughtful people. Prominent among these subjects of discussion is the urgent problem of how to obtain an improved supply of suitably educated officers, which was recently dealt with in a paper read by the Headmaster of Eton at the Royal United Service Institution. Dr. Warre maintains that a wider diffusion of the knowledge of the *elementa* of military science among the educated youth of the nation would tend, not only to raise the standard of military knowledge in the Army and Auxiliary Forces, but to improve the methods of communicating that knowledge to the rising generation, an indirectly widen the area from which a supply of well-educated officers may constantly be drawn. The great majority of the headmasters of our public schools agree with Dr. Warre, and he has drawn up, at the request of the War Office, a memorandum in which he advocates the need for a new Act of Parliament, the tenor of which should be "that all persons *in*

statu pupillari in public secondary schools above the age of fifteen, able and willing to bear arms, should be enrolled for the purpose of instruction in drill, manœuvre, and the use of arms." At the same time the paper makes it quite clear that the Headmaster of Eton thinks mere proficiency in drill is not sufficient—at every step the boy must be taught the reason of everything he is called upon to do, and throughout his training his intelligence must be carefully and steadily developed. Approaching the same question from another point of view, Prof. Armstrong, in a letter to the *Times*, maintains that no amount of mere military training given in schools, or subsequently, will ensure the necessary improvement in our officers, unless the intelligence of boys is more satisfactorily developed in the early years at schools—an end which can best be secured by an adequate training in the scientific method. It may fairly be surmised that the Headmaster of Eton is quite in agreement with Dr. Armstrong as to the paramount importance of early teaching, and that both are equally anxious that intelligent citizens should somehow be produced. Of the value of a familiarity with the methods of science it is here unnecessary to say anything, but it would certainly appear that both contentions are right. What is wanted is Dr. Warre's intelligent military training for public school boys who have all had the advantage of a training in the scientific method for which Dr. Armstrong pleads.

SCIENTIFIC SERIALS.

Transactions of the American Mathematical Society, vol. i. No. 2, April.—On the metric geometry of the plane *n*-line, by F. Morley. The relations which *n*-lines of a plane exhibit, when considered in relation to the circular points, have not received, in Prof. Morley's opinion, systematic attention since the important memoirs by Clifford, on Miquel's theorem ("Works," p. 51), and by Kantor (*Wiener Berichte*, vols. lxxvi. and lxxviii.). He applies certain notions which are fundamental in the geometric treatment of the theory of functions, and especially the notion of mapping. The paper is an interesting extension of Clifford's chain, and adds many curious results.—On relative motion, by A. S. Chessin. A memoir extending to 54 pages. The theory developed in it originated in a memoir by Bour in 1863 (*Journal de Liouville*, Ser. 2, vol. viii.). It deals mainly with the so-called "second form" of differential equations of Lagrange, and with the canonical system of differential equations of Hamilton-Jacobi. The first part of the paper deals only with the *theory* of relative motion. The differential equations are derived from one fundamental principle embodied in the so-called "theorem of Coriolis." This enables the author, not only to write down the differential equations of relative motion *immediately* from the corresponding equations of absolute motion, but to obtain equations *as general as those known for absolute motion*. In this first part there are eleven chapters. The second part (promised) is to contain applications of the theory. Among the problems to be discussed is the problem of Foucault's pendulum when the oscillations are not infinitely small, and the problem of Foucault's top, which Gilbert was unable to solve (sur l'application de la méthode de Lagrange à divers problèmes de mouvement relatif). The two problems, our author states, can be easily solved by the theory and formulas given in this first part.—Plane cubics and irrational covariant cubics, by H. S. White.—The paper considers cubics invariant under *partial* transformation by covariants (2, 2), and those invariant under *complete* transformation by covariants (3, 3). There remain for further treatment the two sets of conics invariant under the third transformation (2, 2), and invariant curves of order higher than the third (*cf.* the author's paper in No. 1). The new covariant cubics are eight in number, all of the type called equianharmonics.—A purely geometric representation of all points in the projective plane, by J. L. Coolidge. After some definitions, the writer gives a representation of all points in a real line by lines in a real plane, and then extends the representation so as to include all points in a real plane, noticing in particular those systems of lines which represent points on an imaginary line. He then takes up the subject of chains of points, showing their application to the general theory of projectivity. Finally, he glances briefly at the system of lines which represent points on a real conic, and concludes with remarks as to other possible solutions of the problem and its extension to three dimensions.—The decomposition of the general collineation of space into three skew reflections, by E. B. Wilson. The paper discusses the question, "Is it possible to decompose the general collineations of space into the product of a number of skew reflections; and if so, what is the least number of skew reflections involved in such a decomposition?"—A new method of determining the differential parameters and invariants of quadratic differential quantics, by H. Maschke, exhibits in a preliminary way a symbolic method in close analogy with the symbolism used in the algebraic theory of invariants, for the construction and investigation of invariants of quadratic differential quantics.—On the extension of Delaunay's method in the lunar theory to the general problem of planetary motion, by G. W. Hill, shows that the tediousness of Delaunay's method disappears when the greatest generality is given to the procedure.—Mr. J. E. Campbell writes on the types of linear partial differential equations of the second order in three independent variables which are unaltered by the transformations of a continuous group.

