THURSDAY, MARCH 25, 1886

THE GREELY ARCTIC EXPEDITION

Three Years of Arctic Service. An Account of the Lady Franklin Bay Expedition of 1881–84, *and the Attainment of the Furthest North.* By Adolphus W. Greely, Lieutenant U.S. Army, Commanding the Expedition. Two Vols. (London: Bentley and Son, 1886.)

THE principal incidents of this wonderfully successful and singularly unfortunate Expedition must be familiar to most of our readers. It formed one of the series of International Polar Stations which carried on a year's observations all round the Polar area in 1882–83. The Greely Expedition, however, took up its quarters at Fort Conger (81° 44′ N., 64° 45′ W.), Discovery Harbour, Lady Franklin Bay, in August of 1881. This, it will be remembered, was the station of the *Discovery* in the last English Expedition. The Expedition consisted of twenty-five men, all told. So far as organisation goes, the Expedition was a military and not a naval one, under the U.S. Signal Service, which is attached to the War Department. It was certainly a mistake not to have had the naval element substantially represented on such an expedition, and a still greater and more fatal blunder not to have provided the party with a ship in which they might have escaped in case no relief party reached them. No time was lost after landing in erecting a substantial wooden house, observatory, and the various instruments with which the scientific work of the Expedition was to be carried on. Observations in all departments of meteorology seem to have been faithfully and regularly taken according to the prescribed programme, and we have no doubt that most of them were preserved and taken home in the rescue ship. Only a few of the results are given in the appendixes to these volumes; the observations themselves will doubtless be sent to the Central Committee to be worked out along with those from other stations. Under the very efficient guidance of Major Greely excellent work of various kinds was carried out in the autumn of 1881 and the spring and summer of 1882. The relief vessel which was sent out in the latter year failed to come near Fort Conger, and the party, well provided, continued their work in the autumn of 1882 and up to the end of August 1883. Two vessels were sent out in the summer of 1883 to reach Fort Conger, but through incredible mismanagement, completely failed in fulfilling their mission, and even carried back with them the bulk of the provisions which they ought to have cached at certain points for the sustenance of the retreating party. It seems a strange perversity and a remarkable piece of red-tapeism in the U.S. Government to have intrusted these relief expeditions entirely to military men. It would surely have been easy to get experienced Arctic navigators for such critical work, and so probably have saved the lives of the poor men who were practically without the means of saving themselves. According to instructions, Major Greely, since no relief reached him, abandoned his station at Fort Conger on September 1, 1883, and with all his men, who up to this time had enjoyed excellent health on the whole, made his way south in a small steam launch and a boat or two, through almost impassable ice. In the end they were forced to land at Cape Sabine about the middle of October, and here, with scarcely any shelter, with only about enough food to sustain one man in these regions, and under the most miserable meteorological conditions, on the bleakest spot in all the Arctic, did these men drearily drag themselves through the winter. When at last Commander Schley did reach the spot in June 1884, he found only six out of the twenty-five alive. Yet up to within a few days of the rescue, such observations as were possible were carried on, and the conduct of the men, on the whole, was as noble as could be imagined. This fearful sacrifice of life is deplorable, all the more so when it is remembered that it was due to blundering and half-heartedness on the part of those at home. It is easy to ask whether the gains to science are worth all this sacrifice to human life, but the question is not so easily answered. And whatever the answer is, we may be sure that the Greely disaster will never deter humanity from attempting to find out all about the remotest and most inhospitable corners of its little home.

During the two years that the Expedition remained in Grinnell Land, it did some admirable work, in addition to the scientific observations carried out in the neighbourhood of the station. One of the most efficient and bravest members of the Expedition was Lieut. Lockwood, who, alas, did not return to reap the reward of his splendid work. He, along with Sergeant Brainard (who, we are glad to believe, will receive an acknowledgment of his services from the Royal Geographical Society), carried the coast of Greenland far beyond the furthest point reached by Beaumont in the Nares Expedition. In doing this, Lockwood reached the furthest point northwards yet attained, 83° 23′·8 N., only three or four miles beyond Capt. Markham's farthest. Of course he was quite justified in waving the Stars and Stripes over this triumph; though it should be remembered that it is a very different thing to travel along an Arctic coast to trudging straight Polewards over palæocrystic ice. As far as Lockwood reached, the coast of Greenland is broken up by fjörds, and skirted with islands, while the interior seemed an ice-bound land. There now remains only a comparatively small section of the north coast of Greenland to lay down, in order to join the furthest points east and west; and it is much to be wished that this section were completed. At the same time if an expedition were sent out specially for the purpose, it would be desirable to endeavour to penetrate southwards into the Greenland interior, to test Sir Joseph Hooker's conjecture, "that vegetation may be more abundant in the interior of Greenland than is supposed, and that the glacier-bound coast-ranges of that country may protect a comparatively fertile interior." It was in search of a green interior, it will be remembered, that Baron Nordenskjöld made his remarkable journey a few years ago. He failed to find what he sought for, probably because he struck too far south.

