THURSDAY, APRIL 16, 1885

A SCIENTIFIC UNIVERSITY

ENGLAND is but just beginning to feel the wave of progress in the question of University organisation that has been sweeping over the rest of the world. University reform as understood in England means a rather fitful movement from within to lift the teaching and methods of the older Universities a little out of the mediævalism that has been settling down upon them. The true University reform has meantime been going on outside in the spread of scientific teaching far away from the quiet collegiate quadrangles, in the establishment of new Universities and University Colleges in the centres of provincial life. It is very hard to make an Englishman believe that there is any subject in which he is not leading the progress of the world. Yet let him look at Germany, at France, at America, and consider what is being done abroad, before he passes his complacent comment on the feeble reforms at home. Let him look at the City of Berlin with its 1,123,000 inhabitants, its teaching University with 6000 students; and then turn to the City of London with its 4,000,000 inhabitants, without a teaching University at all, and having some 2000 students in all under training at its two best educational establishments. The contrast does not stop here, as any person acquainted with the University systems of Europe knows only too well. The fact is that England is wofully behind the rest of the world in the organisation of the higher scientific education. Its Government is absolutely indifferent to the most crying needs in this direction. What does the British Government do for the higher scientific teaching, or for the promotion of the reorganisation of our existing Universities on the modern scientific basis? An annual grant of a few thousands to the South Kensington Normal School, a subsidy of about 25,000*l.* a year to the Scottish Universities, and one of about 12,500*l.* a year to the Welsh University Colleges, whereof perhaps one-half goes to the promotion of science, represent the net result. True a Government some fifty years ago founded the Examining Board, miscalled the University of London, and another Government, some fifteen years ago, gave 90,000*l.* to help the University of Glasgow to complete its buildings. But for the University movement throughout England, such as it is to-day, England owes nothing to one single statesman or Government; it is due to individual and local effort, aided it is true, but on the most minute scale, by the action of one or two of the more liberal corporate bodies. It is well, then, that Englishmen should have the opportunity of reading, as they may do in the present number of NATURE, what has been done in a single small province of Europe, in a city of only 104,000 inhabitants, in the equipment of a great University on modern lines. The completeness of the equipment, and the magnificence of the buildings of the new University of Strasburg are truly startling. It is to the divine right of learning knowledge, not to the divine right of ruling wrong that these modern palaces are erected. The *Zeit Geist* has indeed wrought revenges in the honour thus rendered to science and to philosophy, to literature and to art. Imperial Germany unites with her own province of Alsace-Lorraine to bestow 640,000*l.* upon the new University buildings, and to increase its existing endowments by a sum of 42,000*l.* per annum. Nor is this a solitary fact. During the last nine years France has spent nearly 1,000,000*l.* per annum on increasing and reorganising her University institutions. What has England to show against this? The Imperial Government has with the exception of the little Scotch and Welsh grants named above, done literally nothing. All else that has been done has been done mainly by a few individuals with great difficulty, on a very limited scale, in the teeth of all sorts of unintelligent opposition. Oxford Convocation consents, amid fierce debate, to spend 10,000*l.* on a physiological laboratory. Strasburg, in the meantime, has quietly spent 13,500*l.* for the same purpose; and this (Fig. 15, p. 561) is the smallest of the splendid group of institutes and laboratories in the new University. The Corporation of Nottingham—the only Corporation that has shown public spirit in this direction—has spent some 70,000*l.* upon an institution which includes a Natural History Museum *and* a Public Library, *and* a University College. Nottingham, has a population of 186,000 souls. At Strasburg, with a population of 104,000, a sum equal to this has been spent on institutes of chemistry and anatomy alone (Figs. 5 and 9, pp. 559-60), and nine times as much on the rest of the University buildings and fittings. The Corporation of Liverpool very generously contrived to accommodate its new University College in a disused lunatic asylum. But the whole of the buildings of Liverpool University College would go twice over into the Strasburg Institute of Chemistry (Fig. 5, p. 559). At Cardiff, the Town Council, after an attempt to thrust its University College into a still less suitable site, agreed to rent to it an old infirmary for its various scientific laboratories and lecture-rooms; but the Strasburg University possesses twelve buildings, every one of which is as large as the Cardiff building, and infinitely better adapted to the purpose. Owens College, the Mason College, the Firth College, owe nothing to corporate help: they are sustained by private benefactions. The Yorkshire College is also innocent of any municipal support. At Bristol, with a population of about 200,000 souls—nearly double Strasburg—funds privately subscribed to about 11,000*l.* have resulted in a ragged fragment of ill-assorted rooms to accommodate the local University College; the entire buildings for literature, science, and medicine being less than half the size of the Institute of Physics (Fig. 6, p. 559) at Strasburg. Lastly, the city of Newcastle-on-Tyne, with a population of 150,000, relegates its Science College to the cellars of a Mining Institution, where it is effectually buried from public notice. There is nothing at Strasburg comparable to this.

Englishmen will awake some day to the astounding neglect and apathy that have prevailed and still prevail; and then perhaps some statesman will think it worth his while to turn from endless party squabbles to useful national work. To reorganise the higher education of this country on a scale commensurate with that of other European countries, and o co-ordinate it with the rest of our educational system, and to equip it with buildings and appliances adequate o the needs of the time would be a task of truly national importance, and one which must sooner or later be undertaken. It is a task befitting the ambition of an enlightened statesman. The Minister who shall succeed in the task will leave behind him in the memories of the nation a monument more enduring than marble.

TIMBUKTU

Timbuktu: Reise durch Marokko, die Sahara und den Sudan. Von Dr. Oskar Lenz. 2 vols. (Leipzig, 1884.)

As we have already intimated, Dr. Lenz is about to set out on a new expedition, the purpose of which is to explore the unknown region lying between the upper waters of the Nile and the northern bend of the Congo. The reputation of a scientific explorer already earned by Dr. Lenz through his researches in the Ogoway basin will be much enhanced by the present work, embodying the results of a very successful expedition to North-West Africa, undertaken in the years 1879-80 on behalf of the German African Society. His original commission was restricted to a visit to Marokko, chiefly with a view to a more thorough survey of the Atlas highlands than had hitherto been effected by recent travellers in that still little known region. But the sanction of the Society was easily obtained to extend the field of his operations, so as, if possible, to embrace the still less known section of the Sahara lying between Marokko and the Niger. Timbuktu, the southern terminus of the caravan routes across this part of the desert, thus became the main goal of the expedition. The famous "Queen of the Wilderness" had been reached during the present century only by three European travellers—Major Laing in 1826, René Caillé in 1828, and Barth in 1853. To these illustrious names must now be added that of Oskar Lenz, who not only entered the place on July 1, 1880, mainly by a new route from the north, but also for the first time made his way thence westwards through the Fulah and Negro States of Moássina (Massina) and Bambara down the Senegal river to the Atlantic coast at St. Louis, capital of the French possessions in Senegambia. Hence the most important result of the journey has been to show that Timbuktu, hitherto regarded as practically inaccessible to Europeans, may be reached both through Marokko from the north and through the Senegal basin from the west.

It will be thus seen that the expedition naturally comprises two distinct sections—Marokko and the Atlas ranges as far as the Draa basin, which are exhaustively dealt with in the first volume; the western Sahara and Sudan described in the second volume, which moreover contains some valuable supplementary matter on the French settlements in Senegambia and on the physical constitution of the Sahara, besides an extremely interesting account of the present political and social relations in Timbuktu. Dr. Lenz travelled with a very small suite, limited to his interpreters, Haj Ali Butaleb and Christobal Benitez, and his trusty Marokkan attendant Kaddur. But, thanks partly to a letter of recommendation from Muley Hassan, Sultan of Marokko, partly to the character which he assumed of a Mussulman physician, he managed to pass without much serious risk through the turbulent and fanatical Arab, Berber, Fulah, and Negro tribes encountered along the route. Hence his conclusion, shared in by some other experienced explorers, that single travellers hampered by a minimum of impedimenta are likely to prove more successful in Africa than elaborately equipped expeditions, at least where the object is mere geographical discovery rather than extensive biological and ethnographic collections.

From the observations made at various points in recent times it has become more and more evident that the Sahara can no longer be regarded as having been a marine basin at least since the early Tertiary epoch. The theory may be said to have received its *coup de grâce* from Dr. Lenz, who plainly shows that the whole of the western section traversed by him is not a depression, as has been assumed, but an irregular plateau standing in the north at a mean elevation of from 800 to 1000 feet, and even at Taudeni, its lowest level, still maintaining an altitude of 400 or 500 feet above the Atlantic. The surface is varied with stony and sandy tracts, the so-called "areg" or "igidi," which have nothing in common with marine sedimentary deposits, but have, in fact, been produced by the weathering of sandstone, quartz, and carboniferous limestones, which appear to be the prevailing formations. It is thus evident that this part of the desert has been dry land for vast ages, and the same conclusion must be inferred from the numerous dried-up watercourses, whose deep channels are distinctly the effect of erosion. These wadies, many of which seem to have been flooded within the last few thousand years, radiate from the central highlands north and north-east to the Mediterranean, east to the Nile, south to the Tsad and Niger, west to the Atlantic. Hence down to comparatively recent times the Sahara was a well-watered and wooded region thickly inhabited by agricultural and pastoral communities, themselves the descendants or successors of still more primitive peoples, the contemporaries of Palæolithic and Neolithic man in other parts of the globe. In the Taudeni district, about 20° N., under the meridian of Timbuktu, Dr. Lenz discovered some implements of hard greenstone well worked and polished, and similar objects have also been found by Gerhard Rohlfs as far west as the Kufara oasis south of Tripolitana. The Asiatic camel is here a comparatively recent intruder, preceded by the Garamantian war-horse and by the elephant, trained also to war by the native Numidians and Phœnician Carthaginians. The crocodile even still survives in many of the pools and lakelets here and there marking the course of mighty streams, which formerly sent their perennial floods down to the surrounding marine basins.

Apart from possible cosmic influences, our author attributes the great change that has taken place within the historic period, not with Peschel to the dry north-east Polar winds, which in the Sahara yield to the prevailing northern and north-western atmospheric currents, but largely to the reckless destruction of the woodlands which at one time covered vast tracts in this now arid and treeless region. With the vegetation disappeared the moisture; all the large fauna became extinct, and the settled populations were succeeded by nomad tribes of Berber (Hamitic) stock, joined later on by Semites from the Arabian Peninsula.

Of Timbuktu Dr. Lenz gives on the whole a satisfactory account. During his residence in the place from July 1 to July 18, 1880, he was hospitably entertained by the Kahia, a sort of "Burgomeister," or civil magistrate, who is mayor, aldermen, and town council all rolled into one, but who possesses no political authority whatsoever. Since its capture by the Fulahs in 1826, when the fortifications were razed, Timbuktu has been a purely commercial town, a general emporium for Western Sudan, open to all comers—that is, to all the "Faithful," but unfortunately a constant bone of contention between the rival Tuarik (Berber) and Fulah tribes of the surrounding lands. At the time of Dr. Lenz's visit, the Tuariks, under their "Sultan" Eg-Fandagumu, were in the ascendant, but, beyond levying dues on the imports and exports, neither they nor the Fulahs ever interfere in the local administration, which is left in the hands of the Kahia. This office itself is hereditary in the Moorish family of Er-Rami, originally from the South of Spain, hence known as "Andalusi," and settled in Timbuktu since the sixteenth century. The present Kahia affects the title of "amir," and is said to be aiming at the sovereign power by making himself independent of the Tuarik and Fulah factions. In this he appears to be encouraged by the French, who have lately reached the Niger at Segu, and who have quite recently induced him to send an "envoy" to Paris.

During the journey from Timbuktu to the Senegal Dr. Lenz saw a good deal of the Fulahs, who are now everywhere interspersed among the Negro populations from Wadai and Darfur to Senegambia, and to whom apparently belongs the future of Central and Western Sudan between the Niger and Wadai. Unfortunately, in discussing the origin of this mysterious race, he revives the now exploded theory of a "Nuba-Fulah" family, first suggested by Friedrich Müller, the learned but somewhat venturesome Viennese ethnologist. At least Dr. Lenz goes so far as to say that, "touching the ethnographic position of this people Friedrich Müller has probably hit the mark in grouping together the Nubas and the Fulahs, whom he collectively calls Nubas, and divides into a western and eastern section" (p. 261). This might not be in itself so surprising but for the fact that he further on refers to the writings of G. A. Krause on the subject. Now Krause distinctly separates the Fulahs from the Nubas, or rather ignores the connection altogether, and allies them to the Hamites, calling them "Ur- oder Protohamiten." It may be added that with the materials now available (Lepsius, Nachtigal, Faidherbe, Newman, Krause, Reinisch, &c.), it seems possible to determine the mutual relations of all these peoples with some show of probability. But in any case the Fulahs are certainly not Nubas, nor are the Nubas Hamites.[1] Whether Krause is right in affiliating the Fulahs to the Hamitic group, "mag dahingestellt werden," at least pending further information. The type is distinctly non-Negro, differing from it in almost every racial characteristic—cranial formation, complexion, texture of the hair, figure, proportion of members, mental qualities. Dr. Lenz, who had numerous opportunities of studying full-blood specimens, was amazed at their striking resemblance to Europeans, and describes them as of light complexion, with slightly arched nose, straight forehead, fiery glance, long black hair, shapely limbs, tall slim figures, great intelligence. At the same time, since their diffusion among the Sudanese populations the Fulahs have become much modified by crossings with the Negroes and Arabs. "No territory or state is now found exclusively inhabited by pure Fulahs, who are everywhere intermingled with Negro and Arab communities" (p. 259).

[1] On this point the reviewer must refer the reader to his "Egyptian Ethnology." Stanford, 1885.

The work is illustrated with some good woodcuts and plates, mostly from photographs and sketches by the author, who has also added a general map of the region traversed, and as many as eight carefully prepared itineraries of its several sections. A. H. KEANE

OUR BOOK SHELF

Physical Arithmetic. By A. Macfarlane, D.Sc. (London: Macmillan and Co., 1885.)

THIS is a very thorough work, and one admirably adapted for the use of physical students: indeed, we think so well of it that we would recommend it for use in all schools and establishments where the subjects of which it treats are taught. There is a great amount of matter, tersely put and aptly illustrated by copious worked-out examples, and, in addition, there is good store of exercises to try the pupil's strength. Answers are appended, and a useful index crowns all.

What is its subject-matter? It treats, we should say, *de omni scibili*, and perhaps *de quibusdam aliis*. But to descend to particulars: there are nine chapters, and in these are discussed matters financial, geometrical, kinematical, dynamical, thermal, electrical, acoustical, optical, and chemical. Have we not rightly described its subject-matter above? Dr. Macfarlane has done much good work in other directions, and in this particular direction he gives us, not the result of two or three months' turning over of text-books, but what he has noted down since his student days; hence he speaks of what he does know. A diligent student, an original researcher, he has learned and assimilated methods arrived at by such masters in physics as Thomson, Maxwell, Tait, Everett, and Chrystal, and put them together here in orderly method. This method the author calls the *equivalence* method. "Each quantity is analysed into unit, numerical value, and, when necessary, descriptive phrase. The rate, or law, or condition, according to which one quantity depends on one or more quantities, is expressed by an equivalence. These equivalences are of two kinds—absolute and relative; the former expressing the equivalence of *dependence*, the latter the equivalence of *substitution* or *replacement*."

We cannot give a brick, but we feel sure that the edifice to which we liken the book will be found to be constructed on thoroughly sound principles, and that no student who buys it on our recommendation will regret having done so.

It would take a very long time to test the furniture (*i.e.* the examples); upon its suitability, we cannot now pronounce an opinion; moreover, each student will have his own particular room to explore: after a visit to all the rooms, each appears to be quite *comme il faut*.

Coordonnées parallèles et axiales. Méthode de Transformation géométrique et Procédé nouveau de Calcul graphique, déduits de la Considération des Coordonnées parallèles Par Maurice D'Ocagne. (Paris: Gauthiers-Villars, 1885.)

TWO fixed points, A, B, called the *origin of co-ordinates*, are taken, and through them are drawn two parallel straight lines, Au, Bv; these are called *axes of co-ordinates* (or co-ordinate axes). Lengths, AM, BN, measured on these lines, upwards positive, downwards negative, are the *co-ordinates* of the straight line MN. So much for the *parallel* co-ordinates. Take a straight line, Ox, for *axis*, and on this line a point, O, the *pole* of the system. A straight line is determined by the angle θ, which it makes with the axis, and by the length λ from O of its intersection with Ox. These are the *axial* co-ordinates. Elementary details of these two systems are given for the former in Chapters I.-V. (pp. 1-33); for the latter, in Chapters VI.-VIII. (pp. 36-43). Several applications to examples are discussed. Chapters IX., X. (pp. 52-73) are devoted to a "Méthode de transformation géométrique fondée sur la simple comparaison des coordonnées parallèles avec les coordonnées rectangulaires." The "procédé nouveau" is the closing portion of this chapter (pp. 73-82).

The illustrations in the pamphlet are mostly taken from curves of the second degree, but these co-ordinates—a kind of tangential co-ordinates—are useful for such questions as the following:—Find a curve such that a portion of a tangent intercepted between the point of contact and the axis has a constant length (the tractrix is such that the area between it and the axis is equal the area of a semi-circle, radius equal distance from origin to cusp of tractrix); find a curve such that the portion of a perpendicular TI to the axis Ox drawn through the foot T of the tangent, limited on one side by Ox and on the other by the corresponding normal, has a given length (the curve, of course, is readily seen to be a cycloid).

The pamphlet is an interesting one, and suggests methods of procedure which in some cases have advantages over other methods more familiar.

LETTERS TO THE EDITOR

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

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

The Colours of Arctic Animals

I AM sorry that I cannot agree with my friend Mr. Meldola as to the insufficiency of the explanation of the white coloration of Arctic mammals and birds as due to protective adaptation, since it appears to me that there is no important group of facts in natural history of which the explanation is more complete; while on the other hand I venture (though with some hesitation) to question the basis of his counter explanation, as I am not aware of any sufficient proof that colour, *per se*, affects the radiation of low grade heat. At all events I feel tolerably certain that this cause, if it exists, has had no perceptible influence in determining the white colours of Arctic animals.

I am not myself aware of there being "many species" possessing the white coloration as to which there is any difficulty in seeing the advantage they may derive from it, and there is certainly a large body of facts showing that *colour* is, in almost all animals and in every part of the world, more or less protective or adaptive. If the white coloration of Arctic animals stood alone, it might be thought necessary to supplement the protective theory by any available physical explanation, but we have to take account of the parallel cases of the sand-coloured desert animals and the green-coloured denizens of the ever-verdant tropical forests; and though in both these regions there are numerous exceptional cases, we can almost always see the reason of these, either in the absence of the need of protection or in the greater importance of conspicuous colouring. In the Arctic regions these exceptions are particularly instructive because in almost every case the reason of them is obvious. Let me call attention to a few which now occur to me.