Bulletin of the American Mathematical Society, June.—Prof. Cole furnishes an account of the *Proceedings* at the New York April meeting of the Society, and abstracts several of the papers read; and Prof. Holgate performs a like office for the April meeting of the Chicago section of the Society.—J. G. Hagen gives a short sketch of the history of the extensions of the calculus. The abstract is confined to those theories that are in close relation to the infinitesimal calculus and the theory of functions, and excludes geometrical methods and methods of demonstration. To name one or two points discussed, they are Cauchy's "Calcul des Résidues," Schell's "Quotial and Instaural," the exponential function of higher order, the logarithmic methods of Bergbohm and Oltramare, and the extension of the calculus of finite differences.—Reviews are given of Burnside's "Theory of Groups," by Dr. G. A. Miller; of D'Ocagne's "Traité de Nomographie," by Prof. Morley; of Barton's "Theory of Equations," by J. Maclay; of Rice's "Theory and Practice of Interpolation," by Prof. E. W. Brown; of Von Braunmühl's "History of Trigonometry," by Prof. Cajori; of M. Boyer's interesting "Histoire du Mathématiques," by the same writer; and of Frischauf's "Vorlesungen über Kreis- und Kugel-Functionen-Reihen," by W. B. Ford.—Varied information is supplied in the "Notes" and "New Publications."

The numbers of the *Journal of Botany* for May, June, and July are almost entirely occupied by articles descriptive of new species, or relating to the geographical distribution of plants, chiefly in the British Islands. Mr. H. N. Dixon records the detection of an addition to British mosses in *Amblystegium compacium*, and Mr. S. M. Macvicar an addition to British Hepaticæ, in *Pellia neesiana*.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, June 21.—Prof. Thorpe, President, in the chair. The following papers were read.—Researches on morphine, I., by S. B. Schryver and F. H. Lees. Morphine readily exchanges an alcoholic hydroxyl group for halogen, yielding the bases chloromorphide, $C_{17}H_{18}O_2NCl$, and bromomorphide; when heated with water these substances give isomorphine, $C_{17}H_{19}O_3N$, and on reduction chloromorphine yields desoxymorphine hydrochloride $(C_{17}H_{19}O_2N,HCl)_2,3H_2O$. These four new bases are not narcotics.—On the oxime of mesoxamide and some allied compounds, by M. A. Whiteley. Nitrosyl chloride converts malonamide into the isonitroso-derivative, $CONH_2.C(NOH).CONH_2$; nitrous acid converts the latter into a pseudonitrole, $CONH_2.C(NO)(NO_2).CONH_2$, and hydriodic acid reduces it to aminomalonamide,

$$CONH_2.CH(NH_2).CONH_2.$$

—On dimethyldiacetylacetone, tetramethylpyrone and orcinol derivatives from diacetylacetone, by J. N. Collie and B. D. Steele. Disodiodimethylpyrone and methyl iodide react, giving dimethyldiacetylacetone, $C_7H_8O_3(CH_3)_2$, which is converted into tetramethylpyrone, $C_7H_6O_2(CH_3)_2$ by hydriodic acid; the residues from the preparation of dimethyldiacetylpyrone contain trimethylpyrone, $C_8H_{10}O_2$, and an orcinol derivative, $C_9H_{12}O_2$.—Dehydracetic acid, by J. N. Collie. The author has succeeded in preparing dehydracetic acid from triacetic lactone.—The decomposition of hydroxyamidosulphates by copper sulphate, by E. Divers and T.

Haga.—The degradation of glycollic aldehyde, by H. J. H. Fenton.—Notes on the chemistry of chlorophyll, by L. Marchlewski and C. A. Schunck.—A new series of pentamethylene derivatives, I., by W. H. Perkin, jun., J. F. Thorpe and C. Walker. Ethoxycaronic acid, $C(CH_3)_2\begin{cases}C(OC_2H_5)CO_2H\\CH.CO_2H\end{cases}$, is obtained by treating $\alpha\alpha'$-dibromo-$\beta\beta$-dimethylglutarate with alcoholic potash, and yields *asym*-dimethylsuccinic anhydride, $CMe_2.CO$ / $CH_2—CO$ >O, with sulphuric acid. Ethyl dibromodimethylglutarate and sodiomalonic ether condense, yielding the sodio-derivative, $CMe_2\begin{cases}C(CO_2Et).CNa.CO_2Et\\C(CO_2Et).CO\end{cases}$; numerous derivatives of this substance are described.—Experiments on the synthesis of camphoric acid. III. The action of sodium and methyl iodide on ethyl dimethylbutanetricarboxylate, by W. H. Perkin, jun., and J. F. Thorpe. Ethyl dimethylbutanetricarboxylate is converted by sodium and methyl iodide into a substance which possibly has the constitution