In another direction Sir Joseph Hooker's prophetic faculty has been amply sustained. "We are almost driven to conclude," he wrote in 1877, "that Grinnell Land as well as Greenland, are, instead of ice-capped, merely ice-girt islands." The most noteworthy and novel geographical work done by the Greely Expedition was the exploration of this same Grinnell Land. Previously we only knew its coasts and the country bordering on them in the neighbourhood of Discovery Harbour. Aldrich carried the north coast as far west as 85° W. long. Much of this outline has now been filled up. Archer Fjörd has been traced to its head; a large portion of the interior has been opened up; while on the southern coast another fiord, Greely Fjörd, has been discovered, and the coasts beyond seen stretching northwards and southwards. In the spring and summer of 1882 Greely himself made two considerable journeys into the interior, when he made discoveries which form an important addition to our knowledge of the physical geography of the Arctic regions. Bordering on 82° N. is a considerable freshwater lake (Hazen), skirted on the north by the lofty Garfield and United States Ranges and westwards by the Conger Mountains. Around Lake Hazen are a series of small lakes, and many streams which send their waters into Lake Hazen. Even in April the river which discharges into Chandler Fjörd was found quite open in part of its course, and the country generally remarkably free of snow. In summer the valleys give birth to a comparatively luxuriant vegetation, which serves as pasturage for considerable game. Besides grass in plenty, willows, beds of dryas and saxifrages were common; butterflies added brightness and gaiety to the scene; bumble-bees and "devil's darning-needles" flitted about. Ample remains of recent Eskimo settlements were found, and fossil testimonies to the former temperate character of the climate and the recent elevation of the whole region. Unfortunately, though very excellent collections seem to have been made, none of the members of the Expedition were specially qualified to make the most of the rare opportunity for thorough scientific investigation. Many Eskimo relics were collected, but a study on the spot of the sites of dwellings and remains by one skilled in such investigations would have yielded valuable results to ethnology. Still Major Greely and his men did their best, and the collections they made and information they collected will form important and welcome additions to science. Even on the south side of Archer Fjörd, near Cape Baird, a fossil forest was discovered, one tree over a foot in diameter being found at an elevation of 800 feet above the sea. Of Grinnell Land Major Greely writes: "This fertile belt, 150 miles long and 40 wide, extends from Robeson and Kennedy Channels to Greely Fjörd and the Western Polar Ocean. Its iceless condition depends entirely on its physical configuration. The abrupt, broken character of the country makes it impossible for the winter's scanty snow to cover it. Long, narrow, and numerous valleys not only offer the greatest amount of bare soil at favourable angles to the heating rays of the constant summer sun, but also serve as natural beds, with steep gradients, for the torrents from melting snows. The summer rivers drain rapidly the surface water, and long before continuous and sharply-freezing weather comes, the land is generally free from snow, and the large rivers have dwindled to brooks. The deep intersecting fjörds not only receive the discharging rivers, but, from their frozen surfaces, furnish large quantities of saline efflorescence, which, mixing with the land-snow, facilitates greatly its disappearance in the coming spring. Where such conditions do not prevail in Grinnell Land, ice-caps are found similar to the inclosed ice of Greenland traversed by Nordenskjöld."

Abutting on the north shore of Lake Hazen through a gap in the Garfield Range, is a magnificent glacier, with a convex face some five miles long, and 150 feet high, an outlier of the great ice-cap which covers all the north of Grinnell Land. Major Greely estimates the area of this northern ice-cap at 3000 square miles. "There is but little doubt," he says, "that the Challenger Mountains bound this ice-cap to the north-west, and that its northern face drains through Clements Markham Inlet, and the many ravines which Aldrich speaks of as running far inland from the bays on the shores of the Polar Sea."

Similarly on the south side of this Arctic oasis Lockwood and Brainard found a magnificent glacial wall extending between Archer Fjörd and Greely Fjörd, with a vertical face of an average height of 150 feet. From one mountain the wall was seen trending for forty miles to the south-west. The surface of the Agassiz *mer-de-glace* itself is very elevated, and extended southwards as far as the eye could reach. Lockwood thought that it must be of enormous depth in the interior. No moraines or foreign matter of any kind were observed on the surface, and crevices were extremely few and insignificant. Of moraines along the wall there were very few. The wall was generally of a uniform white colour. The ground to the north of it, especially on the divide, had a singularly smooth appearance, as if it had once formed the base of this mass of ice. We have here evidently a region of singular interest, well deserving the study of the geologist, and especially of the palæontologist.