In the Arctic zone the wolf does not turn white like the fox, the reason evidently being that he hunts in packs, and concealment from his prey is not needed. So the musk-sheep and the yak, though both exposed to the extremest cold, are not white, because they are both swift and strong and need no concealment from their enemies. For the same reason neither the moose, the caribou, nor the reindeer are wholly white. Again, the glutton and the sable are dark-coloured, though inhabiting the coldest regions, and this is clearly because they are arboreal, and are better concealed from their prey by a dark than a light colour. If any useful protection from cold were to be obtained by a white coat, we should expect it to appear in such a case as the Esquimaux dogs, exposed for countless generations to the severest climate. But they gained the required warmth by a thickening of the woolly undercoat in winter, as do many other animals; and this suggests the general proposition that it will be always easier and safer to gain warmth in this way than by a modification of colour, which could certainly have but a very small effect, and might often interfere with adaptations of far greater importance. Exactly analogous cases occur among birds. The raven is, perhaps, the extremest Arctic species, but, feeding on carrion, it has no need of concealment in approaching its prey, and thus it keeps its jet black coat in the depths of the Polar winter.

The physical explanation of melanism in butterflies and some other insects, on the other hand, seems to me to be probably a sound one; but even that requires more evidence and a fuller knowledge of the habits of the species before we can admit it as proved. It may be that the dark colouring is protective, assimilating with the surroundings of the insect when at rest, and this can only be decided by observations specially directed to the point in question.

But even if, in this case, the dark colour has been produced in order to favour the absorption of the direct rays of the northern sun, it affords no support whatever to the totally different case in which the radiation of the obscure heat from an animal body has to be checked. I may, perhaps, be ignorant on the point, as it is rather out of my line, but I am not aware of any good experiments to determine the influence of colour *per se*, as distinct from the structure and surface-texture of coloured substances, on the radiation or absorption of heat of a low grade of temperature, and from a dark source. The only authority I have at hand (Ganot's "Physics," eighth edition) seems rather to imply that colour has no effect in such cases, for I find it stated, at p. 338, that the radiating power of *lampblack* and *whitelead* are identical, both being given as 100, while *Indian ink* is only 88. Again, at p. 352, the absorptive power of these two substances is given as 100, the source of heat being copper at 100° C., while that of Indian ink is given as 85. This seems to show that surface-texture or molecular structure is the important point, while colour has no effect whatever.

In order to determine experimentally whether white fur or feathers are inferior to black as radiators of animal heat, it would not do to employ stained or dyed materials, because the pigments employed might affect the texture of the surface, and produce an effect not at all due to the colour. A fair test would be afforded by two samples of cloth or flannel woven from white and black natural wool respectively, the wool to be obtained from the same breed of sheep, and, if possible, from the same district, while the material must be as nearly as possible identical in weight and texture. I shall be glad to learn from Mr. Meldola, or any other of your readers, whether any experiment of this kind has been made, or whether there is any valid reason for believing that the radiation of animal heat is at all affected by colour alone.

ALFRED R. WALLACE

Civilisation and Eyesight

THE statistics of eyesight given by Mr. H. B. Guppy in NATURE (p. 503) relating to the inhabitants of the Solomon Islands as tested by the Army test-dots, bring us nearer, I think, to the solution of the question of the relative acuteness of vision of civilised and savage races than any previous communication which has appeared in your columns, as we are able to compare them with statistics obtained under similar conditions in this country. The Anthropometric Committee of the British Association gave a series of tables in their Report for 1881 showing the results of their inquiries into the sight of different classes of the community, carried out by means of the Army test-dots; and for the purpose of comparison with Mr. Guppy's figures I have extracted the returns relating to men employed in agriculture and other out-door occupations as most nearly agreeing with the conditions of life of savage people, and have embodied them, together with Mr. Guppy's, in the following table:—

Distance in feet at which the Army test-dots were distinguished	English agricultural and out-door labourers, age 16 to 45 years. No. of obs.	Solomon Islanders, age not stated. No. of obs.	English agricultural labourers, &c., age 21 years. No. of obs.
5 to 10	1	—	—
10—15	1	—	—
15—20	4	—	1
20—25	8	—	1
25—30	15	—	1
30—35	29	—	2
35—40	34	1	3
40—45	27	0	3
45—50	40	0	8
50—55	55 *	7 *	11 *
55—60	52	2	8
60—65	40	7	4
65—70	40	3	2
70—75	20	2	2
75—80	9	—	1
80—85	3	—	1
85—90	2	—	—
90—	5	—	1
Total	385	22	49
Average	52·1	57·5	52·5
Mean	55·0	55·0	52·5

* Mean or value of greatest frequency.

Mr. Guppy's figures are too few in number, and too irregular in their relation to each other and to the columns of figures on either side of them, to be accepted as representative of the range of vision of the Solomon Islanders, and he must have stumbled on some of the better examples, or else the short-sighted men have not presented themselves to him for examination. Nevertheless, taking the figures as they stand, they give no support to the belief that savages possess better sight than civilised peoples. Mr. Guppy gives 60 feet as the distance at which the test-dots were distinguished, but the average of his figures is 57·5 feet, or only half a foot more than Prof. Longmore worked out, from observations on British recruits, as the distance which the test-dots ought to be seen in good daylight. Judging from the run of the figures, I should place the so-called "normal" vision of the Solomon Islanders at 55 feet, or possibly at 52·5 feet, like the English labouring classes of the age of twenty-one years, as our figures representing that age are remarkably uniform in their distribution, and therefore near the truth. The average of the Solomon Islanders is, it is true, higher by 5 feet than the English in my table; but this is obviously due to the absence of observations on the less perfect-sighted individuals belonging to the former race. Even when the test is one of seeing objects at the greatest distance, the best savages are inferior to the best English by about one-third. Mr. Guppy evidently believes that the Solomon Islanders possess very superior sight compared with ourselves, especially for distant object; and Mr. J. A. Duffield, who read a paper recently, at the Anthropological Institute, on the natives of some adjoining islands, was still more firmly of this opinion; but it is obvious that the question cannot be decided by general impressions, nor by the result of comparisons with sight the value of which we are ignorant. Travellers naturally record cases in which their own sight (which they believe to be good, but which may be very bad) is outstripped by savages, but do not encumber their pages with negative evidence of the kind. Their mistake lies in confounding acuteness of vision with the results of special training or education of the faculty of seeing—results quite as much dependent on mental training as on the use of the eyes.

Bolton Row, Mayfair, April 13 CHARLES ROBERTS

Far-sightedness

ALLOW me to corroborate the report of your correspondent, whose letter appears in NATURE of April 2 (p. 506) as to the visibility of very distant terrestrial objects. In the spring of 1837 I was travelling from Rome, northwards, by "Vetturino," and from the summit of the Apennine on the road between Florence and Bologne, I saw, with astonishment, the whole range of the Swiss Alps, not merely distinguishable but conspicuous. Measured on the map in a direct line the nearest part of the range was distant about 200 miles. The extreme portions, including Mont Blanc, were considerably more. I have no doubt that the atmospheric conditions were unusually favourable. For when I asked the Vetturino what mountains they were, he, having often passed that way without seeing them, said they were nothing but clouds. I told him that I knew a snow mountain when I saw it; and as a peasant, living on the spot, shortly passed, I renewed my inquiry—to which he immediately answered, to my surprise, that they were the mountains of Switzerland. J. HIPPISLEY

Stoneaston, April 7

ON September 3, 1874, from the Piz Muraun, near Dissentis, I saw the white dome of Mont Blanc, distant about 110 English miles. As the Piz Muraun is only about 9500 feet I was sceptical, till a reference to maps showed a line of intervening depressions. I feel sure that some Alpine tourists will be able to furnish Herr Metzger with cases of mountains identified at distances vastly exceeding this of mine. E. HILL

Cambridge, April 8

The Pupil of the Eyes during Emotion

IN connection with the above subject the following experiment may be of interest to your readers. It is one I made many years ago when studying the border-land between physiology and psychology. At that time I showed and explained it to a number of my friends.

In this experiment it appears to the observer as if I had control over the muscles of the iris, as I can make the pupil of the eye large or small at will. Placing myself in front of, and looking towards, a window or other bright light, the observer is desired to watch the pupil, and say when to contract or expand it. On the order being given, the pupil is seen to expand or contract as desired. This experiment can be easily made by any one in the following manner:—The eye is directed towards the light and a point looked at, the eye being kept steady during the whole experiment. Under these conditions the bright light causes the pupil to contract automatically, and when desired to expand it all that is necessary is to take the attention away from the eye and fix it on some other part of the body—say, by biting the tongue, pinching the arm, &c. By these means the sensitiveness of the retina is, for well-known reasons, reduced, and the pupil automatically dilates. To cause it again to contract, the mind has simply to be recalled to the eye and attention given to the visual impressions.

This experiment supports the explanation given by Dr. Herdman in Mr. Clark's letter in NATURE, vol. xxxi. p. 433, and also the explanation given by Dr. Wilks at p. 458. When the mind is under the influence of fear, the energies are diverted from the eyes and the pupils dilate on account of the reduced sensitiveness of the retina. While in anger, sight being powerfully called into action, the sensitiveness of the retina is increased and the pupil automatically contracts, so that generally we might expect that during those emotions in which the eyes are called into action the pupils will be small, and that when the nervous energies are directed away from the eyes to other centres, the pupils will be large. JOHN AITKEN

Torquay, April 8

Notes on the Geology of the Pescadores

DURING a stay of two days in Makung Harbour in 1877, I collected a few notes on the geology of this small group, which has, from its recent occupation by the French, been brought before the notice of the public. These islands, which were briefly described in the last number of NATURE (p. 540), have a characteristic appearance, being flat-topped, 100 to 200 feet in height, and presenting a rather barren aspect from the scarcity of trees and shrubs. Dampier, who visited them in 1687, described them as "much like our Dorsetshire and Wiltshire Downs," producing "thick, short grass and a few trees," a description equally applicable at the present day.

As far as I could ascertain, the whole group was of basaltic formation, the columnar structure being well developed, columns 30 to 40 feet high being observable in the faces of some of the cliffs. In the places I visited the cliffs were built up of two basaltic streams superimposed, the two masses towards their junction being scoriaceous and amygdaloidal, and separated by a layer three inches thick of a red, soft rock or laterite. The cavities of the vesicular parts of the rock were often filled by calcite or hæmatite.

The apparent absence of any cone or tuff deposit, the compact and columnar structure of the rock, and the vertical position of the columns, seemed to show that the whole had been originally one continuous sheet of submarine lava-streams, which had been subsequently elevated and cut up by the waves into the several islands—a conclusion which was supported by two other circumstances: the form of the islands and the shallow intervening depths (6 to 9 fathoms).

It is noteworthy that several of the islands sloped away gradually west-south-west to south-west, a direction coinciding with that of the submarine slope in this part of the Formosa Channel. From this circumstance it would seem that the succession of lava-streams flowed in a south-west direction, and that their source lay in the north-east portion of the group.

17, Woodlane, Falmouth, April 11 H. B. GUPPY

A New Bird in Natal

SOME months ago, Mr. Fereirra, a member of my congregation, informed me that he had shot some time previously a bird in the early morning which neither he nor any of his neighbours had seen before. From his description of it I concluded that it probably belonged to the goat-suckers, and on examination of the skin I find that the supposition is correct.

A day or two ago he brought the skin to me: it had been stretched against the wall of his room to display its plumage to the greatest advantage. The measurements which I give cannot therefore be perfectly accurate. One of its long plumes has been broken by a pellet, but otherwise the skin is in tolerably good preservation, and I trust that it may be well stuffed and set up, for the bird is certainly not mentioned in the first edition of Layard's "Birds of South Africa," nor yet in any of the books or catalogues in my possession, and the bird is in itself so very remarkable that one cannot help thinking that it would have been described in the books I have had it been known. I will deposit the skin in the Natal Museum, Pietermaritzburg. The bill is that of a goat-sucker, strongly fenced with strong hairs. The length of the body from tip of the bill to the insertion of the tail is 6 inches; length from tip of bill to tip of tail, 11½ inches; length between tips of wings—probably stretched too much—24 inches.

The colour is the usual brown of the family—bars on the tail of brown black, and mottled bars of light and dark brown; feathers, eight in number, the longest on the outside of the tail.

Wings: Primariæ, 9 in number.

Length of the 1st feather, 7½ inches.
" 2nd " about an inch shorter.
" 3rd " shorter than second; the following three about the same length as the 3rd.

Length of the 7th feather, 7½ inches.
" 8th " 11½ "
" 9th " 27½ "

The first seven of the primariæ are tipped with white, the 2nd and 3rd rather broadly, the 1st scarcely. The 8th becomes greyish towards the tip, and the ribs of the 7th and 8th are brown, while the others are black. Two-thirds of the length of these feathers are black; but a band of white, narrower on the first and increasing to about 3 inches broad on the 8th feather, extends along the roots and middle of them, and crosses over to the 9th long feather, which, for 21 or 22 inches, is of a dullish silver-gray. The secondariæ are tipped with white, with the exception of the 1st and 2nd, which only give indications of being so; they are generally black-brown, with markings of light brown. There is a reddish ring around lower back part of the neck.

The breast is light gray, generally with light brown markings in bands.

Its feet are those of a goat-sucker, but on comparing the foot of the *Caprimulgus europæus*, as drawn by Van der Hoeven (vol. ii. plate 7, Fig. 9, ed. 1858) I find the teeth of the comb of the middle toe much broader and stouter than that of the former. There are only four teeth, with a smaller or false one at the root of the nail. The length of the nail is about one-eighth of an inch, and the breadth of tooth is therefore about one-sixteenth of an inch.

This bird is evidently very closely related to the pennant-winged night jar, or long-shafted goat-sucker (*Macrodipteryx africanus*); but the markings are very different, and the long-shafted feathers are not more than 17 inches long, while those of this bird are more than 27 inches in length, and they do not display any inclination to form a long naked shaft, but are clothed or webbed on both sides from the root to the tip.

It is very singular that this bird should only have become known in this district in 1884. The farmers are close observers, as also are the Kaffirs, but no one has ever seen it. It is the more singular since it was shot on a farm that has been long occupied, and that by a farmer who in his younger days was accustomed to help collectors of birds for our European museums. Perhaps the long and severe droughts, said to prevail this year in the interior, may account for its presence in Natal. JAMES TURNBULL

Pastorie, Grey Town, Natal, March 2

C. T. E. VON SIEBOLD

CARL THEODOR ERNST VON SIEBOLD was born at Würzburg, in Bavaria, on February 16, 1804. His brother was the well-known traveller and philologist. Carl was brought up chiefly, under the superintendence of his father, for the medical profession, and he carried on a practice for a few years as a physician at Heilsberg and Königsberg. In 1835 he received the appointment of Master of the Lying-in Hospital at Dantzic. Early in his life he showed an interest in zoology, and in 1840 he removed from Dantzic to Erlangen, where he taught comparative anatomy, zoology, and veterinary medicine. In 1845 he was appointed Professor of Zoology at Friburg, and shortly afterwards he made a prolonged sojourn on the Adriatic. At this time he worked with immense zeal and ardour at the anatomy of the marine invertebrates, and as the result of this work and his lectures combined he commenced the elaboration of his well-known "Lehrbuch der vergleichenden Anatomie der Wirbellosen Thiere." In his preface to this work, which has been translated into English and French, he insisted on the importance of a knowledge not only of the minute anatomy but also of the developmental stages of the forms described. Generous aid in the completion of this at the time most excellent treatise was given to him by C. Vogt, H. Stannius, A. Krohn, H. Koch, and A. Kölliker, and in 1849 he founded, in connection with the last-named of these eminent biologists, the *Zeitschrift für wissenschaftliche Zoologie*, a journal which has ever held a leading position among the scientific publications of our day, and one which is still known and esteemed wherever zoology is studied.

In 1850 von Siebold was appointed to the Professorship of Physiology in the University of Breslau, and also received the charge of the Physiological Institute of that city.

In 1853 he was appointed Professor of Zoology and Comparative Anatomy in the University of Munich, and Director of the Zoological and Zootomical Cabinet in that city. These positions he filled during the remainder of his life.

Shortly after his appointment to the Munich Professorship he commenced an elaborate series of investigations into the vexed question of "Parthenogenesis," entering on the subject with a belief that facts had been misunderstood; and his treatise on this phenomenon, as found by him to actually exist in bees and moths, was a genuine contribution to science. This work was published at Leipzig early in 1856, and was translated by Mr. Dallas the following year into English.

Somewhat earlier in date he published a memoir on "Tape and Cystic Worms, with an introduction on the Origin of Intestinal Worms," which was deemed worthy of being translated into English, by Prof. Huxley, for the New Sydenham Society. The good that this translation effected by introducing some scientific facts to the notice of our medical men it is not easy to calculate.

In 1858 the Royal Society elected him as one of their honorary members. In 1867 he was made a corresponding member of the Institute of France. There seems little need to enumerate all the honours that were conferred on him during the half century that he was known as one of the distinguished zoologists of Europe.

In the important and indispensable catalogue of Scientific Papers published by the Royal Society, we find a list of over 130 memoirs ascribed to Prof. Von Siebold.

Failing health during the last few years interrupted this, up to 1874, steady flow, and Dr. Ehlers undertook much of the labour of editing the *Zeitschrift*. Those who had a personal knowledge of Von Siebold will remember his pleasant and friendly manners, the readiness with which he placed at the students' disposal all the information in his power, and the visitor to the Zoological Museum at Munich will not soon forget the vast stores, not only collected, but scientifically arranged under the superintendence of Von Siebold.

THE EGGS OF FISHES[1]

II.

THE condition of the fish-fauna of the various grounds may be estimated to some extent by the number of the floating ova near the surface. We have seen that Sars found the water crowded with the multitude of ova off the Loffoden Islands, where enormous numbers of cod are captured. In our seas no fishing-bank is so prolific, the greatest number of ova occurring on Smith Bank, off Caithness, and the next on the rich grounds off the Island of May—both of which present a great contrast with the meagre supply of eggs of round fishes floating in our own bay. The proportional numbers in each case accord very well with the captures of adult cod in the several areas.

No sight can be more interesting to the naturalist than the surface of the sea, in the condition just mentioned, about the beginning of April. The rough water of the great fishing-grounds—such as off Smith Bank, and somewhat further from land—is enlivened by large groups of gulls, guillemots, and the ubiquitous gannets, apparently feeding on the smaller fishes which have been attracted to the surface by the wealth of food. At short intervals the long dorsal fin of a large killer appears above the surface, and the water behind it is churned into foam by the powerful strokes of its tail; while a small group of bottle-noses (another kind of toothed whale) is recognised by the noise and foam, as one or more leap from the sides of a huge wave. The tow-net collects large quantities of ova and minute fishes which have just escaped from the egg. It further shows that innumerable minute crustaceans, such as Copepods (*e.g. Calanus finmarchicus*, Gun., and *Temora longicornis*, O.F.M.), multitudes of the young, or nauplius-stage, of sea-acorns, Sagittæ, and peculiar Annelids (*Ioida*) are present. It is evident, therefore, that the young fishes are placed in the midst of a rich surface-fauna, the more minute forms of which would readily serve as food.