$$CMe_2\begin{cases}CMe(CO_2Et).CO\\CH_2(CO_2Et).CH_2\end{cases}$$

which should be easily converted into a substance having the constitution assigned by Bredt to camphoric acid; the ester is converted on reduction into an isomeride of camphanic acid.—The oxyphenoxy- and phenylenoxy-acetic acids, by W. Carter and W. T. Lawrence.—The condensation of ethyl α-bromoisobutyrate with ethyl malonates and ethyl cyanacetates; α-methyl α'-isobutylglutaric acid, by W. T. Lawrence. The author shows that the following general equations hold:—(1) $CNaRX.CO_2Et + CBrMe_2.CO_2Et = CRX(CO_2Et).CMe_2.CO_2Et + NaBr$, when the sodio-derivative is solid, and (2) $CNaRX.CO_2Et + CBrMe_2.CO_2Et = CRX(CO_2Et).CH_2.CHMe.CO_2Et + NaBr$, when the sodio-compound is dissolved; R = H or an alkyl group and X = .CN or $.CO_2Et$.—Methylisoamylsuccinic acid, II., by W. T. Lawrence.—The estimation of furfural, by W. Cormack. Furfural may be estimated by oxidising it to pyromucic acid by standard ammoniacal silver oxide solution, filtering off the reduced silver and titrating the silver left in solution.—The constitution of hydrogen cyanide, by J. Wade.—Inhibiting effect of etherification on substitution in phenols, by H. E. Armstrong and E. W. Lewis. The substitution of benzoyl, phenylsulphonyl, benzylsulphonyl, the radicle $C_{10}H_{15}O.SO_2$, of Reychler's camphorsulphonic acid, or picryl for phenolic hydrogen in phenolparasulphonic acid renders the substance inert towards bromine.—Bromination of oxyazo-compounds, by H. E Armstrong and P. C. C. Isherwood.—Metasulphonation of aniline, by H. E. Armstrong and W. Berry.—Phenylacetylchloramine and analogous compounds, by H. E. Armstrong.—Benzylanilinesulphonic acids, by I. Smedley.—Benzeneorthodisulphonic acid, by H. E. Armstrong and S. S. Napper.—An isomeride of furfurine, by J. P. Millington and H. Hibbert.—The mono- and di-acetyl and phenacetyl diethyl tartrates, by J. McCrae and T. S. Patterson.

July 5.—Prof. Thorpe, president, in the chair.—The Nilson Memorial Lecture was delivered by Prof. Otto Pettersson, of Stockholm.

Entomological Society, June 6.—Mr. G. H. Verrall, President, in the chair.—Mr. Hedworth Foulkes, B.Sc., and the Rev. H. C. Lang, M.D., were elected Fellows of the Society.—Mr. G. H. Verrall exhibited a species of the genus *Ceratitis*, MacLeay, apparently identical with Bigot's *C. frenicillatus* from the Gold Coast (West Africa), and a very handsome Trypetid reared from the fruit of *Mimusops caffra* by Mr. Claud Fuller at Durban, Natal.—Mr. C. O. Waterhouse exhibited specimens of a Hemipteron, *Aspongopus nepalensis*. They are much sought after by the natives, who use them for food pounded up and mixed with rice.—Mr. Merrifield exhibited a number of pupæ of *Aporia crataegi*, and called attention to the want of correspondence between the markings on the pupal and those on the imaginal wing. As might be expected of an insect whose larva pupates by preference on stems screened by foliage, its colour is not very greatly affected by its surroundings; on comparing some which had had yellow or orange surroundings with others which had had dark ones, it was shown that the former tended to yellow ground colour, and the latter to grey, having also an increase of the dark spots with which the thorax and abdomen are thickly strewn. He also exhibited some enlarged coloured photographs of the green and dark pupal forms of *Papilio machaon*, obtained by causing the larvæ to pupate on green, yellow or orange surfaces, and on dark ones respectively.—Sir G. F. Hampson exhibited specimens of *Oligostigma araealis*, from Ceylon, where his correspondent, Mr. J. Pole, had met with a swarm on an island in a river which he estimated at 20,000; when disturbed the buzz made by their wings was quite audible, and after three waves of the net 236 specimens were bottled from round its edges, the net still appearing quite full; as, in the some thirty specimens sent, the sexes were in almost even proportions, this was not a case of male assemblage. He also exhibited cleared wings, showing the neuration of *Diacrisia russula*, *Tyria jacobaeae*, *Callimorpha hera* and *C. dominula*, and contended that the genus *Callimorpha* should therefore be removed from the *Arctiadae* and placed in the *Hypsidae* where it is closely allied to *Nyctemara*, *Callarctia* and other genera as the fully developed proboscis, the non-pectinate antennæ, the smoother sealing, the more diurnal habit, and the larvæ being scantily clothed with hair all bore out the correctness of this association.—Dr. Chapman exhibited a portion of a stem of *Ferula communis* from Ile St. Marguerite, near Cannes, showing burrows and pupa cases of *Lozopera francillonana*. A number of vacant holes were also visible, being the exit of an ichneumon, which affects a large majority of the Tortrix, believed to be *Chelonus inanitus*, Nees.—Mr. F. Enock exhibited living specimens of male and female *Ranatra linearis*, Linn., from Epping, together with the peculiar forked eggs, which he had observed laid by the *Ranatra*, as it rested upon the upper surface of the leaf grasping the edges with its claws. The short anterior legs are held well up close together, in a line with the body, the head raised about an inch from the leaf, while the tip of the abdomen and ovipositor is pressed against the leaf—a downward and forward movement being given. The ovipositor is thus forced through the leaf, then partially withdrawn and the egg extruded and forced into the hole as far as the forked filaments, which prevent it from going right through the leaf.—Mr. H. K. Donisthorpe exhibited cases of *Clythra quadripunctata*, specimens of *Lomechusa strumosa*, with its host *Formica sanguinea*, sent by Father Wasmann from Holland, the insects mounted in the position assumed by the guest and host when the former is being fed by the latter. He also showed *Cossyphodes bewickii*, Woll., a beetle from Cape Colony, with the ants with which it is found—*Pheidola megacephala*, var. *punctulata*, Mayr.—Mr. C. J. Barrett exhibited two females of *Spilosoma mendica* reared by Mr. J. E. Robson, of Hartlepool, tinged with purplish-pink, and ordinary specimens of the same for contrast.—A paper was communicated on life-histories of the Hepialid group of Lepidoptera by Mr. Ambrose Quail, and a note on the habits and structure of *Acanthopsyche opacella*, H. Sch., by Dr. T. A. Chapman.