Major Greely devotes a chapter to Polar ice, in which he describes some of its more usual forms; this having already been very exhaustively done by Nordenskjöld in his "Voyage of the *Vega*." Major Greely, however, specially discusses the formation of palæocrystic ice. It will be remembered that Sir George Nares attempts to account for the formation of these enormous thick masses of floating ice by supposing that they are due to successive accretions at the base. Major Greely rebuts this hypothesis, and maintains that the origin of palæocrystic bergs is similar to the flat-topped bergs of the Antarctic. He believes that the ice is in origin a land-formation, probably the accumulation of centuries on some islands far to the north of Grinnell Land; that it gets shunted off into the sea, and is floated southwards towards Robeson Channel. We suspect that neither hypothesis can be considered satisfactory; and though we do not think Major Greely has much to advance in favour of his hypothesis, his description of the structure of these great floes is at least instructive. The tidal observations made regularly during the two years are likely to lead to valuable results. Not only were observations taken at Fort Conger, but simultaneous observations, when possible, were taken along Grinnell Land coast. These, combined with the observations of 1875 and those of Bessel in 1871, may enable us to determine satisfactorily the cotidal curves of Robeson and Kennedy Channels and the entrance to the Polar Sea.

Much exploration, it should be said, was also carried out along all the coasts around the Station, and Dr. Pavy made an unsuccessful attempt to push northwards from Cape Joseph Henry. Very fair supplies of musk oxen were met with, and no doubt had the Expedition disobeyed instructions and remained at Fort Conger, it would have been saved most of the hardships it encountered, and all the members might have been saved alive. Much valuable scientific matter will be found in the appendix—ethnology, botany, ornithology, Medusæ, &c. One of the most striking and instructive features about these handsome volumes is the beauty and accuracy of the illustrations. They are most of them from photographs, and are fine examples of the services which photography can render to science. The texture of rocks and ice in these illustrations is wonderful.

The narrative itself, though quite unvarnished, is of intense interest; and the Expedition was in many ways one of the most remarkable ever sent Polewards.

THE KRAKATÃO DUST-GLOWS OF 1883-84

Beobachtungen über die Dämmerung insbesondere über das Purpurlicht und seine Beziehungen zum Bishop'schen Sonnenring. Habilitationsschrift der philosophischen Facultät der Universität Basel vorgelegt von Dr. Albert Riggenbach. (Basel: H. Georg's Verlag, 1886.)

THE Krakatão dust-glows of 1883-84 have already created a not inconsiderable literature. To this the pamphlet now before us is a contribution of some value. The writer has not only diligently studied the observations of others, but has added a long series of his own, and has thus acquired a right to an attentive hearing on the subject of the remarkable appearances which have given rise to so much discussion.

Scientific opinion has all but unanimously adopted the volcanic hypothesis of their origin urged with irresistible logic by Mr. Lockyer in the *Times* of December 8, 1883. It is admitted, though not examined, by Dr. Riggenbach; whose concern is less with the primary cause of the phenomena than with the minute machinery of their production. Questions bearing on the general physics of the globe are left untouched, while attention is concentrated on the intricate optical problems connected with the variegated tints of our skies.

These, according to our author, result mainly from diffraction. But absorption and reflection also play each an indispensable part. The sunset-sky, it must be remembered, is illuminated only by a residuum of sunlight. A long journey across the densest strata of the atmosphere has robbed it of all its more refrangible constituents. The course of the surviving rosy beams is interrupted by encounters with innumerable fine particles of solid matter, always, in greater or less quantity, suspended at considerable heights above the earth's surface. These form fresh points of divergence, whence rays which would otherwise have been transmitted unseen, reach the eye, either directly, or after reflections from interposing veils of fine cloud. Thus, the hurling into the air of 150 cubic kilometres of volcanic dust in August 1883, served only to intensify pre-existent conditions for the production of twilight-pageantry, not to create new ones. What we might almost call the solid constituents of our atmosphere were not alone largely increased in amount, but the added dust-supplies were of unusual fineness, consequently floated at unusual elevations. Displays of colour hence gained both in splendour and duration.