In the foregoing remarks on the floating eggs of British food fishes, those of the cod, haddock, and whiting, have been chiefly alluded to. We shall now refer to others, either wholly or partially unknown till this year. I have already mentioned that Sars found certain floating eggs mingled with the former on the surface of the sea, and identified the young, after hatching, as gurnards. In the present case the eggs were removed from the adult gurnard, and hatched at St. Andrew's in about a week, so that a further step has been made. The eggs of the gurnard float as buoyantly as those of the cod and haddock, but they are considerably larger. Each has a very distinct oil-globule opposite the germinal area, which generally is directed downwards. Some are of opinion that the floating of the eggs of such fishes as we are now considering is due to the oil-globules, but the eggs of several fishes, *e.g.* those of the salmon, have a larger quantity of oil, and yet they do not float. The specific gravity of the eggs is slightly less than that of the sea-water; but the precise connection between the floating of the living ova and the sinking of the dead has yet to be made out. Such would form, indeed, a most valuable and interesting subject for investigation at the Marine Laboratory. So easy is it to hatch the eggs of the gurnard that the water in the instance just narrated was not changed. The rapidity with which the development of the embryo goes on in the egg is remarkable, for in 7 or 8 days the young are extruded, whereas in the salmon, for instance, no less than 60 days are required even in a room with a temperature much higher than that of the open air. If the eggs of the salmon are permitted to hatch in an ordinary river, a period of from 95 to 120 days is usually necessary for hatching. The very great difference, therefore, between the marine and fresh-water fishes in this respect is apparent.

The only flat fish in which the ova had been found to float was the plaice, which Dr. Malm had examined in the Baltic. In May of this year, however, the eggs of the common flounder in St. Andrew's Bay showed the same feature. They floated buoyantly on the surface of the water. Prof. Huxley at this time having suggested that perhaps the floating or sinking of the ova was a question of temperature, the eggs of this species were used in some experiments. They had been removed from the fish on May 2, and placed in the Marine Laboratory. On the 5th the majority still remained on the surface, those on the bottom having been carried down by the attachment of sand-grains. A number from the surface were placed in a test-tube. After standing an hour the majority were floating on the surface, one or two lay on the bottom, while others rested in mid-water. Placed in a vessel of water at 98°, the eggs exhibited lively movements for several minutes, being carried up and down by the currents, but never remaining at the bottom. The test-tube felt quite warm to the touch, yet the eggs floated, and remained floating, as buoyantly in the warm water as in the cold, so that their floating in the sea is not a question of temperature.

An interesting sequel, further, remains to be told in connection with this experiment, in which the test-tube had been placed aside and forgotten. On May 10, while explaining the matter to Prof. Ewart, he noticed motion in the test-tube, and I found that the eggs which had been raised to a temperature of 98° had given birth to little flukes, which thus survived the exigencies of their surroundings, both as regards temperature and water. These little creatures are as symmetrical in outline as the young cod or haddock, an eye being placed on each side of the head, while in the adult flounder, as you are all aware, both eyes are on one side (the right or coloured one). The pigment is quite different from that of the young cod, being of a peculiar pale olive or brownish yellow by transmitted light, and the cells seem to be less branched. Their motions also diverge from those of the cod, for the little creatures hang head downwards in the water, either perpendicularly or obliquely, the yolk-sac being on the upper line of the slope. They then move upward, hang as formerly, or slowly descend, repeating these motions frequently. The young cod, on the other hand, dart nimbly about near the surface of the water, and bear themselves quite differently.

But to return to the ova. Before the summer that has just passed, it was not known whether the ova of the turbot, sole, and lemon-dab—all important and valuable food fishes—floated or sank. Accordingly such fishes were a source of special interest. It was not till the end of June and in July that perfectly ripe turbot could be procured, and then the small ova were found to float as

[1] Introductory Lecture delivered to the Class of Natural History in the University of St. Andrews, on November 10, by Prof. McIntosh, LL.D., F.R.S. Continued from p. 536.

buoyantly as any of the foregoing; and the same was proved to be the case with the eggs of the sole and lemon-dab—all these, moreover, being obtained in the act of spawning far out at sea, and in comparatively deep water. The ova of the long rough dab and the common dab were also added to the list of those with floating eggs. The notion, therefore, that such fishes seek the shallow water for the purpose of spawning is visionary, and mainly rests on the preconceived opinion that the eggs are deposited on the bottom.

Amongst the eggs of the cod floating on the surface of the water off the Island of May, in April, were vast numbers of very young sand-eels. The late Mr. Buckland states that they spawn in "May, June, and September," and that they deposit their eggs in the sand. They would rather seem to spawn in spring, and their eggs probably avoid the sand as much as possible by floating on the surface of the water. Sand is a most objectionable site for the eggs of certain fishes, and no less so for the embryo.

Without going into further detail, it is evident, therefore, that the eggs of many of the most valuable food fishes thus float near the surface of the sea, *e.g.* those of the cod, haddock, whiting, bib, and other Gadoids, mackerel, gar-fish, red mullet, weever, plaice, long rough dab, common dab, lemon-dab, sole, common flounder, and probably sand-eels. There is hardly a marine fish, excepting those of the herring group, which appears in our markets, but has this remarkable provision in regard to its eggs. It would also appear that some of these eggs range throughout the water, so as to be caught by a tow-net sunk many fathoms beneath the surface.

There can be little doubt that this wonderful provision is one of the main reasons why such marine fishes have held their own in the struggle for existence—not only with respect to their predatory neighbours, but still more in regard to the persistent inroads on their numbers made by man. Marine fisheries have hitherto been conducted as if practically inexhaustible, both lines and trawlers taking as much from the sea as possible, while no margin has ever been afforded the spawning fishes.

Let us for a moment glance at the working of this arrangement. The comparatively small eggs of the chief food fishes rise to the surface, or nearly to the surface, wherever the shoals of adult fishes happen to be feeding, and this occurs not during a brief period, but it extends over a considerable space of time. The tiny young in their helpless state are carried, along with multitudes of eggs, by every tide into sheltered creeks and bays, in the shallow water of which they find both safety and food. We are familiar with these tiny embryos, furnished with a yolk-sac—and so fragile that they would fall an easy prey to hosts of swimming crustaceans on which, in the adult state, they would hardly deign to feed—near the surface of the sea; but a hiatus yet remains in the history of the young cod, for instance, between the date of complete absorption of the yolk-sac and that in which it is found swimming in the forests of tangles in the laminarian region—for example, off the Castle and Pier Rocks, or even venturing into the harbour. There, as a rule, it is free from the pursuit of both liners and trawlers, and quietly grows apace, feeding on the swarms of minute crustaceans and the myriads of very young mussels which characterise such a region. In the early part of the season they range from one and a half to two inches, and are variegated with a series of pale spots, somewhat rectangular in outline. The general colour is olive, lighter or darker according to circumstances, though a few of the larger examples have a reddish hue, such as signalises the "rock-cod" of the liners, but the pale spots are similar. Many of these young cod are infested by parasitic crustaceans (*Chalimus*), which adhere by a long median process that penetrates the skin. They are accompanied in the laminarian region by the young of the coal-fish, whiting, pollack, rockling, long-spined cottus, and lump-sucker.

Sars is of opinion that the intermediate stage—about which, as above-mentioned, our knowledge is imperfect—is passed by the young cod-fish in the shelter of the jelly-fishes, on the rich grounds off the Loffoden Islands. It is true that once or twice young cod, of the intermediate stage, and coal-fish have been caught in our seas in the tow-net in July, but the result of the present observations gives no support to this view. The jelly-fishes in our seas are not in sufficient numbers at the time of the intermediate stage, especially in regard to the spawning in April, to act as shelter-forms to the young fishes. It is probable that as soon as they gain sufficient strength to withstand the force of the ordinary ebb-tides, they remain amongst the tangles and other seaweeds of our rocky shores, to which they have meanwhile been carried by the currents. While a few, therefore, are found here and there near the surface of the sea amongst other pelagic types, the majority of those in the intermediate stage probably swim somewhat deeper.

The after-history of the little cod of one and a half to two inches, which are found in considerable numbers off the Pier and Castle Rocks in the beginning of July, appears to be as follows. They remain in the laminarian region for some months (many being captured even at this season), and rapidly increase in size on the rich and abundant food placed within easy reach. Moreover, it is probable that in this region they are much less liable to the attacks of predatory fishes than in the open sea. We find, indeed, that, while young haddock and whiting abound in the stomachs of cod, haddock, gurnards, and other fishes, it is rare in our seas to find young cod of the size we are now considering. Prof. Sars, on the other hand, procured them abundantly in the stomachs of the pollack (a fish which swims high) off the Norwegian shores; but it has to be borne in mind that they form the chief feature of the young fish-fauna of the region at the time indicated. As they grow larger and bolder, they seek deeper water, and are found in numbers near rocky or rough ground, such as off the Bell-rock, and the North Carr rocks, and indeed all along the rocky eastern shores. They then mingle with their progenitors on the various fishing-banks, and are caught in numbers by both hook and trawl. The main cause of this migration from the shore seawards is probably the nature of the food, which, as the animals grow older, becomes of a different character, the larger Crustacea especially—such as hermit-crabs, Norway lobsters, and many short-tailed crabs—being eagerly sought after, along with various kinds of fishes. So far as our knowledge at present goes, a cod probably takes between three and four years to attain full growth.

A feature which requires special mention is that, when the shoals of young cod are watched at any of our rocky shores during several months, one is struck by the fact that throughout the period many small forms are present, that is, some do not appear to have grown; but we have seen that the spawning of the adult fishes extends over a considerable period, and, further, that only a portion of the eggs in any given fish come to maturity at once. There is thus a succession of young fishes coming at a certain stage shorewards, and another migrating outwards. This and other facts already mentioned show how intimately the in-shore ground depends on the off-shore; in other words, the eggs and very young fishes are carried from the offing by every tide during the season, while a constant stream of young fishes of a large size goes to swell the ranks of the adults beyond the three-mile limit. The prosperity of the one region is thus intimately associated with that of the other.

In this rapid sketch, then, it will have been observed how complex are the relations which surround the increase of marine fishes. Conspicuous above all others, however, is the remarkable provision whereby the eggs of almost all the chief food fishes, except the herring group, float at or near the surface of the water—so that they are carried hither and thither by every surge of the tide, or more steadily borne by the deeper currents to stock anew exhausted waters. The minute and imperfectly-developed embryos and the delicate young, moreover, are conveyed into regions best suited for their future growth and well-being. Further, we cannot but be impressed by the fitness of the arrangement which ordains that these young fishes are placed from the first amidst a rich surface-fauna of minute forms which serve them as food. These range from the microscopic Infusoria, which cause the crest of every ripple at the ship's side to sparkle with light and the tow-nets to gleam like tunnels of fire; the wonderful Plutei, or painter's easel-like larvæ of star-fishes, swarms of larval sea-acorns, Copepods, and the beautiful zoeæ of the higher crustaceans. Besides these, are the peculiar Appendiculariæ and Sagittæ, and countless myriads of larval mussels, which in summer crowd the surface of St. Andrew's Bay, and at a still later stage, as they are forsaking their pelagic existence to settle on the stones and seaweeds, form the food of the more advanced young cod, haddock, whiting, coal-fish, pollack, and others that seek shelter for a time amidst the shaggy belt of tangles encircling the rocks. The latter thus in their larval state, by nourishing in their profusion the delicate young of the food-fishes, in a sense repay the wise conservancy bestowed by the Town Council of this city on the fine mussel-beds of the Eden. It will, moreover, be observed that it is not only the eggs of the higher marine animals which float, but that for a long time zoologists have been familiar with the pelagic eggs and young of many invertebrate groups of importance. How else, indeed, could the ubiquitous mussels, the sedentary oysters, and the equally stationary sea-acorns and barnacles be spread throughout the ocean? Moreover, not only do these swimming larval forms nourish the very young food-fishes around them, either directly or indirectly, but as they—for instance, the young crabs, lobsters, star-fishes, and mussels—grow larger and older, a kind of rain, so to speak, of such forms takes place from the surface to the bottom, which is readily taken advantage of by the larger fishes, and thus the wonderful cycle is completed.

Finally, I need not point out to you the importance of the Marine Laboratory, to which I have already alluded, and at which the foregoing and other investigations were made during the summer. We have facilities in this and in the Practical Class, which are unusually favourable for study and research, but at the same time our responsibilities are not diminished by such advantages. We must all render an account of our stewardship. When I mention that many facts have yet to be determined in regard to our common food-fishes—their development, rate of growth, their life-histories and migrations—that we have much to find out as to the best methods of increasing such valuable fishes as the cod, the haddock, the sole, and turbot, and of maintaining that increase, it will be apparent that such problems are not only of moment to us but to the country, and that we cannot begin too soon to attempt their solution, as well as to increase our knowledge in regard to many of the lower forms of animal life.

THE NEW UNIVERSITY OF STRASBURG

THE following account of the new university buildings of Strasburg is taken, with a few abbreviations, from an article contributed to our contemporary *La Nature*, by M. Charles Grad, who is himself a deputy to the Imperial Reichsrath from Alsace.

On Monday, October 27th, 1884, the new buildings of the University of Strasburg were opened with due formalities. These buildings form an entire quarter of the city, and constitute a magnificent series of palaces for the prosecution of science. No city in Europe, not even excepting the great capitals, can show such a rich provision for higher education, or one in which the various parts are so admirably combined. Every branch of study has its own proper and distinct location allotted to it, with laboratories, museums, library, and special appliances. It has been done on the large scale, and most successfully. The Imperial Government and the representatives of the Alsatian population arrived at an understanding, and vied in their efforts to endow the province of Alsace-Lorraine with a school of learning unrivalled in its arrangements and in its wealth of buildings. Even those who were most severely touched by the annexation to Germany, agree that in raising this splendid monument—the new University of Strasburg—the one wish has been to serve the interests of science apart from all sinister or narrow national considerations.

The former Académie of Strasburg, broken up in 1870 by the war, was replaced by the new University by virtue of a decree issued from the Chancelry of the German Empire, under date of December 11th, 1871—the same day on weich the additional convention of the treaty of peace was signed at Frankfort. This decree entrusted the organisation of the teaching staff to M. von Roggenbach, formerly Minister of the Grand Duchy of Baden. From

FIG. 1.—University of Strasburg: The Collegiate Palace.

the summer semester of 1872 onwards a body of forty-two professors constituted the staff. They began their work on May 1st of that year, being the three hundred and fifth anniversary of the opening of the Académie, which was founded May 1st, 1567, by the Stattmeister Johann Sturm von Sturmeck. At the present time the new University of Strasburg counts seventy-three ordinary and nineteen extraordinary professors, who during the summer semester of the year 1884, have conducted in the five faculties no fewer than 242 courses of lectures and classes. The work is thus distributed between the five faculties:

Faculty.	Professors.	Classes and Lectures.
Theology	7	26
Law and Political Sciences	12	29
Medicine	26	60
Philosophy	25	77
Natural Sciences & Mathematics	22	50

Side by side with the laboratories and hospitals attached to each special branch of the natural and medical sciences, there exist the seminaries appropriate to the other branches of learning duly equipped for the purpose of initiating the student into the real work of his subject. A fine library of 560,000 volumes, and a reading-room furnished with 571 periodicals, reviews, and journals, are fitted up in the ancient episcopal residence or château, for the use of both pupils and masters. At the beginning of the year 1884 the University counted 858 matriculated students, of whom but 266 were from Alsace-Lorraine. We may complete these statistical details by recalling how, since the annexation, the sum devoted to the outfit of the University of Strasburg has amounted to 16,000,000 francs (£640,000), without reckoning the value of the establishments of the ancient Académie, or the cost of the library, which was 1,785,000 francs (£71,400). There is also an annual endowment of 1,087,227 francs (£43,000) for the maintenance of the University, and one of 150,000 francs (£6,000) for that of the library, both charged to the Imperial budget, to meet the current necessities, in addition to the income derived from older special endowments.

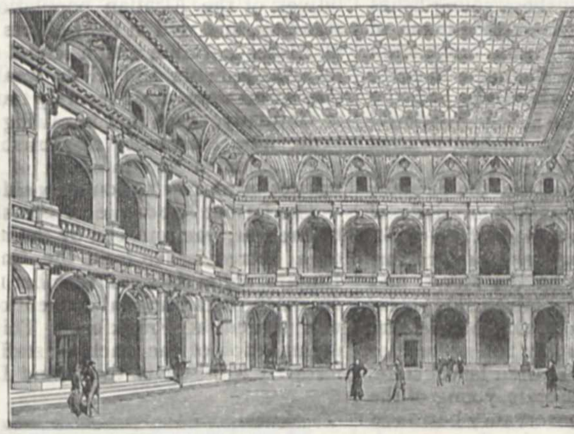

FIG. 2.—The Collegiate Palace: Salle des Pas-Perdus.

The cuts which illustrate the different establishments of the University, and which convey better than any mere description some faint sense of the scale on which this work has been done, and for which we have to thank the kind attention of M. Schricker, secretary of the Senate of the University, were prepared from photographs taken to accompany a memorial document published at Strasburg in 1884 entitled *Festschrift zur Einweihung der Neubauten der Kaiser-Wilhelms Universität.* The buildings at present finished are spread in two great groups around the civil hospital and in the new quarter of the town now rising between the Promenade des Contades and the Porte des Pêcheurs; the latter being outside the line of fortifications demolished in 1871. It may be remembered that Strasburg now covers within its new fortifications an area thrice as great as that of the old city before its

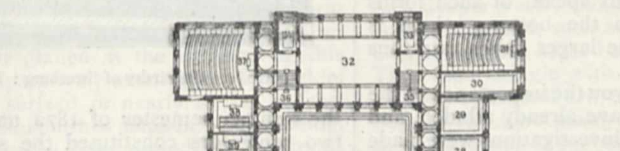

FIG. 3.—The Collegiate Palace: Plan of Ground Floor.—1, Entry.—2, 3, 4, Central Gallery.—5, 6, Corridors.—7, Salle des Pas-Perdus.—8, 9, Side Staircases. 10, 11, University Counting House.—12, 13, Rooms for Meetings of Faculties.—14, Rector's Room.—15, Rector's Antechamber.—16, Secretary of the University.—17, Secretary of the Senate.—18, Senate Hall.—19, Antechamber of Senate.—20, Room for Musical reunions.—21, Music Hall.—22, Curator's Office.—23, Secretary of Curator.—24, Curator's Room.—25, Curator's Antechamber.—26, Store Room.—27, Class Room.—28 to 30, Theological Seminary.—31, Class Room.—32, Reading Room.—33, Ante-room.—34, Cloak-room—37 to 40, Lecture and Class Rooms.—41, Store Room.—42, 43, Class Rooms.—44 to 46, Seminary of Mathematics.—47 to 54, Lecture and Class Room.—55, Professor's Parlour.—56, 57, Lavatories. &c.—58, Janitor.

annexation to Germany: and its population was 104,000 at the census of 1880.