Zoological Society, June 19.—Prof. G. B. Howes, F.R.S., Vice-President, in the chair.—Dr. Walter Kidd read a paper on the significance of the hair-slope in certain mammals, in which reference was made to previous investigations into the hair-slope on the extensor surface of the human forearm, and its bearing upon Weissmann's doctrine of the non-inheritance of acquired characters. Details were given of further observations as to the hair-slope on the nasal and frontal regions of certain mammals. The ordinary type and the exceptional type of slope were described, and lists of animals conforming to the two types were given. These results were held to be opposed to the doctrines of Weissmann, and to be attributable to the habits of the animals in question.—Mr. F. E. Beddard, F.R.S., read a paper on the anatomy of *Bassaricyon alleni*, based on an examination of a specimen of this mammal which had recently died in the Society's gardens. The result arrived at was that this genus was clearly referable to the family Procyonidæ, as had been usually supposed, and allied, especially in external form, to *Cercoleptes*, but distinguished by well-marked characters.—Mr. W. F. Lanchester read the first part of a paper on a collection of crustaceans made at Singapore and Malacca by himself and Mr. F. P. Bedford. It contained a list of the Brachyura comprised in the collection, some notes on the nature of the collecting area, and on the habits of certain of the species, together with descriptions of twelve new forms.—A communication was read from Dr. Einar Lönnberg, of Upsala, on the structure and anatomy of the musk-ox (*Ovibos moschatus*). It

contained an account of the development of the horns, descriptions of the hoofs and skull, and a comparison between the skull of the musk-ox and that of the Takin (*Budorcas*).—A communication was read from Mr. A. L. Butler, containing the description of a supposed new species of mountain-antelope from the Malay Peninsula, for which the name *Nemorhoedus swettenhami* was proposed.—The Society then adjourned till November next.

Mathematical Society, June 14.—Lord Kelvin, G.C.V.O., President, in the chair.—Three foreign members being present, the chairman requested them to make communications to the Society. This they did. Prof. Klein spoke on the continuation of the edition of Gauss's collected works; Prof. Darboux, "Sur différents problèmes relatifs aux transformations de l'espace et aux déformations finis de la matière et sur leurs rapports avec la théorie des systèmes triples orthogonaux"; and Prof. Poincaré, "Sur quelques théorèmes relatifs à l'analysis situs et sur les propriétés des polyèdres dans l'espace à plus de trois dimensions."—Votes of thanks were passed to them by acclamation.—Prof. Stringham also made a few remarks on a proof by non-Euclidian geometry of the form and directrix property of a plane section of a cone.—Prof. Elliott, F.R.S., communicated some notes on the concomitants of binary quantics.—Lord Kelvin read the titles of the following papers which had been received: Some multiform solutions of the partial differential equations of physical mathematics and their applications, Pt. ii., by H. S. Carslaw; Some quadrature formulæ, by W. F. Sheppard; Extensions of the Riemann-Roch theorem in plane geometry, by Dr. Macaulay; On the invariants of a certain differential expression connected with the theory of geodesics, by J. E. Campbell; On the transitive groups of degree n and class $n-1$, by Prof. Burnside, F.R.S.; The invariant syzygies of lowest order for any number of quartics, by A. Young; Canonical reduction of bilinear forms, Pt. ii., by T. J. Bromwich; The energy function of a continuous medium, by H. M. Macdonald; Note on the representation of a circle by a linear equation, by J. Griffiths.

Geological Society, June 20.—J. J. H. Teall, F.R.S., President, in the chair.—On the skeleton of a Theriodont reptile from the Baviaans River (Cape Colony), by Prof. H. G. Seeley, F.R.S. The fossil described in this paper was discovered by Mr. W. Pringle at Ealdon, in the bed of the Baviaans River, a tributary of the Great Fish River. It is now preserved in the Albany Museum. The slab containing it is of hard siliceous sandstone, and is 31 inches long by 10 inches wide. It is split so as to expose a portion of the skull, the vertebral column and ribs as far as the pelvis, the scapula, part of the humerus, the femur, and parts of the tibia and fibula. The tail and left hind-limb, and apparently part of the right fore-limb, are lost, owing to the jointed condition of the rock. The bones have decomposed, and are represented by natural moulds from which a beautiful cast was obtained by means of a jelly mould in the Geological Department of the Natural History Museum, before the specimen was returned to Grahamstown. The remains indicate an animal about 2 feet long, exclusive of the tail, and standing probably about 8 inches high; it was not more than 6 inches wide in the fore part of the body. The animal was of great mobility, capable of easily bending the body, and, by straightening the limbs, of occasionally raising its height to 10 inches or more. It is a new type of Theriodont reptile, contributing important facts to the osteology of the group, and especially in regard to the natural association of the bones. It is possibly to be included in the Cynodontia, from which it differs in characters of the ilium, scapula, and skull.—Fossils in the Oxford University Museum (IV.): notes on some undescribed trilobites, by H. H. Thomas. Two new species of *Dalmania* from the Wenlock Shales and one of *Olenus* from the Shineton Shales of Shropshire are described in this paper. The specimens on which the first species of *Dalmania* is founded were collected by the late Dr. Grindrod at Malvern Tunnel. The species has a strong resemblance to certain varieties of *D. caudatus*, especially those more nearly approaching *D. longicaudatus*; its nearest ally seems to be *D. nexilis*. Among its characters are spines round the head, the height of the head-shield, and the distance between the eyes. The type-specimen of the second species came from the Wenlock Shale of Builth. The Shineton specimen was presented to the Oxford Museum by the Right Rev. Bishop Mitchinson.—On radiolaria from the Upper Chalk at Coulsdon (Surrey), by W. Murton Holmes. The radiolaria described in this paper were contained in the cavities of two small flints which were thrown out of the new cutting between Coulsdon Station and the new Merstham Tunnel on the L. B. & S. C. Railway. They were probably derived from the zone of *Holaster planus*. After treatment with hydrochloric acid, the material yielded silicified casts of foraminifera as well as radiolaria. The surface of the radiolaria is so much altered by corrosion that specific identification is in most cases impossible. Twenty genera have been recognised, and the organisms appear to belong to forty-one species of these genera. A list of the radiolaria is given, accompanied by a short description of each form, and four new species are described. The Discoidea appear to have the predominance, and the species of *Dictyomitra* come next in numerical order.—The Society then adjourned until Wednesday, November 7.

Linnean Society, June 21.—Dr. A. Günther, F.R.S., Vice-President, in the chair.—Prof. M. Hartog exhibited and made remarks on flowers of new *Abutilon*-seedlings, recently raised by him, and pointed out the extreme variability shown in the form of many of the leaves.—Dr. O. Stapf exhibited fruits of various forms of *Trapa* from Europe, China and India, and discussed the differentiation of the genus into species.—Mr. Clement Reid, F.R.S., exhibited a series of plum-stones recently found in a drain of the Roman baths, and in a rubbish pit, at Silchester. The species identified were Cherry (*Prunus avium*), Damson (*P. domestica*), Bullace (*P. insititia*), Sloe (*P. spinosa*), and Portuguese Laurel (*P. Lauro-cerasus*). Besides these, there was a large variety of Plum, and a very small Sloe, the species of which had not as yet been precisely determined.—On behalf of Dr. O. St. Brody, Mr. B. Daydon Jackson exhibited a small series of British orchids dried by a new process, by which the flexibility of the plant and the natural colours were in a great measure retained.—Mr R. Morton Middleton exhibited several rush baskets, plaited ropes and dredgers made from *Rostkovia grandiflora*, Hook. f.; and a crab-catcher and limpet-detacher made from *Berberis ilicifolia*, Forster, all used by the Yahgans south of Beagle Channel, Tierra del Fuego.—Mr. F. Enock exhibited and made remarks upon some living specimens of *Ranatra linearis*, Linn., together with their curious eggs.—A paper by Miss Georgina Sweet, Melbourne, was read, "On the Structure of the Spermiducal Glands and associated parts in Australian Earthworms."—Dr. Charles Chilton read a paper on the subterranean Amphipoda of the British Islands, reviewing the known species of the genus *Gammarus*, and giving some account of the "Well-Shrimp" and its distribution in England so far as he had been able to determine it from specimens collected.—Dr. A. B. Rendle, referring to his recently published "Revision of the genus *Najas*" (*Trans.* Linn. Soc. 2nd Ser., Bot. vol. v. Part 12), read a supplementary paper on the same subject, in which he gave additional information gained from a recent examination of specimens in eleven Continental herbaria, particularly those at Paris, Geneva, Vienna and Berlin.—The Society then adjourned until Thursday, November 1.

DUBLIN.

Royal Dublin Society, May 16.—The Earl of Rosse, F.R.S., in the chair.—Mr. R. J. Moss read a paper on the adhesive and other physical properties of copper preparations used in potato spraying.—Dr. W. E. Adeney read a paper, entitled "Studies in the analysis of fresh and salt waters."