It will take you half-an-hour to walk from the medical institutes, grouped around the square of the civil hospital, across the old streets, which still preserve the primitive appearance and the characteristic marks of mediæval German cities, to the new collegiate palace. As you cross from the Kaiserplatz towards the Ill, there rises before you the façade of the collegiate palace, built in sandstone from the Vosges (Fig. 1). This is, properly speaking, the chief building of the University, the various institutes being so many annexes. The palace is a very fine building, in the style of the Renaissance, with simple lines, standing behind a square with fountains and gardens. The plan is of an inverted **T** shape, giving a frontage of 410 feet in length to the façade. The two lateral wings and the central member are thrown forward a little and rise slightly above the rest of the building. A fine external flight of steps leads into the interior. The basement is of red sandstone; the two stories of grey. Over the five entrance porches stand five Corinthian columns supporting a frieze, and surmounted by a group of five sculptured figures, considerably above life-size. Pallas Athene, protectress of science, stands before her throne in a calm and solemn attitude, holding up her torch in her right hand, and lowering a crown in her left. On the two sides of the throne the personifications of philosophy and natural science are each occupied in teaching a young man who reclines at their respective feet. One of these youths endeavours to raise a veil from a sphinx, under the direction of the elder muse, whilst the younger sister, with compass and crystal explains to her scholar a scientific

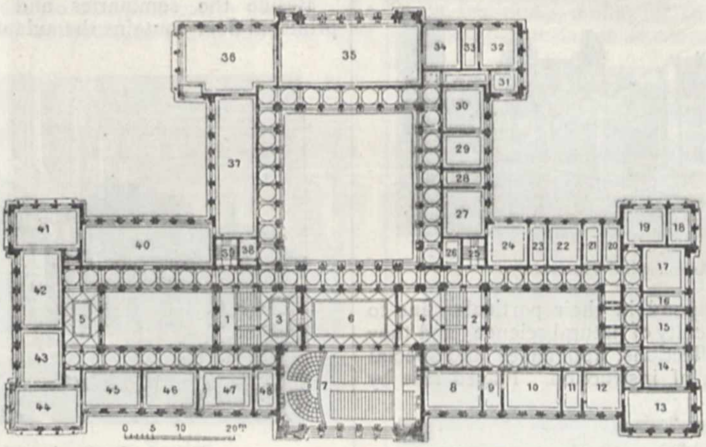

FIG. 4.—The Collegiate Palace: First Floor.—1, 2, Chief Staircases.—3, 4, Vestibules.—5, Corridor.—6, Vestibule of the Theatre.—7, The Theatre.—8, Roman Seminary.—9, Director's Cabinet.—10, English Seminary.—11 to 13, Philological Seminary.—14, 15, Institute of Archæology.—16, 17, Seminary of German Philology.—18 to 20, Seminary of Geography.—21, 22, Seminary of Philosophy.—23, 24, Seminary of Modern History.—25, Staircase.—26, Servants.—27, 28, Seminary of Mediæval History.—29, 30, Seminary of Jurisprudence.—31 to 33, Seminary of Political Science.—34, 38, 40, 42, 45, Institute of History of Ancient Art.—39, Staircase.—43, Hall of Egyptology.—44 to 47, Institute and Lecture Hall for History of Art.—48, Library of this Institute.

problem. Under the group is the inscription in Roman letters: LITTERIS ET PATRIÆ. In five niches under the windows of the upper floor, and between the five columns, are five bronze busts, representing the five faculties in the persons of Saint Paul, Solon, Aristotle, Hippocrates, and Archimedes. Two other niches on the right and left of the five columns contain female statues personifying Strasburg and Germany. There are also thirty-six stone statues at the angles of the building. As will be seen from the plans (Figs. 3 and 4) the central block and each of the wings encloses an internal court. The central court is glazed, and constitutes an enormous hall, the Salle des Pas Perdus (Fig. 2), 92 feet long, 82 feet wide, and 52½ feet high. The galleries of the upper floor open upon this hall, which is lighted exclusively from the top. The inauguration ceremony was held in this hall. All official notices are posted here or in the side alleys. In allocating the various rooms of the building the architect placed on the lower storey the offices of the administrative departments and the class rooms in the wings. The seminaries of the faculty of philosophy and the collections of archæology and historical art are placed, along with the aula or great theatre on the higher storey. The plans were drawn by Prof. Warth of Carlsruhe, who also directed the works of construction from 1874 to 1884.

The official rooms of the secretary and of the rector, spacious in proportion, occupy the south wing of the ground floor, along with the senate hall and the music hall: for musical science enters also into the curriculum of the University. In the richly decorated hall for meetings of the senate the ceiling is particularly noticeable. On the left of the entrance in the north wing of the ground floor the corridors lead to the professor's parlour and to the lecture-rooms of the various faculties. These lecture-rooms contain altogether 963 seats, varying in individual rooms according to the varying requirements from 27 to 208 places. With the exception of two, the seminaries for practical studies are placed on the higher floors, so as

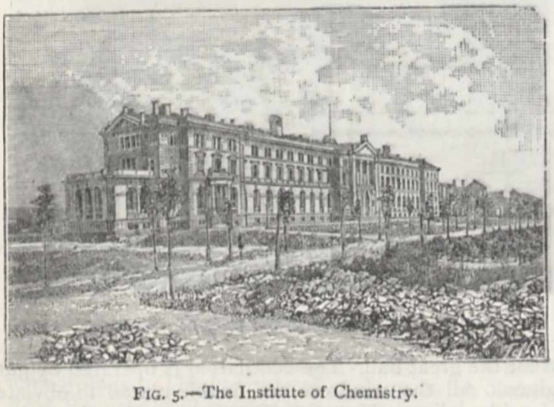

FIG. 5.—The Institute of Chemistry.

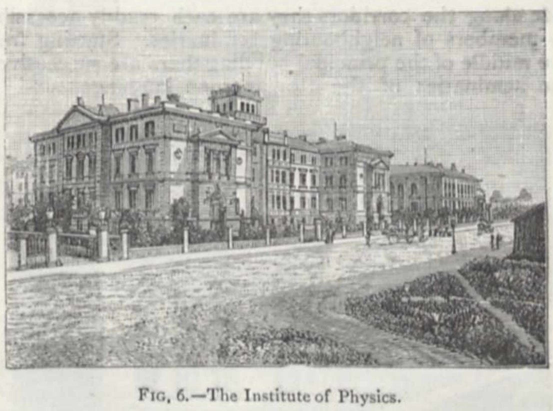

FIG. 6.—The Institute of Physics.

to be quiet enough for their purpose. They are open either all day or during certain hours, under the superintendence or direction of the professors, who each have their own private room beside the room allotted to students.

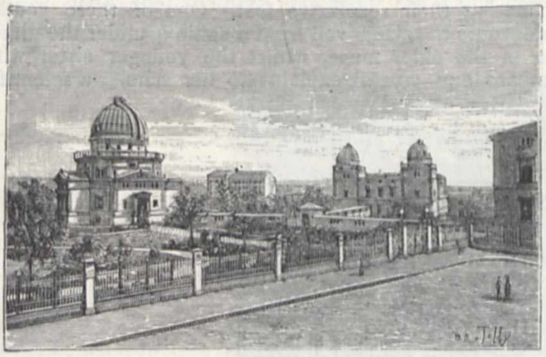

FIG. 7.—The Astronomical Observatory.

These seminaries correspond in their particular line to the laboratories of the faculty of natural science; and they provide for students' collections, appliances and special libraries for each branch of instruction. Placed side by

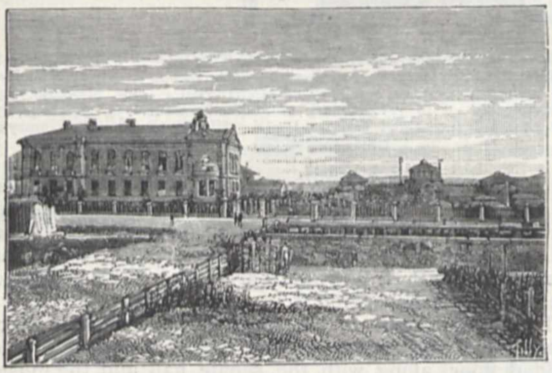

FIG. 8.—The Institute of Botany.

side along the corridors they are each readily accessible to members of neighbouring seminaries. Starting from the middle of the principal building there are successively the seminaries of the Romanesque languages and of

FIG. 9.—The Institute of Anatomy and Pathology.

English, the philological seminary, the institute of archæology, the German seminary, the seminaries of historical science, of philosophy, of jurisprudence, and of political science. All the northern half of the first floor is devoted to art collections, extending from the seminary of political science to the aula or great theatre. In the middle of the western façade is the common lecture hall, flanked on the one side by the library of the institute of archæology, on the other by the rooms of the institute of historical art. A particular hall is reserved for temporary exhibitions. Then comes the hall of Egyptology and the archæological museum organised with as much taste as science by M. Michaelis, the professor of archæology. Egyptology and Arabic have each a special professor.

Beside the seminaries and the art collections the principal floor contains the aula or festival theatre, for the

FIG. 10.—The Surgical Clinical Hospital.

University commemorations. Lit from above this hall occupies the middle of the front façade, and is approached at both ends by the grand staircases. Five open arcades separate the aula from an exterior room reserved for the public. The theatre itself is 82 feet long, $47\frac{1}{2}$ wide, and 33 high. It seats 450 persons, whilst the external chamber admits of 200 to 300 standing places. The decorations are in plaster, and there is a bust of the Kaiser Wilhelm against the northern wall in white marble.

The heating arrangements—partly hot air, partly hot water—are in the basement, a combined system being used for the class-rooms, hot air alone for the corridors

FIG. 11.—The Clinical Hospital for Mental Disorders.

and for the great hall. The ventilation is operated by gas engines. All the windows are double-glazed to obviate too rapid cooling. No scientific appliance has been forgotten which might secure good sanitation. The aula, the rector's apartments, the staircases, and the Salle des Pas Perdus are richly ornamented in plaster and with painting. The lecture halls and class rooms are more simple and severe as befits their purpose, but for that very reason nothing has been omitted to give them a solid and almost monumental construction. Sandstone relieved with marble prevails in the interior; whilst the floors of the vestibules and corridors are of mosaic and terrazo.

Each of the special institutes of chemistry, physics, botany, pharmacy, and astronomy, which are grouped behind the collegiate palace, merit a particular description, as well as the hospitals of surgery, obstetrics, and psychiatry, and the institutes of anatomy, physiological chemistry, and of physiology belonging to the faculty of medicine, which are grouped around the civil hospital. Views of these are given in Figs. 5 to 15. Each of these institutes is independent and separate from the others, provided with everything appropriate to its specific purpose. In order to enable the professors, who are the directors of the special institutes, to follow fully the work of the students and the practice of the laboratory, they are provided with residential apartments in the same buildings. To the institute of astronomy is added an astronomical observatory. This is at the present time directed by Dr. Schur, in consequence of the protracted illness of Prof. Winnecke, who was assistant at the observatory of Pulkowa before coming to Strasburg. At the institute of botany, Prof. von Bary, whose work on cryptogamic flora is well known, has laid out a new botanic garden, to which a second hothouse is yet to be added. To complete the organisation of the University establishments there remain to be erected an institute of geology, an institute of zoology, and an institute of meteorology. The institute of geology, to be directed by Prof. Benecke, will receive the mineralogical and palæontological collections, and at the same time will accommodate the work of the geological survey of Alsace-Lorraine. As to the institute of meteorology, its utility has been already admitted by the provincial government, and its establishment is only a question of time.

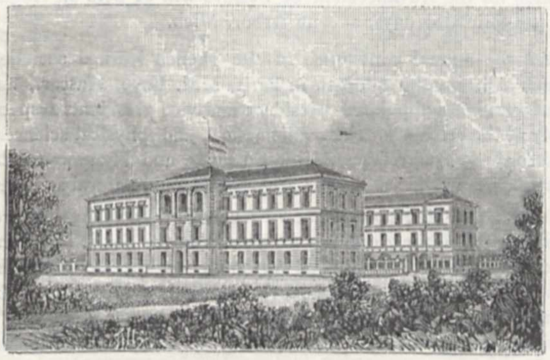

Fig. 12.—The Maternity Hospital.

Fig. 13.—The Institute of Physiological Chemistry.

Toward the sum of 16,000,000 of francs (£640,000) expended up to this year on the new University of Strasburg the German Empire has contributed the sum of 3,800,000 marks, or 4,750,000 francs (£190,000); and of this sum 2,875,000 francs (£115,000) were spent on the collegiate palace. The institute of chemistry alone cost 875,000 francs (£35,000); the institute of physics, 728,750 francs (£29,150); the institute of botany with its garden, 655,000 francs (£26,200); the astronomical observatory, 642,000 francs (£25,600); the institute of anatomy, 1,048,500 francs (£41,740); the surgical clinical hospital, 662,500 frans (£26,500); the institute of physiological chemistry, 400,000 francs (£16,000); the institute of physiology, 337,500 francs (£13,500). It is impossible to give here the details of each institute. Suffice it that each establishment has profited by the latest advances of science, and provides every means of research to students. Henceforth the institutes annexed to the University of Strasburg will serve as models for the installation of similar buildings. They are not only most complete, but are already sought by students. Thus the institute of chemistry, under the direction of Prof. Fittig, is designed to receive 100 students in its two divisions of organic and inorganic chemistry; and there is not a single vacant place. Further information respecting the various institutes and their organisation can be learned from the *Festschrift*, already alluded to as having been written by M. Schricker to commemorate the opening. As the great library of the country has been but temporarily housed in the episcopal château near the Cathedral (in consequence of the fire during the bombardment of 1870) it is intended to remove it to the neighbourhood of the collegial palace of the University. At present, beside the special libraries of the several seminaries, there is only one reading-room (Fig. 3, No. 32) for periodicals and reviews.

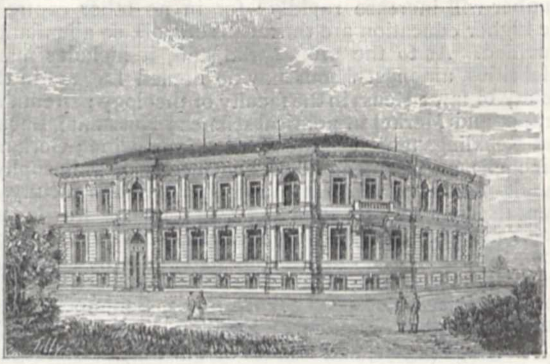

Fig. 14.—The Institute of Pharmacy.

Fig. 15.—The Institute of Physiology.

Down to the present time the native Alsatians and Lorrainers have not frequented the new university as much as might have been expected in proportion to the needs of the province. Young men still turn towards France to follow their studies for the professions at Paris or at

Nancy. Meantime the recruiting of lawyers and doctors goes on at Strasburg with foreign elements, not without some regret on the part of the native inhabitants. But little by little the force of circumstances is tending to bring the young Alsatians to constitute the University of Strasburg in spite of sentiment. Instead of 69 students, natives of Alsace-Lorraine, registered in 1872, the University registers showed 252 in 1884—a notable increase. As against 5,990 matriculated students at the University of Berlin, 3,399 at Leipzig, 2,276 at Munich, 1,646 at Breslau, 1,452 at Halle, 723 at Heidelberg, 625 at Freiburg, there were to be reckoned but 858 at Strasburg during the summer semester of 1884. No doubt this number will increase rapidly; for in no other centre of the higher education are the means of work so abundantly provided. As to the professorial staff, it includes many celebrities, amongst whom may be named Labaud in the faculty of law; Reuss in the faculty of theology; Brentano, Krapp, and Merkel in political science; Kussmaul, Lucke, and Recklingshausen in the faculty of medicine; Gerland, Michaelis, and Studemond in the faculty of philosophy; Kundt, Benecke, von Bary, and Fittig in the faculty of natural sciences. In selecting these names we do not forget the glory of the former university of the last century, when Strasburg had amongst the number of its celebrities Profs. Blessig, Lauth, Schœpflin, Schweighæuser, Oberlin, worthy predecessors of the Duvernoys, Schimpers, Gerhardts, Pasteurs, Daubrées, Sédillots, Janets, Fustels, Coulanges, Forgets, and Kusses of our time. On August 6th, 1771, Goethe graduated doctor of laws of the University of Strasburg, with a thesis on the respective rights of State and Church. If to-day the new University has as an accessory function that of contributing to the Germanisation of the annexed provinces, it may at least be said that the staff of professors of the older university of last century had rallied to French politics in the most open manner. Witness the address to King Louis XV. dated October 6th, 1744:—"Sire, the most faithful of the universities in your kingdom offers to your Majesty its homage and its good wishes. Penetrated with joy at the convalescence and at the arrival of its august monarch, it to-day, Sire, finds united in you the father of the people, the protector of the muses, the liberator of Alsace, and the hero. It is to these glorifications of your rare virtues, great king, that we consecrate our work, happy if our words may correspond to the effusion of our hearts, and merit the continuation of the good graces of the most puissant and most beloved of the sovereigns of Europe."

Formerly the Académie of Strasburg took up the special task of serving as an intermediary between France and Germany for the propagation of ideas and of the scientific movement. More richly endowed, the new University, applying its greater powers to the development of the human mind, will recognise that the representatives of the people of Alsace-Lorraine have wished to promote its efforts in the largest and most generous manner in the higher interests of science. Science ought to contribute to the union of the people; it has no exclusive national character, and it serves to advance the reign of peace in the world by assuring to us greater prosperity and greater light, whilst developing in us all the love of our own country.

NOTES

THE Royal Medals of the Royal Geographical Society will this year be awarded to Mr. Joseph Thomson and Mr. H. E. O'Neill—to the former for his well-known work in Africa, and to the latter for his thirteen journeys of exploration along the coast and in the interior of Mozambique. The Murchison Grant for 1885 will be awarded to the Pandit Kreshna for his four explorations made while attached to the Survey of India, and especially for his extensive and important journey in the interior of Tibet. The Back Grant goes to Mr. W. O. Hodkinson for his Australian explorations, and the Cuthbert Peek Grant to Mr. J. T. Last for his surveys and ethnological researches in the Southern Masai, Nguru, and other neighbouring countries. The following will be made Honorary Corresponding Members:—Chief-Justice Daly, President of the Geographical Society of New York; M. Elisée Reclus, the eminent geographer; and Herr Moritz von Déchy, the distinguished Austrian explorer of the Sikkim Himalayas, the Caucasus, and other regions.