June 20.—Sir Howard Grubb, F.R.S., in the chair.—Mr. J. A. Cunningham read a paper, entitled "A contribution to the theory of the order of crystallisation of the minerals in igneous rocks." The author discussed the theory recently published by Dr. J. Joly, F.R.S. (*Sci. Proc. Roy. Dubl. Soc.* vol. ix. part 3, No. 20, p. 298), and then gave additional facts in support of Bunsen's theory, that the order of melting points of the minerals may be inverted by pressure. Mr. Cunningham showed a rough method of arriving at the relative latent heats of the minerals by means of their fusibilities; and proceeded to show how the latent heats might be determined by simple chemical measurements. As an example, in the case of quartz, the specific heats of quartz and amorphous silica are already known, and by measuring the difference of the heats of solution of the two substances in HF, the disengagement of heat in passing from the one form of SiO_2 to the other at any temperature is known. Thus, assuming 1425° C. as the melting point of quartz, the number 135·3 was arrived at as a safe minimum for the latent heat of quartz.—Prof. J. Joly, F.R.S., communicated a

paper on the order of crystallisation of silicates in igneous rocks. Referring to a previous communication, the author has extended the observations of the viscous yield of quartz fibres to a temperature of 735° C. Dealing with finely powdered rock-crystal, it is found that this when wrapped in strong platinum foil and exposed for twenty-four hours in a Bunsen flame, shows unmistakable evidence of softening. The powder is loosely caked, and although the great mass is apparently optically unaltered, the particles which have been pressed against the platinum have adhered and melted into blebs, which cannot be removed by friction. Their examination is effected by a vertical illuminator and high power. Finely powdered quartz placed in the meldometer and exposed for four hours to a temperature between 1085° C. and 1070° shows similar evidence of fusion. Finely powdered olivine, augite, hornblende and quartz exposed in the meldometer for two and a half hours to a temperature between 1105° C. and 1080° reveal, on subsequent examination, that the evidence of fusion was conspicuously more apparent in the case of quartz. The experiments were repeated in an atmosphere of CO_2, as coloration changes thought to be due to oxidation appear on heating in the case of hornblende and olivine. In CO_2 these changes still appear in less degree. Results otherwise the same as before. The author urges that these results support his view that the softening temperature of the silicates will not be found discordant with the observed normal order of solidification in igneous rocks, but will be found to harmonise with Rosenbusch's law, the depression of the softening point in the scale of temperature being influenced by the amount of silica in combination. On the legitimacy of recent attempts to apply the thermodynamic expression connecting dp/dt with change of volume in reversible systems, the author points out that calculations based on the change of volume of a crystallised silicate to its glass must give erroneous results, and possibly widely erroneous results, seeing that the glass has never existed in the magma at any time, but the crystal was built up from the molecules diffused in the magma. The withdrawal of the molecules from solution may probably have given rise to a volume-change which cannot be ignored.—Mr. S. R. Bennett read a paper containing the results of actinometric observations of the solar eclipse. By exposing an actinometer at intervals of a few minutes throughout the afternoon of the solar eclipse of May 28, it was found that the actinic power of the sun's rays declined rapidly from 2h. 13m. to 3h. 40m. and then increased more rapidiy till 4h. 27m. After this there was a regular decrease due to the approach of evening. The exposure at 2h. 13m. was 50s., at 3h. 40m. it was 101s., and 86s. at 4h. 27m. Curves were plotted to represent these results as well as the corresponding ones deducible from theoretical considerations. The curves representing the eclipse effect as found from observation and from theory (on the assumption that the amount of light received from the sun is proportional to the area of his disc exposed) did not agree. That found from observation indicated a greater amount of light received, in the ratio of 2·3 to 1·6 at 3h. 22m., the moment of greatest phase. No satisfactory explanation of this incongruity was given.—Mr. Charles Martin read a paper on heat-radiation observations made at Dunsink Observatory during the eclipse of May 28.

EDINBURGH.

Royal Society, June 18.—Dr. Burgess in the chair.—Prof. Copeland and Mr. Thomas Heath gave descriptions of the preliminary work, the installation of instruments, and the general character of the observations made by them at the recent eclipse. Mr. Heath's communication gave a particular account of the various operations undertaken in connection with the 6-inch Cooke triple object-glass. This object-glass was constructed so as to bring to one focus both the visual and photographic rays. Tested by the most severe tests the instrument was perfectly achromatic. Four photographs of the corona were taken during totality on plates 8½ by 6½ inches. Prof. Copeland manipulated the 40-foot telescope which has already done duty on previous occasions. Mr. Frankland Adams had charge of cameras for taking long exposure photographs, and in the working of these had the valuable assistance of officers of H.M.S. *Theseus*. The navigating officer supplied them with time signals; and by means of beautiful maps, for which they were indebted to the courtesy of the director of the Madrid Observatory, they were able to determine with great ease and accuracy the latitude and longitude of their station near Santa Pola. The Spanish authorities did everything possible to facilitate their operations; and the members of the expedition experienced nothing but kindness at the hands of the people of the town. Photographs began to be taken 16 seconds before totality, and were continued for 60 seconds after totality. The first contact was observed by Prof. Copeland 10·2 seconds sooner than the time expected, there being a projecting mountain ridge on the limb of the moon which first moved across the sun's edge. The shadow bands which occur just before and just after totality were observed by some of the men of the *Theseus* on a vertical wall which had previously been coated with plaster of Paris.—Dr. Buchan and Mr. Omond reported to the Society the nature of the publication of the Ben Nevis observations. For the satisfactory development of meteorological science it was necessary to publish the continuous daily records, and not merely monthly or weekly means. This was now being done with the Ben Nevis observations, both high-level and low-level; and when the work was completed the meteorologist would be in a position to discuss many problems of the greatest interest and importance. It would require three volumes of the Society's *Transactions* to complete the publication of the observations on the scale that had been determined upon. To meet the expense of publication, the Royal Society of London had voted 500*l.*, and an equal grant had been voted by the Royal Society of Edinburgh.