IT is announced that the next meeting of the American Association for the Advancement of Science will be held on August 26 and following days, at Ann Arbor, Mich.

AT the annual conference of the French learned societies, which met on the 8th inst. in Paris, MM. Faye, Mascart, and Darboux, were appointed president and vice-presidents respectively of the section for the mathematical and physical sciences; and MM. de Quatrefages, Milne-Edwards, and Maunoir to the same offices in the section for geographical and natural sciences.

M. HERVÉ-MANGON, the new French Minister of Agriculture, is a Member of the Academy of Sciences in the Section of Rural Economy and a Professor of Agronomy to the Conservatoire des Arts et Métiers. He was for some time a Director of the establishment, but resigned in order to secure a seat in the French Lower House. He married the daughter of the late M. Dumas.

THE next Ordinary General Meeting of the Institution of Mechanical Engineers will be held on Thursday, April 30, and Friday, May 1, at 25, Great George Street, Westminster. The chair will be taken by the President, Mr. Jeremiah Head, at half-past three o'clock p.m. on Thursday, and at half-past seven o'clock p.m. on Friday. The following papers will be read and discussed, as far as time will admit:—Description of the Maxim automatic machine-gun, by Mr. Hiram S. Maxim, of London; Abstract of results of experiments on riveted joints, with their applications to practical work, by Prof. Alexander B. W. Kennedy, of London (including the latest experiments described in Prof. Kennedy's Report, issued to the members in February); Description of the Tripier Spherical Eccentric, by M. Louis Poillon, of Paris; Description of a blooming mill with balanced top roll at the Ebbw Vale Works, by Mr. Calvert B. Holland, of Ebbw Vale.

The Annual Report of the French Central Meteorological Department states that the weather forecasts last year were verified in 90 cases out of every 100, the percentage having steadily risen from 81 in 1881 to 83 in 1882 and to 87 in 1883. Out of 189 alarm signals sent to the ports, 128 were fully verified, 24 were fairly correct, 37 incorrect, and only two gales were not foreseen. This year the gale of January 11 was foretold, but that of March 22, which did such damage at Cherbourg, was not predicted. It took place in exceptional circumstances, and was of short duration.

DURING the second half of last year several communications appeared in NATURE relating to the nests from which the Chinese birds'-nest soup is made. Mr. Pryer, whose account of his visits to the Gomantin Caves in North Borneo, where the nests are chiefly found, initiated the discussion, has now addressed a long communication on the subject to an English journal published in Japan, the main points of which appear to be as follows:—(1) Owing to a misapprehension, Mr. Pryer was represented as saying that the bats which inhabit the caves constructed the nests as well as the swifts. The bats have nothing to do with the nests. (2) Mr. Layard, in his letter published in NATURE (November 27, 1884), speaks of "traces of blood, from the efforts of the birds to produce the saliva." Mr.

Pryer thinks that the patches of brown-red on the nests may be due to blood from the hands of the gatherers, or to the betel-juice which they constantly expectorate, but not to the bird's blood. (3) The birds do not eat algæ; they are purely insectivorous. (4) Mr. Green says (NATURE, December 11) that a chemical and microscopical examination of the nests suggests that they are made from the saliva of the bird. This Mr. Pryer regards as a physical impossibility, for the bird could not secrete in a few days a mass of saliva more than equal, when dried, to the entire bulk of its own body, and then do this nine consecutive times a year. He thinks that, undoubtedly, some saliva is used by the birds, the algæ (which Mr. Pryer incorrectly called "fungoid growth" in his first account) being used in the same way as a Japanese swallow (*Cecropis japonica*) uses mud. This bird gathers pellets of mud and works them up in its mouth, forming a strong cement, constructing a large bottle-shaped nest, sometimes nearly two feet long; and exactly as the *Cecropis japonica* uses mud, so the Bornean *Collocalia fuciphaga* uses algæ, producing thereby the delicate structure known as edible bird's nest. Besides, Mr. Pryer states that the nest examined by Mr. Green was probably not genuine, as the substance is very easily imitated, and the high price would stimulate adulteration. (5) His previous theory that the distinction between white and black nests is due to the brown outside of the algæ being used for the latter, he now renounces. The birds can only use the inside, and black nests are simply white nests grown old and repaired frequently. The difference is not due to any difference in the site or in the kind of bird. This is the writer's present theory. Owing to some accident (a native printer's mishap possibly), portions of Mr. Pryer's paper are not quite coherent and connected, and some of the words and phrases are misplaced with that ingenious absurdity so characteristic of printers' blunders; but we believe we have given the substance of the communication here.

THE sixteenth annual report of the American Museum of Natural History has just been published. Besides various additions to the collections during the year—the principal being 44 specimens of North American birds, 29 specimens of North American mammals, and 20 monkeys—the trustees report a step of great importance taken in creating a section in the museum called "The Department of Public Instruction." The Legislature of the State of New York having appropriated a sum to enable the curators of the museum to give free lectures, illustrated by its collections, to the teachers of common and normal schools throughout the State, the trustees have accepted the duty, and have arranged for a series of lectures extending over four years, twenty in each year, all to be richly illustrated with original views and drawings specially prepared for the course. The curriculum for the first course 1884–85 includes human anatomy and physiology, forestry, building and ornamental stones, and the animal kingdom.

MR. J. A. ALLEN, who for many years has had charge of mammals and birds at the Museum of Comparative Zoology at Cambridge, has, *Science* states, accepted the curatorship of mammalogy and ornithology in the American Museum of Natural History in New York, where he will enter upon his new duties about May 1.

THE American Government have sent 30,000 land-locked salmon to the National Fish Culture Association, which arrived on Saturday in excellent condition. In this country the hybridisation of the various species of Salmonidæ is extensively prosecuted; and it is proposed to try the experiment of cross-breeding the land-locked salmon with the brook trout or char, thus promoting the culture of a better class of fish than the trout which now abound in our rivers.

DR. H. J. JOHNSTON-LAVIS, of Naples, announces the approaching publication of a "Monograph of the Earthquakes of Ischia," a memoir dealing with the seismic disturbances in that island from remotest to recent times, with special observations on those of 1881 and 1883, by himself, with some calculations by Rev. Prof. Samuel Haughton, M.D., F.R.S., F.G.S., &c. The work will be published by subscription, and intending subscribers should communicate with the author, 7, Chiatamone, Naples.

A SHARP shock of earthquake was felt in Rome on the night of the 9th inst. Bells were set ringing, and many persons were momentarily alarmed by the movement, but that was the extent of its effect. Prof. Stefano Michele de Rossi has communicated the following report to the Press:—"At 2.44 a.m. a distinct shock of earthquake aroused a great part of the population of Rome. From the observations obtained it belonged to the sixth degree of the conventional scale of 10 degrees for intensity. It undulated from south-west to north-east, and then from north-west to south-east. The full duration was about 10 seconds, of which four were occupied by the second phase of the phenomenon. A telegram from Avezzano states that the shock was very strong there in the direction of north to south. No damage done." Telegrams received later from Frosinone report that a shock was felt there at the same time with sufficient force to create general alarm among the population.

THERE has been a renewal of earthquake shocks in the provinces of Granada and Malaga. Early on the morning of the 11th oscillations of more or less violence are reported from Velez Malaga, Antequera, Motril, and the city of Granada itself and some surrounding villages. So far as is known there has been no loss of life or serious damage, but the panic at some places is described as intense, and the inhabitants, refusing to return to their houses, remain in the open country.

SEVERAL shocks of earthquake were felt at Geneva on the 13th.

THE most recent contribution to the much-discussed question of the origin of the mound-builders of the United States is a pamphlet by Mr. C. E. Putnam, issued by the Academy of Natural Sciences of Davenport, Iowa. The Bureau of Ethnology connected with the Smithsonian Institute champions the theory that the race which constructed these mounds may be traced to the ancestors of the present American Indians, while another school of archæologists holds that the mound-builders were more advanced in civilisation than the American Indians, and have endeavoured to trace them to a Mexican origin, or to some common ancestry. This being the broad question at issue, the Davenport Academy, which appears to have adopted no theory on the subject, became possessors by donation of three inscribed tablets and two elephant pipes, *i.e.* pipes with the figure of an elephant carved on them, which are stated to have been found in Iowa. In the words of Mr. Putnam, "if their authenticity is established, then archæologists will find in them strong corroborative evidence that man and the mastodon were contemporary on the American continent, and the mound-builders were a race anterior to the ancestors of the present American Indians, and of higher type and more advanced civilisation." But doubts have been cast on the authenticity of these curious relics by the Bureau of Ethnology, and the Davenport Academy has taken the matter up with some warmth. Mr. Putnam's pamphlet is the Academy's reply, and is a vigorous defence of the genuineness of the elephant pipes and inscribed tablets. It describes in detail the circumstances under which they were discovered, the witnesses present, &c., and lays especial stress on the fact that the two pipes were dug up at different times and places, by independent persons, one, at least, of whom had no notion of the value of the object. The whole subject is one of extraordinary interest, and Mr. Putnam's statement, vouched as it is by a formal resolution of the Davenport Academy, must play an important part in any subsequent discussion as to the value to be attached to these remains, which, if authentic, are acknowledged to have much influence on the final settlement of the question as to who the mound-builders were.

THE use of artificial teeth is not so modern as is generally believed. *Cosmos* states that in the museum of Corneto, on the coast of Italy, there are two curious specimens of artificial teeth found in Etruscan tombs probably dating to four or five centuries before our era. These graves contained the bodies of two young girls. On the jaw of one is still to be seen two incisors fixed to their neighbours by small gold rings; in the other the rings remained, but the artificial teeth had fallen out. The teeth, carefully cut, had evidently been taken from the mouth of some large animal. The dentist's art amongst the ancients was not confined to drawing teeth, and replacing them by artificial ones, for natural teeth have been found which have evidently been treated in various ways. That this curious fact has escaped notice so long, is due to the rarity of Etruscan skeletons, the Etruscans employing cremation generally, and also to the circumstance that modern inquirers are more interested in objects of Etruscan art and industry than in the remains of their ancient owners.

WE have received from the Rev. H. H. Higgins the reprint of a paper read by him before the Literary and Philosophical Society of Liverpool on Museums of Natural History. The writer discusses the subject under four heads, to which a fifth, on the British Museum of Natural History, is added. These are Museum visitors' desiderata, arrangements and appliances. Judging from the attendance at the Liverpool Museum, he calculates that a large majority (about 780 in 1000) of the visitors are those who are not conscious of any purpose beyond a wish to see the Museum, but who fix their attention with more or less intelligence on the objects displayed. The students would number about ten to twenty, and loungers, including children, 200 in the thousand. The first desideratum in a public museum is a better treatment of the specimens which they already possess. The Museum, Mr. Higgins thinks, is a rare one, in which a donation of 100*l.* could *best* be spent in the purchase of fresh specimens; in almost all instances it could be better spent in making the order more intelligible and more instructive, and much of this good work might be done without spending any money. The sections on arrangements and appliances contain many interesting suggestions on these important elements in the success of a museum. A *stammbaum*, or phylogenetic scheme of the pedigree of animals and vegetables, by Prof. Herdman, of University College, Liverpool, is added to Mr. Higgins's paper.

WE have received Dr. Howden's presidential address to the Montrose Scientific and Field Club, on the "Aims of a Naturalists' Field Club," which contains much useful advice as to the methods in which the members of such societies should regulate their studies and researches. What has already been done in local natural history in the vicinity of Montrose and suggestions as to what still lies ready at hand to be done, are described in the concluding portion of the address.

Timber, a weekly journal devoted to the timber and kindred interests, is the title of a new journal, the first number of which appeared on February 28. A large portion of this periodical is occupied with trade announcements and records of sales, with a sprinkling of short articles and paragraphs on subjects connected with the uses of timber or the timber supply. The paper is intended for circulation among, and as the representative of, the numerous trades who work in timber, and does not profess to be anything else.

THE experiments in Paris by the Triboulet system of photographing all the country seen from a captive balloon by opening the valve of a panoramic object-glass with a current sent from the ground has succeeded wonderfully well. As the operators remain on the ground a very small balloon is sufficient to carry the photographic apparatus. The impressions being taken on films can be inspected with a microscope, and are useful for military purposes.

THE additions to the Zoological Society's Gardens during the past week include a Pig-tailed Monkey (*Macacus nemestrinus* ♀) from Java, presented by Mrs. Urquhart; a Chinese Mynah (*Acridotheres cristatellus*) from China, presented by Mr. George Rowler; a Galeated Curassow (*Pauxis galeata* ♂) from Venezuela, presented by Mr. G. A. Crawley; a Chilian Sea Eagle (*Geranoaetus melanoleucus*) from Chili, presented by Mr. Richard J. Jones; a Carrion Crow (*Corvus corone*), British, presented by Mr. A. Browning Priestley; a Smooth Snake (*Coronella lævis*) from Hampshire, presented by Mr. W. H. B. Pain; a Tibetan Wild Ass, or Kiang (*Equus hemionus* ♀) from Tibet, four Sonnerat's Jungle Fowls (*Gallus sonnerati* ♂ ♂ ♀ ♀) from Southern India, deposited; a Mandarin Duck (*Æx galericulata* ♂) from China, a Dark Green Snake (*Zamenis atrovirens*), South European, purchased; two Rendall's Guinea Fowls (*Numida rendalli*) from East Africa, received in exchange; a Gigantic Salamander (*Megalobactrachus giganteus*) from Japan, two Bull Frogs (*Rana catesbiana*) from North America, received on approval; a White-fronted Lemur (*Lemur albifrons*), born in the Gardens.

GEOGRAPHICAL NOTES

MR. WADA, of the Japanese Legation in Berlin, recently laid before the Geographical Society there certain maps produced by the Geological Survey of Japan, which represent the work up to the present of that establishment. It was founded in 1879, and was organised by Dr. Naumann, a German geologist. It consists of topographical, geological, and agrenomical sections, and of a technical and chemical laboratory. The maps prepared by the department for the Geological Congress of Berlin this year were:—(1) An oroplastic map, on a scale of 1 : 860,000, showing the general position and form of the Japanese archipelago, the coasts, ranges of mountains, as well as the depths of the ocean off the coast. (2) A magnetic map. During the preliminary topographical survey magnetic variations were investigated by the help of a portable magnetometer. Magnetic investigations are of extraordinary interest in Japan. The maps show that the variations are frequently very different in kind, the numerous volcanoes causing great irregularity. (3) A geological map constructed from the preliminary surveys of Dr. Naumann and native geologists. This is based on a topographical map, which is not reliable in detail; but it shows the knowledge attained so far of the geological structure of Japan. From this it appears that all the formations are met with in that country, the Palæozoic being universal. Next to these in extent comes granite. A complete report on this subject is to be made by the head of the Survey to the Congress. The topographers have worked now for about four years, and the area surveyed is more than eighty geographical miles square. The completion of the maps for the whole country will take another eight years. The detailed geological survey has reached about the same extent as the topographical survey, but none of the sheets of the map have yet been published, although they exist in manuscript down to the 38th parallel, with the exception of Yezo. The maps, as well as the text, appear in Japanese and English, and the Survey publishes also annual reports, eight of which have already appeared, but only in Japanese. Another map, also prepared for the Congress, is one of the volcanoes, the ages being distinguished by colours. An important portion of the work of the Survey is the study of soils. According to Mr. Wada, a volcanic tufa, consisting for the most part of decomposed silicates, forms a large part of the numerous uncultivated plains at the foot of the mountains. An accurate knowledge of this will be of much value to agriculture. Japanese soils in general are stated to be poor in chalk. This subject will also be dealt with by the head of the Agronomical Section before the forthcoming Congress.

THE last *Bulletin de la Société de Geographie* (1er Trimestre, 1885), contains a paper by M. de Mailly-Chalon on a journey in Manchuria. With two countrymen he left Peking for Newchwang, and thence passing to the east of Moukden, through Kirin to Ninguta, where the party turned to the south-east along the Tiumen, towards the ocean, and reached Vladivostock. The journey the whole way was along the Corean frontier. Leaving Vladivostock the travellers crossed Siberia to Tomsk, from which they went to Samarkand. From this point the story of the journey is taken up by another member of the party, Baron Benoist-Méchin, whose paper on the journey across Turkestan succeeds M. Mailly-Chalon's. This journey led them from Samarkand through Karshi, to Bokhara, thence to the Amou-Darya at Charjui. They followed the river then down to Petro-Alexandrovsk, whence they deviated to Khiva. From the latter town they retraced their steps up the river, and from Kurgan-Chin started across the Kara-Kum to Merv, and so to Sarakhs and Persian territory at Meshed. The journey, here barely indicated, lasted two years, *i.e.* from the departure from Japan for Peking to the arrival in Teheran. M. Rabot writes on Nordenskjöld's expedition to Greenland, the paper being compiled from the Professor's reports to Mr. Oscar Dickson, published in the *Journal* of the Swedish Society of Anthropology and Geography. M. Charles Huber brings to an end his long journeys in Central Arabia, between 1878 and 1882, to which we have adverted in noticing previous numbers of the *Bulletin*.

AT the meeting of the Paris Geographical Society on the 7th inst., M. Giraud was received with great distinction, and detailed his recent travels in Africa. The explorer has received the gold medal of the Society and the Cross of the Legion of Honour.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, *APRIL* 19-25

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

At Greenwich on April 19

Sun rises, 4h. 57m.; souths, 11h. 59m. 0·7s.; sets, 19h. 1m.; decl. on meridian, 11° 20′ N.: Sidereal Time at Sunset, 8h. 53m.

Moon (at First Quarter on April 21) rises, 8h. 10m.; souths, 16h. 4m.; sets, 23h. 58m.; decl. on meridian, 18° 14′ N.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury ...	5 4 ...	12 44 ...	20 24 ...	18 2 N.
Venus ...	4 57 ...	11 45 ..	18 34 ...	8 47 N.
Mars ...	4 36 ...	11 7 ...	17 38 ...	5 21 N.
Jupiter ...	12 45 ...	20 2 ...	3 19* ...	14 3 N.
Saturn ...	7 22 ...	15 28 ...	23 34 ...	22 3 N.

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

Occultations of Stars by the Moon

April	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
20 ...	λ Geminorum ...	3½ ...	22 59 ...	23 20 ...	187 232
22 ...	B.A.C. 3122 ...	6½ ...	21 4 ...	22 4 ...	127 255
23 ...	π Leonis ...	... 5 ...	18 46 ...	19 42 ...	14 290
24 ...	*d* Leonis ...	... 5 ...	23 7 ...	23 58 ...	135 238

Phenomena of Jupiter's Satellites

April	h. m.		April	h. m.	
20 ...	1 12	I. tr. ing.	22 ...	2 24	III. occ. disap.
	22 19	I. occ. disap.		20 14	I. ecl. reap.
21 ...	1 45	I. ecl. reap.	23 ...	2 28	II. occ. disap.
	19 39	I. tr. ing.	24 ...	20 34	II. tr. ing.
	21 59	I. tr. egr.		23 30	II. tr. egr.
			25 ...	19 55	III. tr. egr.

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

April	h.	
19 ...	1 ...	Saturn in conjunction with and 4° 1′ north of the Moon.
22 ...	3 ..	Jupiter stationary.
23 ...	19 ...	Jupiter in conjunction with and 4° 37′ north of the Moon.

ON A REMARKABLE PHENOMENON OF CRYSTALLINE REFLECTION[1]

Introduction.

IN a letter to me, dated March 29, 1854, the late Dr. W. Bird Herepath enclosed for me some iridescent crystals of chlorate of potash, which he thought were worth my examination. He noticed the intense brilliancy of the colour of the reflected light, the change of tint with the angle of incidence, and the apparent absence of polarisation in the colour seen by reflection.

The crystals were thin and fragile, and rather small. I did not see how the colour was produced, but I took for granted that it must be by some internal reflection, or possibly oblique refraction, at the surfaces of the crystalline plates that the light was polarised and analysed, being modified between polarisation and analysation by passage across the crystalline plate, the normal to which I supposed must be sufficiently near to one of the optic axes to allow colours to be shown, which would require no great proximity, as the plates were very thin. To make out precisely how the colours were produced seemed to promise a very troublesome investigation on account of the thinness and smallness of the crystals: and, supposing that the issue of the investigation would be merely to show in what precise way the phenomenon was brought about by the operation of well-known causes, I did not feel disposed to engage in it, and so the matter dropped.

But more than a year ago Prof. E. J. Mills, F.R.S., was so good as to send me a fine collection of splendidly coloured crystals of the salt of considerable size, several of the plates having an area of a square inch or more, and all of them being thick enough to handle without difficulty. In the course of his letter mentioning the despatch of the crystals, Prof. Mills writes: "They [the coloured crystals] are, I am told, very pure chemically, containing at most 0·1 per cent. foreign matter. They are rarely observed—one or two perhaps now and then in a large crystallisation . . . I have several times noticed that small potassic chlorate crystals, when rapidly forming from a strong solution, show what I suppose to be interference colours; but the fully formed crystals do not show them."

Some time later I was put into communication with Mr. Stanford, of the North British Chemical Works, Glasgow, from which establishment the crystals sent me by Prof. Mills had come. Mr. Stanford obligingly sent me a further supply of these interesting crystals, and was so kind as to offer to try any experiment that I might suggest as to their formation.

On viewing through a direct-vision spectroscope the colours of the crystals which I had just received from Prof. Mills, the first glance at the spectrum showed me that there must be something very strange and unusual about the phenomenon, and determined me to endeavour to make out the cause of the production of these colours. The result of my examination is described in the present paper.

Section I.—*Preliminary Physical Examination.*—1. It will be necessary to premise that chlorate of potash belongs to the oblique system of crystallisation. The fundamental form may be taken as an oblique prism on a rhombic base, the plane bisecting the obtuse dihedral angle of the prism being the plane of symmetry. Rammelsberg denotes the sides of the prism by P, and the base by C, and gives for the inclinations of the faces PP = 104° 22′ and CP = 105° 35′. The face C, which is perpendicular to the plane of symmetry, is so placed as to bring three obtuse plane angles together at two opposite corners of the parallelepiped. The salt usually forms flat, rhombic or hexagonal plates parallel to the C plane, the edges of the rhombus being parallel to the intersections of the P faces by the C plane, and the hexagons being formed from the rhombic plates by truncating the acute angles by faces parallel to the intersection of the C plane by the plane of symmetry.

The plane angles of the rhombic plates, calculated from the numbers given by Rammelsberg, are 100° 56′ and 79° 4′, while the hexagonal plates present end-angles of 100° 56′ and four side-angles of 129° 32′. These angles are sufficiently different to allow in most cases the principal plane of a plate, or even of a fragment of a plate, to be determined at once by inspection. But in any case of doubt it may readily be found without breaking the crystal by examining it in polarised light. There are

[1] Paper read at the Royal Society on March 19 by Prof. G. G. Stokes, M.A., Sec. R.S., Lucasian Professor of Mathematics in the University of Cambridge.

good cleavages parallel to the two P planes and to the C plane. The crystals are very commonly twinned, the twin plane being C.

2. If one of the brilliantly coloured crystals be examined by reflection, and turned around in its own plane, without altering the angle of incidence, the colour disappears twice in a complete revolution. The vanishing positions are those in which the plane of incidence is the plane of symmetry. The colour is perhaps most vivid in a perpendicular plane; but for a very considerable change of azimuth from the perpendicular plane there is little variation in the intensity of the colour. There is no perceptible change of tint, but on approaching the plane of symmetry the colour gets more and more drowned in the white light reflected from the surface.

3. If instead of altering the azimuth of the plane of incidence a plane be chosen which gives vivid colour, and the angle of incidence be altered, the colour changes very materially. If we begin with a small angle the colour begins to appear while the angle of incidence is still quite moderate. What the initial colour is, varies from one crystal to another. As we increase the angle of incidence the colour becomes vivid, at the same time changing, and as we continue to increase the angle the change of colour goes on. The change is always in the order of increasing refrangibility; for example, from red through green to blue. Not unfrequently, however, the initial tint may be green or blue, and on approaching a grazing incidence we may get red or even yellow mixed with the blue, as if a second order of colours were commencing.

4. The colours are not in any way due to absorption; the transmitted light is strictly complementary to the reflected, and whatever is missing in the reflected is found in the transmitted. As in the case of Newton's rings, the reflected tints are much more vivid than the transmitted, though, as will presently appear, for a very different reason.

5. As Dr. Herepath remarked to me long ago, the coloured light is not polarised. It is produced indifferently whether the incident light be common light or light polarised in any plane, and is seen whether the reflected light be viewed directly or through a Nicol's prism turned in any way. The only difference appears to be that if the incident light be polarised, or the reflected light analysed, so as to furnish or retain light polarised perpendicularly to the plane of incidence, the white light reflected from the surface, which to a certain extent masks the coloured light, is more or less got rid of.

6. The character of the spectrum of the reflected light is most remarkable, and was wholly unexpected. A direct-vision hand spectroscope was used in the observations, and the crystal was generally examined in a direction roughly perpendicular to the plane of symmetry; but it is shown well through a wide range of azimuth of the plane of incidence. No two crystals, we may say, are alike as to the spectrum which they show, but there are certain features common to all. The remarkable feature is that there is a pretty narrow band, or it may be a limited portion of the spectrum, but still in general of no great extent, where the light suffers total or all but total reflection. As the ang'e of incidence is increased, these bands move rapidly in the direction of increasing refrangibility, at the same time increasing in width. The character of the spectrum gradually changes as the angle of incidence is increased; for example, a a single band may divide into two or three bands.

The bands are most sharply defined at a moderate angle of incidence. When the angle of incidence is considerably increased, the bands usually get somewhat vague, at least towards the edges.

7. The commonest kind of spectrum, especially in crystals prepared on a small scale, which will be mentioned presently, is one showing only a single bright band; and I will describe at greater length the phenomena presented in this case.

When the angle of incidence is very small, the light reflected from the reflecting surfaces of the crystal shows only a continuous spectrum. As the angle of incidence is increased, while it is still quite moderate a very narrow bright band shows itself in some part of the spectrum. The particular part varies from one crystal to another; it may be anywhere from the extreme red to the extreme violet. It stands out by its greatly superior brightness on the general ground of the continuous spectrum, and when it is fully formed the reflection over the greater part of it appears to be total. The appearance recalls that of a bright band such as the green band seen when a calcium salt, or the orange band seen when a strontium salt, is put into a Bunsen flame. The bright band is frequently accompanied right and left by maxima and minima of illumination, forming bands of altogether subordinate importance as regards their illumination. Sometimes these seem to be absent, and I cannot say whether they are an essential feature of the phenomenon, which sometimes fail to be seen because the structure on which the bands depend is not quite regularly formed, or whether, on the other hand, they are something depending on a different cause.

Disregarding these altogether subordinate bands, and taking account of the mean illumination, it seems as if the brightness of the spectrum for a little way right and left of the bright band were somewhat less than that at a greater distance.

When the main band occurs at either of the faint ends of the spectrum, it is visible, by its superior brightness, in a region which, as regards the continuous spectrum, is too faint to be seen, and thus it appears separated from the continuous spectrum by a dark interval.

When the angle of incidence is increased, the band moves in the direction of increasing refrangibility, and at the same time increases rapidly in breadth. The increase of breadth is far too rapid to be accounted for merely as the result of a different law of separation of the colours, which in a diffraction spectrum would be separated approximately according to the squared reciprocal of the wave-length, while in bands depending on direct interference the phase of illumination would change according to the wave-length.

8. The transmitted light being complementary to the incident, we have a dark band in the transmitted answering to the bright band in the reflected. In those crystals in which the band is best formed, it appears as a narrow black band even in bright light. When the band first appears as we recede from a normal incidence it is extremely narrow, but it rapidly increases in breadth as the angle of incidence is increased.

9. Some of the general features of the phenomenon were prettily shown in the following experiment:—

Choosing a crystal in which the bright band in the reflected light began to appear, as the incidence was increased, on the red side of the line D, so that on continuing to increase the incidence it passed through the place of the line D before it had become of any great width, I viewed through the crystal a sheet of white paper illuminated by a soda flame. A dark ring was seen on the paper, which was circular, or nearly so, and was interrupted in two places at opposite extremities of a diameter, namely, the places where the ring was cut by the plane of symmetry. The light of the refrangibility of D was so nearly excluded from the greater part of the ring that it appeared nearly black, though slightly bluish, as it was illuminated by the feeble radiation from the flame belonging to refrangibilities other than those of the immediate neighbourhood of D. The ends of the two halves of the ring became feeble as they approached the plane of symmetry. A subordinate comparatively faint ring lay in this crystal immediately outside the main one.

10. Suspecting that the production of colour was in some way connected with twinning, I examined the cleft edge of some of the crystals which happened to have been broken across, and found that the bright reflection given by the exposed surface was interrupted by a line, much finer than a hair, running parallel to the C faces, which could be easily seen with a watchmaker's lens, if not with the naked eye. This line was dark on the illuminated bright surface exposed by cleavage, a surface which I suppose illuminated by a source of light not too large, such as a lamp, or a window at some distance. The plane of incidence being supposed normal to the intersection of the cleavage plane by the C faces, on turning the crystal in a proper direction around a normal to the plane of incidence, the light ceased to be reflected from the cleavage surface, and after turning through a certain angle, the narrow line which previously had been dark was seen to glisten, indicating the existence of a reflecting surface, though it was much too narrow to get a reflected image from off it. The direction of rotation required to make the fine line glisten was what it ought to be on the supposition that the fine line was the cleavage face of an extremely narrow twin stratum.

11. On examining the fine line under the microscope, it was found to be of different thicknesses in different crystals, though in those crystals which showed colour it did not vary very greatly. On putting a little lycopodium on the cleavage face interrupted by the fine line, it was seen that in those crystals which showed colour the breadth of the twin stratum varied from a little greater to a little less than the breadth of a spore. The thickness

accordingly ranged somewhere about the thousandth of an inch, such being the diameter of the spores. The stratum was visibly thicker in those crystals which showed their bright band in the red than in those which showed it in the blue.

12. That the thin twin stratum was in fact the seat of the colour, admitted of being proved by a very simple experiment. It was sufficient to hold a needle, or the blade of a penknife (I will suppose the latter), close to or touching the surface of the crystal while it was illuminated by light coming approximately in one direction, suppose from a lamp, or from a window a little way off, and to examine the shadows with a watchmaker's lens. The light reflected from the crystal comes partly from the upper surface, partly from the twin stratum, partly from the under surface, which, however, may be too irregular to give a good reflection. The twin stratum is much too thin to allow of separating the light reflected from its two surfaces in an observation like the present, and it must therefore be spoken of as simply a reflecting surface. Corresponding to the three reflecting surfaces are three shadows, where the incident light is cut off: (1) from the upper surface, (2) from the twin stratum, (3) from the under surface. By examining these shadows in different crystals and under varied conditions, it is shown beyond doubt that the coloured reflection comes from the twin stratum.

The conclusion was confirmed by observations made with sunlight; but the simple method of shadows is quite as good, and even by itself perfectly satisfactory.

13. Another useful method of observation, not so very simple as the last, is the following. A slit, suppose horizontal, not very narrow, is placed in front of the flame of a lamp at some distance, and an image of the slit is formed by a suitable lens, such as the compound achromatic objective of an opera-glass. The crystal is placed so as to receive in focus the image of the slit, being inclined at a suitable angle, usually in a plane perpendicular to the plane of symmetry. The eye is held in a position to catch the reflected light, and the images formed by the different reflections are viewed through a watchmaker's lens. If the slit be not too broad, the images formed by reflection from the upper surface, from the twin stratum, and from the under surface are seen distinct from each other, so that the light reflected from the twin stratum may be studied apart from that reflected from the upper and under surfaces.

In this mode of observation it can readily be seen, by turning the crystal in its own plane, and noticing the middle image, which is that reflected from the twin stratum, how very small a rotation out of the position in which the plane of incidence had been the plane of symmetry suffices to re-introduce the coloured light, which had vanished in that critical position, which appears to be a position not merely of absence of colour, but of absence of light altogether; at least if there be any it is too feeble to be seen in this mode of observation, though from theoretical considerations we should conclude that there must be a very little reflected light, polarised perpendicularly to the plane of incidence.

14. On allowing a strong solution of chlorate of potash in hot water to crystallise rapidly, in which case excessively thin plates are formed in the bosom of the liquid, I noticed the play of colours by reflection mentioned by Professor Mills as belonging to the crystals in general at an early stage of their growth. This, however, proved to be quite a different and no doubt a much simpler phenomenon. The difference was shown by the polarisation of the light, and above all by the character of the spectrum of the light so reflected, which resembled ordinary spectra of interference, and did not present the remarkable character of the spectra of the peculiar crystals.

15. When, however, the whole was left to itself for a day or so, among the mass of usually colourless crystals a few were found here and there which showed brilliant colours. These colours were commonly far more brilliant than those of the crystals mentioned in the preceding paragraph, and they showed to perfection the distinctive character of the spectrum of the peculiar crystals. It would have been very troublesome, if possible at all, to examine the twinning of such thin and tender plates as those thus obtained by working on a small scale; but the character of the spectrum, which is perhaps the most remarkable feature of the phenomenon, as well as the dependence of the colour on the orientation, may be examined very well; and thus any one can study *these* features of the phenomenon, though he may not have access to such fine coloured crystals as those sent me by Professor Mills.

16. A certain amount of disturbance during the early stages of crystallisation, whether from natural currents of convection or from purposely stirring the solution, somewhat gently so as not to break the crystals, seems favourable to the production of the peculiar crystals. When the salt crystallised slowly from a quiet solution I did not obtain them.

17. As it is easy in this way, by picking out the peculiar crystals from several crystallisations, to obtain a good number of them, the observer may satisfy himself as to the most usual character of the spectrum. It is best studied at a moderate incidence, as it is sharper than when the incidence is considerable.

18. The number of coloured crystals obtained by crystallisations on a small scale, though very small, it is true, compared with the number of colourless ones, was still so much larger than Prof. Mills's description of the rarity of the crystals had led me to expect, that I at one time doubted whether the simply twinned crystals which are so very common, if taken at a period of their growth when one component is still very thin, and of suitable thickness, might not possibly show the phenomenon, though the thin twin was in contact on one face only with the brother twin, the other face being in the mother-liquor or in air. The circumstances of reflection and transmission at the first surface of the twin plate must be very different according as it is in contact with the brother crystal, or else with the mother-liquor, or air, or some other fluid; and yet the peculiar spectrum was shown all the same whether the crystal was in air, or immersed in the mother-liquor, or in rock oil. However, to make sure of the matter I took a simply twinned crystal, and ground it at a slight inclination to the C face till the twin plane was partly ground away, thus leaving a very slender twin wedge forming part of the compound crystal, and polished the ground surface. On examining the reflected light with a lens, no colour was seen about the edge of the wedge, where the thickness of the wedge tapered away to nothing; and that, although the bands seen near the edge in polarised light, which was subsequently analysed, showed that had colours been producible in this way, as they are by a thin twin stratum, they would not have been too narrow to escape observation.

In another experiment a simply twinned crystal was hollowed out till the twin plane was nearly reached. The hollowing was then continued with the wetted finger, so as to leave a concave smooth surface, the crystal being examined at short intervals in polarised light as the work went on, so as to know when the twin plane was pierced. But though in this case the twin plane formed a secant plane, nearly a tangent plane, to the worked surface, and near the section the twin portion of the crystal must have been very thin for a breadth by no means infinitesimal, as was shown by examination in polarised light, yet no colours were seen by reflection. I conclude therefore that the production of these colours requires the twin stratum to be in contact on *both* its faces with the brother crystal.

19. The fact that a single bright band is what most usually presents itself in the spectrum of the reflected light, though sometimes two or three such bands at regular intervals may be seen, seems to warrant us to regard that as the kind of spectrum belonging to the simplest form of twin stratum, namely, one in which there are just the two twin surfaces near together. The more complicated spectra seem to point to a compound interference, and to be referable to the existence of more than two twin planes very near together; and in fact in some of the crystals which showed the more complicated spectra, and which were broken across, I was able to make out under the microscope the existence of a system of more than two twin planes close together. Restricting ourselves to what may be regarded as the normal case, we have then to inquire in what way the existence of two twin planes near together can account for the peculiar character of the spectrum of the reflected or transmitted light.

Section II.—*Of the Proximate Cause of the Phenomenon.*—20. Though I am not at present prepared to give a complete explanation of the very curious phenomenon I have described, I have thought it advisable to bring the subject before the Society, that the attention of others may be directed to it.

That the seat of the coloration is in a thin twin stratum, admits I think of no doubt whatsoever. A single twin plane does not show anything of the kind.

For the production of the colour the stratum must be neither too thick nor too thin. Twin strata a good deal thicker than those that show colour are common enough; and among the crystals sent to me I have found some twin strata which were a good deal thinner, in which case the crystal showed no colour.

The more complicated spectra which are frequently observed seem referable to the existence of more than two twin planes in close proximity. There is no reason to think that the explanation of these spectra would involve any new principle not already contained in the explanation of the appearance presented when there are only two twin planes, though the necessary formulæ would doubtless be more complicated.