July 2.—Sir Arthur Mitchell, Vice-President, in the chair.—In a paper on the craniology of the people of India, Part ii, Sir William Turner, F.R.S., described the skulls of the aboriginal hill tribes from the Central Provinces, Chiita, Nagpur, and Orissa. Most of the specimens were in the Indian Museum, Calcutta, but others were in the Anatomical Museum of the University of Edinburgh. They belonged to the so-called Kolarian and Dravidian groups of people. From a comparison of skulls the conclusion was drawn which supported the view advocated by Mr. H. H. Risley from the examination of living persons, that these groups did not differ from each other in physical characters, and that they formed a Dravidian type. A comparison was also made of the Dravidian type of skull with the Australians and the Negritos of the Andaman Islands. Skulls of the Uriya speaking people of Orissa were also described, and the presence of dolichocephalic and brachycephalic types, with skulls of intermediate or mesaticephalic proportions, was shown to occur amongst them.—Sir John Murray and Mr. F. P. Pullar communicated the second part of their bathymetrical survey of the fresh-water lochs of Scotland, in which they dealt with Lochs Chon, Ard, Monteith, and Leven of the Forth drainage area, and with Lochs Ericht and Garry in the Tay basin. These lochs differ greatly in elevation, the extremes being: Monteith, 55 feet above the sea; Ericht, 1152 feet above the sea-level. Their areas vary from 277 acres (Chon) to 4690 acres (Ericht). In this most elevated of the larger lochs of Scotland there are two depressions in which the depth exceeds 300 feet, the maximum depth recorded being 512 feet. The deposits in the deeper parts of all the six lochs consist of a dark brown mud containing much organic matter, but in some there is a second layer, three to six inches beneath the upper layer, of a light brown colour and greater consistency, containing less organic matter. Numerous examples were given of the effect of the wind in driving the warmer surface waters towards the leeward end or side of a loch and in drawing up the colder and deeper layers towards the windward end or side. The shallow lochs were warmer in spring and summer than the deeper lochs, and contained more pelagic life. In these discussions it was important to bear in mind the fundamental difference between temperature and amount of heat. It was calculated that the larger lochs with their much smaller change in temperature really stored up more heat than the smaller lochs with their greater change in temperature.—A note by Dr. R. Sydney Marsden was read, drawing attention to a paper he had read in 1880 (see *Proc.* R.S.E., 1881), which contained an account of his method for the artificial preparation of diamonds. M. Henri Moissan, of Paris, described in 1893 a method for the preparation of adamantine carbon which differed from Dr. Marsden's method in details which did not seem to be essential. The note was a claim for priority in a matter in which the later experimenter was now getting all the credit in the eyes of the scientific world.

PARIS.