Corresponding to a wave incident in any direction, in one component of a twin, on the twin plane, there are in general two refracted waves in the second component in planes slightly inclined to each other, and two reflected waves which also have their planes slightly inclined to each other, the angle of inclination, however, being by no means *very* small, as chlorate of potash is strongly double refracting. The planes of polarisation of the two refracted waves are approximately perpendicular to each other, as are also those of the two reflected waves; but on account of the different orientation of the two components of the twin, the planes of polarisation of the two refracted waves are in general altogether different from those of the incident wave and of its fellow, the trace of which on the twin plane would travel with the same velocity. In the plane of symmetry at any incidence, and for a small angle of incidence at any azimuth of the plane of incidence, the directions of the planes of polarisation of the two refracted waves agree accurately or nearly with those of the incident wave and its fellow. In these cases, therefore, an incident wave would produce hardly more than one refracted wave, namely, that one which nearly agrees with the incident wave in direction of polarisation. In these cases the colours are not produced. It appears, therefore, that their production demands that the incident wave shall be very determinately divided into two refracted waves, accompanied of course by reflected waves

It seems evident that the thickness of the stratum affects the result through the difference of phase which it entails in the two refracted waves on arriving at the second twin plane. But whereas in the ordinary case of the production of colour by the interposition of a crystalline plate between a polariser and an analyser, we are concerned only with the difference of retardation of the differently polarised pencils which are transmitted across the plate, and not with the absolute retardation, it is possible that in this case we must take into account not only the difference of retardation for the differently polarised pencils which traverse the stratum, but also the absolute retardation; that is, the retardation of the light reflected from the second relatively to that reflected from the first twin plane.

21. I have not up to the present seen my way to going further. It is certainly very extraordinary and paradoxical that light should suffer total or all but total reflection at a transparent stratum of the very same substance, merely differing in orientation, in which the light had been travelling, and that, independently of its polarisation. It can have nothing to do with ordinary total internal reflection, since it is observed at quite moderate incidences, and *only within very narrow limits* of the angle of incidence.

RECENT PROGRESS IN CHEMISTRY[1]

THE progress of chemistry during the last year has been considerable, and a great deal of interesting and important work has been done. Nevertheless it cannot be said to have been a year productive of any very special discoveries. In physical chemistry the subjects connected with heat have occupied a good deal of attention, such as the heat of formation of chemical compounds, &c. Experiments on the liquefaction and solidification of gases by pressure and low temperature have also been continued, and, in addition to the results which were obtained some time since, we now know chlorine, not only as a liquid, but also as a crystalline solid. The same is true of hydrochloric acid, carbonic oxide, silicon fluoride, and assinuretted hydrogen.

Last year I referred to the work which was being done with hydroxylamine, and also mentioned that another analytical reagent of equal importance was claiming attention, viz. Emil Fischer's phenylhydrazine. The promise of new work which this substance gave has been fully realised, and it has proved useful, not only as an analytical reagent, but has been the means of producing a number of new and important products.

Work is still actively pursued on the pyrroline, pyridine, and quinoline series, and it is remarkable to see how new methods for the production of bodies of this description are being constantly discovered. Those of A. Behrmann and Hofmann, who obtain pyridine derivatives from citramide, and of H. v. Pechmann, who obtains them from malic acid, may be taken as illustrations.

It is interesting to notice, in reference to the pyridine series, Ladenburg's experiments (*Ber.*, xvii. 772-74), who finds that the compounds formed by the union of these bases with the iodides of the alcohol radicals, when strongly heated, yield substituted pyridines in the same way as Hofmann showed some time since that aniline, under like circumstances, yielded substituted anilines, such as toluidine, &c. Hofmann (*Ber.*, xvii. 1200) has also found that conine hydrochloride, when distilled with zinc dust, yields a base he has named conyrine, which he believes to be a propyl or isopropyl pyridine; and this, by treatment with hydriodic acid at 280°-300°, regenerates conine, which has exactly the same physiological action as the natural (though it is probably optically inactive). Ladenburg (*Ber.*, xvii. 1196) has obtained a propylpyridine which, when treated with sodium and alcohol, yields a base smelling very much like conine; it has many properties in common with conine, and, like it, is poisonous, acting in the same manner and to the same degree. It is, however, optically inactive, as might be expected. It will be remembered that Schiff (*Ann. Ch. Pharm.*, clvii. 352) obtained a base very similar to conine from isobutyric aldehyde and ammonia some years ago, but it did not appear to agree in all its properties with that body. From the new work which has been done in this subject we may now soon expect to have the constitution of this base definitely established. Ladenberg has also succeeded in producing piperidine from pyridine. The identity of this product with that obtained from piperine from pepper has been established (*Ber.*, xvii. 513-515).

Hofmann, while continuing his work on the action of bromine in alkaline solutions in amides, has found the curious fact that nitriles are produced in considerable quantities containing one atom of carbon less than the amide—in fact, corresponding with the amines formed in the reaction, and are, in all probability, produced from them by the removal of the hydrogen atoms. As these nitriles can be converted into amides by sulphuric acid, and again treated with bromine and alkali, it is evident that by this means we can gradually work down step by step from one member of the homologous series to another.

It will be remembered that Pechmann and Duisberg (*Ber.*, xvi. 2119-2128) succeeded in obtaining substituted coumarins and their hydroxy derivatives by acting on aceto and benzoylacetic acids with phenols. Pechmann (*Ber.*, xvii. 929-936) has now succeeded in obtaining coumarins by treating malic acid and phenols with sulphuric acid or chloride of zinc; with ordinary phenol he has obtained coumarin; with resorcinol, umbelliferone and with pyragallol, daphnetin, which gives all the reactions of the natural body.

Some very curious results have lately been obtained in reference to the destructive action of aluminium chloride on hydrocarbons. Friedel and Crafts communicated a paper on this subject to this Society in 1882; it has now been further studied by Auschütz, Immerdorff, and by Jacobson (*Ber.*, xviii. 657). They have found that this action consists in "a transference of the alcohol radical from one molecule of a hydrocarbon to another molecule of the same hydrocarbon." Thus toluene yields, on the one hand, benzene, and on the other, xylene and more highly methylated benzenes, orthoderivatives being very rarely found among the products.

Last year I referred to the discovery of thiophene, or, more properly, thiophen, and its homologues by Victor Meyer. During the year our knowledge of this interesting body has been considerably extended, and its preparation rendered comparatively easy. H. E. Schulze (*Ber.*, xviii. 497) has recently shown that it is contained—as might be expected—in the sulphuric acid used to purify crude benzene, and that if its decomposition be prevented by diluting the acid with an equal bulk of water as soon as it is separated from the benzene, the thiophen which is doubtless present in the form of a sulpho acid may easily be recovered by hydrolysing, by merely passing steam into the acid liquid.

The synthesis of thiophen, recently effected by J. Volhard and H. Erdmann (*Ber.*, xviii. 454) by merely distilling sodium succinate with phosphorus trisulphide (by which about 50 per cent. of the theoretical yield is obtained), is also of interest, as well as the production of methylthiophen from sodium pyro-

[1] From the Annual Address of the President of the Chemical Society, Mr. W. H. Perkin, F.R.S., March 30, 1885.

tartrate by the same reagent. The methylthiophen, however, appears to be isomeric with that separated from coal-tar toluene by Victor Meyer. According to Volhard and Erdmann, thiophen, when cooled in a mixture of carbon dioxide and ether, crystallises like benzene. Paal's synthesis of methyl-phenyl-thiophen from aceto-phenone-acetone, and of thiophen-carboxylic acid—which is easily resolved into carbon-dioxide and thiophen—from mucic acid, may also be referred to here.

One of the most interesting of recent researches is that of R. Nietzki and T. Benckser on hexhydroxybenzene ($C_6HO)_6$ (*Ber.*, xviii. 499)), which they have succeeded in obtaining from nitranilic (dinitrodehydroxyquinone). They find the diimido body obtained from this when treated with nitric acid, yields a product of the composition $C_6H_{16}O_{14}$, which when treated with reducing agents, yields this substance. They also find that when heated with concentrated nitric acid, hexhydroxybenzene is converted into a body having the remarkable formula $C_6H_{16}O_{14}$. This decomposes when heated to 100°, or when boiled with water, carbon dioxide being given off, and on adding potash solution to the residue or the boiled solution, orange yellow needles of a potassium salt of the formula $C_5K_2O_5$ are obtained, which they have identified as potassium croconate, and they believe that the bodies obtained by Lerch (*Am. Chem. Pharm.*, cxxiv. 20) from the compounds of potassium carbonic oxide (formed during the preparation of the metal) were hexyhydroxy-benzene, tetrahydroxyquinone, and the compound $C_6H_{16}O_{14}$, and in fact that the compound $C_6(OK)_6$ is present in "potassium carbonic oxide." From experiments on the remarkable substance $C_6H_{16}O_{14}$, they came to the conclusion that it is a compound of $C_6O_6+8H_2O$, and is a quinone which they call tri-quinoylbenzene. This appears to be confirmed by the production of the intermediate hydroxy compounds, the following being the series of products;—

$$C_6(OH)_6,$$
$$C_6(OH)_4O_2,$$
$$C_6(OH)_2O_4,$$
$$C_6O_6.$$

In reference to agricultural chemistry Messrs. Lawes and Gilbert have contributed a most important and interesting paper to our Society (1884, pp. 305-407) on the ash of wheat-grain and wheat-straw. They gave the analyses of no less than ninety-two wheat-grain and wheat-straw ashes, every ash being of produce of known history of growth as to soil, season, and manuring, all the specimens having been grown at Rothampstead. Out of the many important deductions this paper contains, the following are extremely interesting:—It appears, in reference to the grain, that on the whole there is great uniformity in its mineral composition under different conditions of manuring, provided only it is perfectly and normally ripened. The influence of season producing a much wider range in the mineral constituents of the grain than the manuring. This, however, is not the case with the straw, as it is found that the amount of mineral ash constituents found in the straw, and therefore in the total crop, have a very direct connection with the amounts available in the soil, but the amounts stored up in the grain itself are little influenced by the quantity taken up.

Besides the researches just referred to there has been a considerable amount of good work done, but it would be out of place for me to refer to it more fully in this short review.

Last year I took occasion to refer to the comparatively small amount of original work which was being prosecuted in this country, notwithstanding the increased number of laboratories and the greater facilities which existed for the encouragement of research. It will be seen from the list of papers that the number brought before the Society during the past year has not increased, but if the papers themselves are examined I think we shall find that the amount of work done is somewhat larger, though certainly not so large as it should be; and it is to be hoped that the spirit of research will be stimulated in the laboratories of the kingdom, and that men may be turned out who are not only more or less analysts, but thorough chemists. Let us not be contented with looking back with pride to what our ancestors have done, but let us follow their example.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, January 15, No. 2, 1885.—Determination of Verdet's constants in absolute units (2 figures), by Prof. Leo Arons.—On the formation of ozone hydrogen peroxide and peroxide of sulphur (S_2O_7) by the electrolysis of dilute sulphuric acid (2 figures), by Franz Richarz.—Reply to some statements by F. Kohlrausch, by H. Wild.—On the method of damping for determining the ohm, by Lord Rayleigh.—On the determination of specific heats and melting points at high temperatures (11 figures and 6 tables).—Inaugural address, by Otto Ehrhardt.—Two new methods of finding the angle of polarization of metals, by H. Knoblanch (tables).—The determination of the specific heat of uranium, by Ad. Blüncke.—Experimental research on laws of the emission of light from glowing bodies (5 figures and 7 tables), by W. Möller.—Remarks on J. Fröhlich's treatise, "Kritisches zur Theorie des gebeugten Lichts," by M. Réthy.—Observations on fluorescence, by E. Lommel.—On the double acetates of uranium (9 figures), by C. Rammelsberg.—Note on Kundt's dust figures (2 figures), by H. J. Oosting.

Journal de Physique Théorique et Appliquée, February.—Observations upon the corona now visible around the sun, by M. A. Cornu.—Researches on the combustion of gaseous explosive mixtures, with figures and tables, by MM. Mallard and Le Chatelier.—A new telegraphic system, by M. Estienne.—An experiment in hydrodynamics, by M. P. Parize.—A magneto-electric phenomenon, by C. V. Boys.—A new interference phenomenon produced by sheets of glass with parallel surfaces, and on a method of verifying the parallelism of the surfaces of these sheets, by O. Lummer.—Influence of change of condition from the liquid to the solid state on vapour-pressure, by W. Ramsay and Sydney Young.—Non-sparking key, by W. E. Ayrton and John Perry.—A new arrangement for measuring work, by C. F. Brackett.—Coloured dust particles, by H. H. Hagen.—The horizontal motion of small floating bodies, and the truth of the postulates of the theory of capillarity, by J. Leconte.—Method of registering the free vibrations of a tuning-fork, and the beats, by A. G. Compton.—The expression of electrical resistance as the function of velocity, by F. E. Nipher.—Contributions to meteorology: the reduction of barometric observations to the sea-level, by E. Loomis.—The influence of light on the electrical resistance of metals, by A. E. Bostwick.—On atmospheric absorption, by S. P. Langley.—On the absorption of radiant heat by carbonic acid gas, by J. E. Veller.—The duration of luminous impressions on the retina, by E. L. Nichols.—The relation between the electromotive force of a Daniel cell and the strength of the solutton of zinc sulphate, by H. S. Cattzart.

The Journal of the Franklin Institute, No. 710, February, 1885.—Electro-metallurgy, by Nathaniel S. Keith. A lecture delivered at the International Electrical Exhibition of the Franklin Institute, Tuesday, September 23, 1884.—The divining rod, by Rossiter W. Raymond, Ph.D. Conclusion of a lecture delivered at the International Electrical Exhibition, September 18, 1884.—Glimpses of the International Electrical Exhibition, by Prof. Edwin J. Houston. No. 5, Edison's telephonic inventions. Annual summary of engineering and industrial progress, 1884.—Report of the Franklin Institute; items; Japanese colony in Germany; spontaneous decomposition of explosive gelatine; a new refractory brick; globular lightning; solar phenomena in Switzerland; supplement; International Electrical Exhibition report on underground wires. The following systems are described: the American Sectional Underground Company; the Anderson conduit for underground wires; the Brook's underground conduit; the Continental Underground Cable Company; the Cosmopolitan Underground Telegraph, Telephone, and Electric Light Company of New Jersey; the Electric Tube Company; the National Underground Company of New Jersey; Henley's conduit for underground lines; Magner's underground conduit; Philadelphia and Seaboard Telegraph and Cable Company (Pennock's); the Union Electric Underground Company of Chicago; Woodward's curb conduit; the Delany Cable.

Rivista Scientifico-Industriale, February 15-28.—Description of a new galvanometer, with illustration, by Aurelio Mauri.—Experimental researches on earth-currents and those of absorption, by Prof. Antonio Racchetti.—Variations in the electric resistance of solid and pure metallic wires, according to the temperature (continued), by Prof. Angelo Emo.—On an improved method of preserving butterflies' wings, by P. Milani and A. Garbini.

Rendiconti del R. Istituto Lombardo, February 26.—Report on soundings taken in lakes Orta and Idro, Lombardy, for the purpose of determining their mean depths, by Prof. Pietro Pavesi.

—On the analogy observed by Warming between Koch's comma bacillus and *Spirillum tenue*, Ehr., by Prof. Leopold Maggi.—On an integer more general than that of living forces, for the movement of a system of material points, by Dr. Giovanni Pennacchietti.—On the psychological action of *attention* in the animal series (continued), by E. T. Vignoli.—On Grimaldi's proposed agrarian credit to relieve the distress of the Italian peasantry, by P. Manfredi.—Remarks on the *legatum optionis* of Roman jurisprudence, by Prof. C. Ferrini.—Critical inquiry into the new Italian Penal Code, by Prof. A. Buccellati.—Meteorological observations made at the Brera Observatory, Milan, during the month of February.

SOCIETIES AND ACADEMIES

London

Royal Society, March 19.—"The Paralytic Secretion of Saliva." By J. N. Langley, M.A., F.R.S.

It has been shown by Claude Bernard and by Heidenhain that section of the chorda tympani nerve on one side, causes a slow continuous secretion from both sub-maxillary glands. Since the secretion which takes place on the side of the body on which the nerve is cut is called the "paralytic" secretion, that which takes place on the opposite side may be called the "anti-paralytic" or "antilytic" secretion. The author finds that the antilytic secretion becomes slower when the chorda tympani nerve is cut, and stops when, in addition, the sympathetic nerve is cut. It is, then, caused by nervous impulses sent out by a secretory centre in the medulla oblongata. This centre is in a state of increased irritability, for dyspnœa causes a much more rapid flow of saliva, and causes it sooner than it does normally. The paralytic secretion during the first day or two of its occurrence is also caused by stimuli proceeding from the central secretory centre; since the paralytic secretion is more copious than the antilytic secretion, and since dyspnœa causes a greater increase of the former than of the latter, it follows that the increase of irritability in the central secretory centre is greater on the side on which the chorda tympani has been cut than on the opposite side. In this state of increased irritability the central nerve-cells are probably stimulated by the blood supplied to them. The paralytic secretion in its later stages is probably brought about by a similar state of increased irritability in nerve-cells in the gland itself, *i.e.* of a local secretory centre. In its later stages the secretion continues after severance of all the nerve-fibres proceeding from the central nervous system to the gland; it is, however, increased by dyspnœa, stopped by apnœa, and by large doses of anæsthetics, which indicates that it is brought about by nerve-impulses. The peripheral end of the chorda tympani remains irritable for two to three weeks, which is a further indication that the secretory nerve-fibres are connected with some, at any rate, of the many nerve-cells present in the gland. Notwithstanding the continuous paralytic secretion, the gland-cells become slightly more mucous than normal; except for this and a decrease in size they remain normal. They secrete as usual when the sympathetic nerve is stimulated.

Geological Society, March 25.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the chair.—Charles De Laune Faunce De Laune and William Hill were elected Fellows of the Society.—The following communications were read:—On the relationship of *Ulodendron*, Lindley and Hutton, to *Lepidodendron*, Sternberg, *Bothrodendron*, Lindley and Hutton, *Sigillaria*, Brongniart, and *Rhytidodendron*, Boulay, by Robert Kidston, F.G.S.—On an almost perfect skeleton of *Rhytina gigas*=*Rhytina Stelleri* ("Steller's sea-cow") obtained by Mr. Robert Damon, F.G.S., from the Pleistocene peat-deposits on Behring's Island, by Henry Woodward, LL.D., F.R.S., F.G.S. The author spoke of the interest which palæontologists must always attach to such animals as are either just exterminated or are now in course of rapid extirpation by man or other agents. He referred to the now rapid destruction of all the larger Mammalia, and expressed his opinion that the African elephant, the giraffe, the bison, and many others, will soon be extirpated unless protected from being hunted to death. The same applies to the whale- and seal-fisheries. He drew attention to a very remarkable order of aquatic animals, the *Sirenia*, formerly classed with the Cetacea by some, with the walruses and seals by others, and by De Blainville with the elephants. He particularly drew attention to the largest of the group, the *Rhytina*, which was seen alive and described by Steller in 1741. It was then confined to two islands (Behring's Island and Copper Island). In forty years (1780) it was believed to have been entirely extirpated. It was a toothless Herbivore, living along the shore in shallow water, and was easily taken, being without fear of man. Its flesh was good, and it weighed often three or four tons. The author then described some of the leading points in the anatomy of *Rhytina*, and indicated some of the characters by which the order is distinguished. He referred to the present wide distribution of the Sirenia:—*Manatus* with three species, namely, *M. latirostris*, occupying the shores of Florida and the West Indies; *M. americanus*, the coasts of Brazil and the great rivers Amazon and Orinoco; *M. senegalensis*, the west coast of Africa and the rivers Senegal, Congo, &c. *Halicore*, with three species, namely, *H. tabernaculi*, the Red Sea and east coast of Africa; *H. dugong*, Bay of Bengal and East Indies; *H. australis*, North and East Australia. The fossil forms number thirteen genera and twenty-nine species, all limited to England, Holland, Belgium, France, Germany, Austria, Italy, Malta, and Egypt, and to the United States and Jamaica. The author gave some details as to the dentition of fossil species, of which *Halitherium* and *Prorastomus* are the two most remarkable types. Lastly, with regard to the geographical area occupied at the present day by the Sirenia, the author pointed out that two lines drawn 30° N. and 30° S. of the equator will embrace all the species now found living. Another line drawn at 60° N. will show between 30° and 60° N. the area once occupied by the twenty-nine fossil species. He looked upon *Rhytina* as a *last surviving* species of the old Tertiary group of Sirenians, and its position as marking an "*outlier*" of the group now swept away.

Physical Society, March 28.—Prof. Guthrie, President, in the chair.—The President announced that the meeting on May 9 would be held at Bristol; further particulars would be communicated to the members.—Mr. Hawes was elected a member of the Society.—The following papers were read:—On calculating-machines, by Mr. Joseph Edmondson. Calculating-machines are of two classes—the automatic and the semi-automatic. The former were invented by Mr. Charles Babbage between 1820 and 1834, and were designed mainly for the computation of tables. The difficulties against which this inventor contended and the perseverance he displayed in the construction of part of the "difference-engine" he had imagined are now a matter of history. On account of the great cost and high degree of complexity of this machine it was never completed, and the calculating-machines of the present day belong to the semi-automatic class the first example of which is found in a rough and incomplete instrument by Sir Samuel Moreland in 1663. From 1775 to 1780 the Earl of Stanhope invented machines which were a great advance upon those of Sir S. Moreland. In these is found the "stepped reckoner," the basis of all modern instruments. This "stepped reckoner" was improved by M. Thomas de Colmar, who, in 1851 produced a machine which is now largely in use. This machine, somewhat improved in detail and construction, is now made by Mr. Tate of London, and Mr. Edmondson has patented a modification in which the form of the instrument is circular, by which means an endless instead of a limited slide is obtained. A collection of various valuable instruments, which had been kindly lent for the occasion, were exhibited. A discussion followed in which Gen. Babbage, Mr. Tate, Prof. McLeod, Dr. Stone, the Rev. Prof. Harley, Mr. Whipple, Prof. Ayrton, and other gentlemen took part.—On the structure of mechanical models illustrating some properties in the ether, by Prof. G. F. Fitzgerald. The author had recently constructed and described before the Royal Society of Dublin a model illustrating certain properties of the ether (NATURE, March 26, p. 498). This model was one-dimensional, but the author now showed how a tri-dimensional model might be imagined, though probably mechanical difficulties would render its actual construction impossible. Each element of the ether is to be represented by a cube on each edge of which there is a paddle-wheel. Thus on any face of the cube there will be four paddle-wheels. Now, if any opposite pair of these rotate by different amounts, they will tend to pump any liquid in which the whole is immersed into or out of the cube, and if the sides of the cube be elastic there will be a stress which will tend to stop this differential rotation of the wheels. If however the other pair rotate by different amounts, they may undo what the first pair do, and thus the stress will depend on the difference between the differential rotations of these opposite pairs of wheels. If η represent the angular rotation of one pair, and ζ that of the other, the stress will depend upon $\frac{d\eta}{dx} - \frac{d\zeta}{dy}$. In order that these four wheels may not similarly work with any other wheel, it is necessary to place diaphragms dividing the cube into six cells, each a pyramid standing on a face of the cube. They must be so made that liquid may not be able to pass from one cell to another through the diaphragm or beside the paddle-wheels; to effect this the floats on the paddle-wheels would have to be drawn down while passing the diaphragms. Thus the energy of distorsion of such a medium would depend upon

$$\left(\frac{d\zeta}{dy} - \frac{d\eta}{dz}\right)^2 + \left(\frac{d\xi}{dz} - \frac{d\zeta}{dx}\right)^2 + \left(\frac{d\eta}{dx} - \frac{d\xi}{dy}\right)^2.$$

And Maxwell has shown that this is also true for the ether. The faces of the cubes should be filled up with diaphragms, past which the paddles should pump liquid, and whose elasticity should be the means of storing electrostatic energy in the medium. The most complicated results follow from supposing the faces of the cubes of which the medium is constructed to have different elasticities. Such a structure represents a crystalline medium, and vibrations would be propagated in it according to laws the same as those regulating the transmission of light in crystalline media. If the cubes were twisted, the structure would be like that of quartz or other substances rotating the plane of polarisation. To represent magnetic rotation of the plane of polarisation it would be necessary to introduce some mechanism connecting the ether with matter. The author, in conclusion, insisted upon a view which regards the vibrations constituting light to be of the nature of alterations of structure, and not of displacements executed in a medium possessing the properties of an elastic jelly.—At the close of the meeting the following instruments were exhibited and described in a conversational manner by their makers: a chrono-barometer and a chrono-thermometer by Mr. Stanley. These instruments consisted of clocks regulated by pendulums formed in the first instrument of a mercurial barometer, and in the second of a similar barometer inclosed in a hermetically-sealed air-chamber, the inclosed barometer thus acting as an air-thermometer. Increase of pressure in the one case, and of temperature in the other, causes the mercury to rise, and thus accelerates the pendulum. By the gain or loss of time the mean pressure or temperature can be calculated for any period.—A heliostat and a galvanometer, by Mr. Conrad W. Cooke. The galvanometer is intended to show the internal current in a cell. The battery plates are in two cells connected by four glass tubes in multiple arc coiled around an astatic needle. The glass work is by Mr. Gimingham.—A spherometer, by Mr. Hilger, was made of aluminium, and combined lightness with rigidity. By an electrical contact the maker asserted that measurements could be made to one-millionth part of an inch.—Col. Malcolm exhibited a spectroscope and a binocular field-glass in which the two eyepieces were separately adjustable; and Dr. Watts exhibited a simple modification of a quadrant electrometer.

Royal Microscopical Society, March 11.—Rev. Dr. Dallinger, F.R.S., President, in the chair.—Mr. Crisp exhibited Winkel's class microscope with movable stage, Tolle's clinical microscope, Seibert's portable microscope, and Swift's microscope for examination of skin of sheep having a very long working distance, Griffiths' and Bertrand's objective adapters and a new form of "finder."—Mr. H. G. Madan exhibited some new kinds of glass, having found that a combination of ordinary blue glass with a peculiar bluish-green glass, known as "signal-green" glass, was much more convenient than the usual glass cell filled with solution of cuprammonium sulphate.—Mr. Baker exhibited some object-boxes in book-form for placing on a shelf with books, the objects then lying flat.—Dr. C. v. Zenger's letter was read describing a new mounting medium consisting of tribromide of arsenic in bisulphide of carbon, and giving a refractive index of from 1·6696 to 1·7082. An improved slide for viewing the object on both sides was also described.—Mr. C. H. Hughes's description was read of a stage for use with high powers to prevent the decentring of the condenser, especially when used with immersion contact. Vertical, horizontal, and oblique motions are given to the slide, while the stage remains stationary but can be rotated.—Mr. E. M. Nelson exhibited a drawing of comma bacillus showing the flagella.—Mr. J. Mayall, jun., described the original ruling machine of the late Herr F. A. Nobert, which was exhibited to the meeting. The foundation of the machine was a dividing engine calculated to produce parallel divisions far finer than could be marked by any ruling point yet discovered. The division-plate had twenty circles of "dots," and these were supplemented by extremely fine graduations on two bands of silver imbedded near the edge, which were viewed by means of two compound microscopes, each provided with eyepiece screw micrometers of special construction. The movement of rotation was effected by a fine tangent screw acting on a worm on the vertical edge of the division-plate. The method employed by Herr Nobert for obtaining the minute divisions of his test-plates (ranging from 1-1000th to 1-20,000th of a Paris line) was to convert the radius of the division-plate into a lever to move the glass plate on which the rulings were made at right angles to the motion of the ruling point. For this purpose he attached to the centre of the rotating division-plate a bent arm, on which slid a bar of silver, having at one end a finely-polished steel point which could be adjusted by a scale and vernier so as to project more or less beyond the centre of the division-plate or axis of rotation. The radius of the division-plate thus became the long arm of the lever, whilst the radius of the projection of the polished steel point beyond the axis of rotation formed the short arm, the centre of the division-plate being the fulcrum. The motion of the short arm of the lever was communicated by contact with an agate plate to a polished steel cylinder adjusted to slide at right angles to the movement of the ruling point in V-shaped bearings of agate. The steel cylinder carried a circular metal table, on which the glass plate to be ruled was fixed by wax and clamps. The arrangement for carrying the diamond point was, he believed, wholly designed by Herr Nobert, and was a most ingenious combination of mechanism.—Mr. Mayall referred briefly to the preparation of the glass plates for the rulings, which, he said, were of specially "mild" composition. It was abundantly proved by Herr Nobert's work that the perfection of the mechanical part of the dividing-engine was not the only difficulty which he had understood, and conquered. There was a still greater dfficulty which he had understood, and in which he had met with a success that gave him pre-eminence in this department of micro-physics, and that was the preparation of the diamond ruling-points. The description of these was deferred until the next meeting.—Mr. C. Beck exhibited a modification of the "complete" lamp fitted with a shallow glass reservoir instead of the original one of metal, also a vertical illuminator with a new form of diaphragm.—Dr. Van Heurck's note was received, sending a copy of Prof. Abbe's opinion on the photographs of the "beads" of *A. pellucida*, in which he stated that he had no reason to doubt the reality of the beads.—Dr. J. D. Cox's note was read as to actinic and visual foci.—Mr. F. Kitton's remarks in commendation of balsam of Tolu for mounting were read.—Dr. Ord exhibited and described some objects illustrating the erosion of the surface of glass when exposed to the action of carbonate of lime and a colloid.—Mr. J. W. Stephenson read his paper, on a new catodioptric illuminator, having an aperture exceeding that of any existing objective, or equal to 1·644 N.A. in flint glass, and 1·512 N.A. in crown glass.—Mr. Cheshire and Mr. E. Chayne's paper on the pathogenic history of a new bacillus (*B. alvei*) was then read, in which it was shown that the disease attacking bees, and known as "foul brood," was due to a bacillus. They had also discovered that the disease yielded readily to treatment which consisted in feeding the larvæ with a syrup containing 1-600 per cent. of phenol. A detailed explanation was given of the methods adopted in tracing out the life-history of the bacillus, and a series of tubes and bottles in which its propagation had been carried on were exhibited.—Mr. Fowke read a paper on the first discovery of the comma bacillus of cholera. He showed that the bacillus was known and recognised thirty-five years ago by two Englishmen, Messrs. Brittain and Swayne. It was pointed out that it was by the breaking up of the rings discovered by original observers that the so-called "comma" bacilli were formed.—Sixteen new Fellows were proposed and elected.

Manchester

Literary and Philosophical Society, February 10.—Prof. W. C. Williamson, LL.D., F.R.S., President, in the chair.—On some undescribed tracks of invertebrate animals from the Carboniferous rocks, and on some inorganic phenomena, simulating plant remains, produced on tidal shores, by Prof. W. C. Williamson, LL.D., F.R.S., President. Prof. Williamson's memoir first contained descriptions and figures of a new form of Chrossocorda, which he named *C. tuberculata*, from the Yoredale rocks of Stonyhurst, in Lancashire, which genus has hitherto been found only in Palæozoic rocks of much older age than the Yoredale beds. Reciting the views of Schimper and others, who believe that the genus Chrossochorda represents some fucoidal form of Palæozoic life, the author regards the various modifications of it as consisting of tracks of marine animals, probably crustaceans. He assigns the name of *Chrossochorda tuberculata* to that now described. A second form of track, of a different type, was found by Mr. J. W. Davis, F.G.S., of Chevinedge, near Halifax. It consists of a line of curved footprints in groups of eight—four on each side—the successive groups varying from five-eighths of an inch to two inches apart from each other. The specimen described was found in a quarry of Yoredale beds, near Hawes. The author assigns to it the name of *Protichnites Davisi*, after its discoverer. Casts of two series of markings, produced by water, were exhibited and described. One of these series represented branching forms easily mistaken for fucoidal remains. They were in reality casts, made in plaster of Paris, of remarkable drainage lines left by the retiring tide, on the sandbanks at Llanfairfechan, in North Wales. The second series consisted of allied objects, but in this case drainage lines had combined with ripple marks to produce an effect easily mistaken for the geometrically arranged scale-leaves of some cycadean stem. These casts were obtained from sandbanks to the north of Barmouth. The author called attention to the controversy bearing on these subjects still in progress, especially between Prof. Nathorst and the Marquis of Saporta, and renewed an objection, recorded in more than one of his previous publications, to such anomalous objects as those in dispute being made use of, when attempting to frame, from Palæontological evidences, a pedigree of the vegetable world.

Cambridge

Philosophical Society, March 16.—Prof. Foster, President, in the chair.—The following communications were made:—Further remarks on the urea-ferment, by Mr. Lea.—On some points in the anatomy of Nebalia, by Mr. Weldon.—Observations on the constitution of callus, by Mr. Walter Gardiner.—Observations on vegetable proteids, by Mr. J. R. Green.—On the development of K', E', J', G' in powers of the modulus (Part II.), by Mr. J. W. L. Glaisher.

Sydney

Linnean Society of New South Wales, January 28.—Annual General Meeting.—The President, C. S. Wilkinson, F.L.S., in the chair.—The President delivered an address upon the Pleistocene period, and its influences upon the present distribution of the fauna and flora of Australia. He gave also a short review of the work of the Society during the past year.—It was resolved that ladies may be admitted upon election as associates of the Society, with all the privileges of ordinary members except the right to attend the monthly meetings, at the reduced subscription of one guinea, without entrance fee.—The following papers were read:—A monograph of the Australian sponges: Part iv., the Myxospongiæ, by R. von Lendenfeld, Ph.D. In this paper the Australian species are described. (The author partly adopts the view of Sollas regarding the separation of the Halisarcidæ and Gumminæ.) The structure of Bajalus, a new genus of Halisarcidæ, is described. The subdermal cavities are remarkably developed. Amœboid wandering cells were found in a dense layer beneath the outer skin. Gland cells are described. Sexual products mature only in the innermost part. The gastral cavity serves as a marsupium. The anatomy of *Chondrosia Ramsayi*, n.sp., *Chondrilla papillata*, n.sp., and *corticata*, n.sp., shows some points of interest. Peculiar subdermal cavities are described in the former. The two latter possess a special cortical skeleton.—The method of section-cutting with some improvements, by R. von Lendenfeld, Ph.D.—*Amœba parasitica*, a new parasitic Protozoan infesting sheep, by R. von Lendenfeld, Ph.D.—The meteorology of Mount Kosciusko, by R. von Lendenfeld, Ph.D.—The Glacial period in Australia, by R. von Lendenfeld, Ph.D. The author gives the results of his recent expedition to the central part of the Australian Alps in this paper, as far as they bear on the above question. He ascended the two highest peaks in Australia, and found on the plateau which surrounds them undoubted glacial remains in the shape of *roches moutonnées* in many places above 5800 feet. He concludes that Australia was affected by a glacial period at the same epoch as New Zealand, but that, owing to the lowness of the mountains (only 7256 feet the highest peak), the low latitude, and the warm and dry winds from the interior, the glaciers attained but small dimensions, and only covered an area of about 100 square miles. He considers it probable that no other glaciers existed in Australia at the time, as even those on the highest elevation of the continent were so small.—On the Proteaceæ, by the Rev. W. Woolls, Ph.D., F.L.S.—On a new snake from the Barrier Ranges, by William Macleay, F.L.S., &c. The description is here given of a species of *Furina*, to which the specific name of *Ramsayi* is affixed. Some specimens of it were exhibited, as well as specimens of *Vermicella*, *Typhlops*, and *Delma*, from the same locality.

Paris

Academy of Sciences, April 6.—M. Boulay, President, in the chair.—Obituary notice of M. Rolland, Member of the Section for Mechanics, who died on March 31, by the President.—Remarks on the agreement between geological and cosmogonic epochs, by M. Faye. These remarks are made in connection with his work, "Sur l'Origine du Monde," recently presented to the Academy, in which he develops his theory on the cosmic evolution of the solar system. Here this theory is supported by fresh arguments drawn from thermodynamics, biology, and solar physics.—On the artificial and supplementary manures proper for soil of different qualities, by M. de Gasparin. It is shown by numerous examples that such manures should be selected, not only according to the nature of the crops to be raised, but also according to the character of the lands requiring to be enriched.—On the resistance offered by a fluid in repose and without weight to the varied movement of a solid sphere immersed in it when the velocities are continuous, but so slow that their squares and products may be neglected, by M. J. Boussinesq.—On the "polhodie," a curve introduced by Poinsot into his new theory on the rotation of bodies, by M. A. Mannheim.—On the liquefaction and solidification of formene and of the deutoxide of nitrogen, by M. K. Olszewski.—On the amides of the oxalo-adipose group, by M. L. Henry.—Funeral orations pronounced at the obsequies of M. Rolland on April 7, by MM. Phillips and Schlösing.

Stockholm

Royal Academy of Sciences, March 11.—Prof. Gylden communicated a paper by A. Shdanow on the computation of the intermediate orbit of the comet of Faye-Möller when it was in the vicinity of Jupiter in 1841.—Prof. Mittag-Leffler presented papers (1) on periodical functions with a discontinuous period-system of the first kind, by himself; and (2) annotations on the mathematician, Petrus de Dacia, and his writings, by G. Engström.—The Secretary, Prof. Lindhagen, presented (1) the doctrine of Linnæus on the species of plants determined and permanent in the nature, represented according to the works of Linnæus and compared with the corresponding views of Darwin, by Prof. T. G. Agardh; (2) Desmidiæ collected during the expedition of Nordenskiöld to Greenland in 1870, by Prof. Berggren, and described by Dr. O. Nordstedt.

CONTENTS