Academy of Sciences, July 2.—M. Maurice Lévy in the chair.—Communication from M. Darboux concerning the International Association of Academies (p. 249).—Permanent but unequal heating by radiation of a wall of indefinite thickness reduced to the case of an analogous heating by contact, by M. J. Boussinesq.—The combustible gases of the atmosphere; the air of woods and of mountains, by M. Armand Gautier. Following up the experiments, previously described, made with the air of Paris, air was examined in the middle of a pine wood, and on the summit of a mountain away from all vegetation. The ratios of carbon to hydrogen found in the three cases were 3·5 for Paris, 2·2 in the air of woods, and 0·33 in the mountain air, the quantities of hydrocarbons per 100 litres of air expressed as methane being 22·6 c.c., 11·3 c.c., and 2·2 c.c. respectively. It was also found that air taken at a high altitude, collected in a place denuded as far as possible of animals, plants and humus, is nearly entirely free from hydrocarbons, but still contains about 2/10,000,000ths of its volume of free hydrogen.—Synthesis of αα-dimethyl-γ-cyanotricarballylic ester and of the corresponding acid, by MM. A. Haller and G. Blanc. Cyanosuccinic ethyl ester is heated with sodium ethylate and α-bromoisobutyric acid, and the resulting ester separated in the usual way.—M. Zambaco was elected a correspondent for the Section of Medicine and Surgery.—Occultation of Saturn of June 13 observed with the Brunner equatorial at the Observatory of Lyons, by M. J. Guillaume.—On a prerogative of the Gregorian Calendar, by M. Joseph Lais.—On the method of Neumann and the problem of Dirichlet, by M. A. Korn.—On the motion of a wire in space, by M. G. Floquet.—On the propagation of condensed waves in hot gases, by M. H. Le Chatelier.—On the decomposition of harmonics by the ear, by M. F. Larroque.—On the thermo-electricity of some alloys, by M. Emile Steinmann. Nickel steel containing 28 per cent. of nickel gave an electromotive force against lead of 385 microvolts between 20° and 260° C.—On the true atomic weights of ten elements deduced from recent works, by M. G. Hinrichs. By applying the method previously described by the author to some recent determinations of atomic weights, the latter are made to appear as whole numbers exactly.—Attempt at a general theory of acidity, by M. de Forcrand. The theory put forward allows of the prediction of the acidity of a compound containing hydrogen replaceable by a metal when the formula of constitution is known; and also of the heat of fusion when this cannot be determined directly.—Addition of hydrogen to acetylene and ethylene in presence of finely divided platinum, by MM. Paul Sabatier and J. B. Senderens. A mixture of hydrogen and acetylene, the former being in excess, when passed over platinum black reacts vigorously, ethane together with a little ethylene being produced, the secondary products noticeable with nickel being practically absent. With acetylene in excess, ethylene is the chief product, although ethane is still produced in notable quantities. Working at 180° instead of at ordinary temperatures the reaction becomes more vigorous, but the quantity of secondary condensation products increases.—On the methoxy-hydratropic acid obtained by the oxidation of anethol. Identity of phloretic acid and of hydropara-coumaric acid, by M. J. Bougault.—Method for preparing synthetically higher homologues of acetolacetic ester and acetylacetone, by M. L. Bouveault. By the interaction of acetoacetic ether and the fatty acid chlorides, the β-ketonic ethers and β-diketones are easily obtained.—On the mode of formation of the compounds $\{C_2H_2.(Cu_2Cl_2).KCl$ and $C_2H_2[(Cu_2Cl_2)_2KCl.]$, by M. Chavastelon.—On the metallic compounds of diazoamido-benzene, by M. Louis Meunier.—Action of nitric acid upon trichlor-guaiacol, by M. H. Cousin. The action of nitric acid upon the trichlor-derivative is quite different from that of the tetrachlor- and tetrabromo-derivatives as instead of the orthoquinones produced in the latter case, a complicated condensation product is produced.—On the aloins, by M. E. Léger.—Solubility of cupric chloride in organic solvents, by M. Œschner de Coninck.—On the composition of the albumin of the seed of *Gleditschia triacanthos*, by M. Maurice Goret. The reserve hydrocarbon in this case is a mannogalactane; hydrolysis yielding only a mixture of mannose and galactose.—Hermaphroditism and parthenogenesis in the Echinoderms, by M. C. Figuer.—Study of the digestive apparatus of *Brachytrupes achatinus*, by M. L. Bordas.—Prehnite considered as a constitutive element of metamorphic limestones, by M. A. Lacroix.—On the combinations of the nucleins with metallic compounds, alkaloids and toxins, by M. H. Stassano.—The power of selective coloration by methylene blue, possessed by living spore-bearing filaments of *Spirobacillus gigas*, by M. A. Certes.—A preventive remedy against the mannite disease of vines, by M. P. Carles.

CAPE TOWN.

South African Philosophical Society, June 6.—L. Péringuey, President, in the chair.—Mr. W. L. Sclater exhibited a series of photographs of birds and their nests taken by Mr. R. H. Ivy, in the neighbourhood of Grahamstown.—Dr. J. D. F. Gilchrist exhibited:—(1) A Gadoid fish, belonging to the genus *Haloporphyrus* and probably a new species, found by the Government steamer in trawling about 40 miles off Cape Town, in over 100 fathoms. (2) Four fishes showing luminous organs, viz.: a *Monocentris* from shallow water, Mossel Bay; an *Argyropelecus*, a *Paraliparis* and a *Scopelus* from over 100 fathoms off the Cape Peninsula, probably all new species. (3) A number of new Alcyonarians which have been procured by the Government steamer and described by Prof. Hickson, F.R.S. These included the new genus, *Acrophytum claviger*, and three new species—*Heteroxeina capensis*, *Sarcophytum trochiforme*, *Gorgonia capensis*. (4) Specimens of *Veritillum* illustrating the difference in size of the fauna of the east and west coasts of Africa, the eastern forms being larger than those from the west coast. (5) A specimen of *Agriopus torvus*. (6) A new species of Anchovy from East London, this being the second species of the genus *Engraulis* discovered in South African waters.—Dr. F. Purcell exhibited specimens of all the known South African species of Peripatus, including, in addition to the three previously described forms, four others recently described by himself in the annals of the museum, making seven in all. Dr. Purcell in his remarks on the genus maintained that the supposed great antiquity of Peripatus was very doubtful, depending as it did on the supposition that the tracheæ of the tracheate Arthropods could only have originated once, for it is now known that true tracheæ have originated independently in at least three different ways, for instance, in two ways in spiders and in a third way in insects. It would be reasonable to suppose, therefore, that Peripatus may also have acquired its tracheæ independently of those of the insects.

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