The effects of this strange reinforcement from the antipodes did not, however, manifest themselves at sunrise and sunset only. On September 5, 1883, Mr. Sereno G. Bishop first noticed at Honolulu a peculiar white halo of a pinkish tint encircling the sun (NATURE, vol. xxix. p. 260). The phenomenon had never previously been observed, and is now known as "Bishop's Ring." It was perceived later in Europe, and proved extraordinarily persistent. For fully two years, whenever the air was sufficiently clear, it continued visible, thus long outlasting the twilight-glows, with which, nevertheless, it was most intimately connected. Dr. Riggenbach observed that the rosy illumination began to show after the sun had dipped below the horizon, precisely at the same angular distance from his limb with the maximum intensity of the ring or "corona." And it may be taken as ascertained that the latter was purely an effect of diffraction. The succession of colours was the opposite to that seen in an ordinary halo, the blue lying *inside;* while the diameter (measured to the middle of the red zone) was about 28°, that of the refraction-halo being 45°. The observed dimensions of the ring gave the means of calculating the size of the particles concerned in producing it; and they were accordingly found by Prof. Hagenbach to be 0·003 mm., by M. Flögel 0·001 mm. in diameter. Yet, though far finer than the minute vesicles occasioning the diffraction-rings frequently observed in comparatively close proximity to the sun and moon, their bulk (even adopting the lower estimate) would still be at least one million times that assigned by Sir William Thomson to the ultimate atoms of matter.

Seen from the Bernese Oberland, or other high ground in Switzerland, during the summer and autumn both of 1884 and 1885, this curious aureola presented a striking appearance. A silvery field of diffused radiance extended to about 10° from the sun's limb, and was terminated by coloured circles, the prismatic order of which grew distinct in proportion as the air gained transparency. Below 1000 metres of elevation, the whole phenomenon became effaced. It was independent of meteorological conditions, taking its origin in a region of the atmosphere beyond the reach of ordinary disturbances. The invariability of its presence was painfully experienced by Mr. C. Ray Woods during his sojourn on the Riffel in the summer of 1884. No more effectual obstacle to the work of photographing the sun's proper corona can indeed be imagined than that which, by a linking of causes not difficult to trace, though impossible to foresee, was interposed by the memorable eruption two and a half years ago in the Sunda Straits.

OUR BOOK SHELF

The Star Guide. By Latimer Clark, F.R.A.S., and Herbert Sadler, F.R.A.S. (London: Macmillan, 1886.)

THIS is a most useful and carefully planned guide to the best use of small telescopes. It consists of a list of the most remarkable celestial objects visible with such instruments, with their positions for every tenth day, and partly serves as an introduction to Webb's "Celestial Objects for Common Telescopes." Very considerable trouble has been taken in the compilation of the table of double-stars. Test objects, lunar craters, shooting-star radiants are also catalogued, and although small apertures are principally considered, objects suitable for examination with larger ones up to seven inches are given.

Much trouble has been taken with a very convenient result; and as the author shows what corrections to apply to make the volume useful in future years, we must regard it as one of the most useful books an amateur astronomer can possess.

Practical Introduction to Chemistry. By W. A. Shenstone. Lectures on Chemistry in Clifton College. (London: Rivingtons, 1886.)

ALTHOUGH several courses of practical chemistry for beginners have lately been introduced the author has not found any of them suitable for school work, and so he has undertaken to write one himself.

In his selection of experiments, he says he has been guided by two main considerations. First, that they should be suitable for the young boys who chiefly will have to perform them, and who will have but a limited amount of time to do them in. Secondly, that when completed they shall constitute a body of experience which shall be as valuable as possible to appeal to when the students pass to the classes which have lecture teaching.

The first three chapters deal briefly with the elements, compounds, acids, &c. Chapters IV. and V. deal with the law of chemical combination and the classification of chemical changes; Chapters VI. and VII. with the decomposition of water and air. Chapter VIII. is devoted to a few very elementary experiments on the relations between solids, liquids, and gases. In Chapters IX. and X. attention is drawn to the use made of these differences in experiment.

The appendixes contain a list of apparatus and also a description of the balance and how to use it.

The book is divided into two sections. In the first section the student is given instructions how to perform the experiments, but he is not told how they will "come out," so that as the experiment proceeds, he has to observe and note what takes place, and when it is finished he can compare his notes with those given in Section II., where full explanations are afforded. Certainly if this method is well carried out we shall have a vast improvement upon the ordinary "test tubing" process, in which, as a rule, little theoretical construction is given to the beginner. W.

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.*]

Permanent Magnetic Polarity

SINCE the subject of the permanent polarity of quartz has been brought prominently forward by the researches of Dr. Tumlirz, published in the January number of *Wiedemann's Annalen*, and by the recent discussion of it in your pages, it is perhaps allowable for me to put on record the fact that I have been engaged during the course of this winter with very similar experiments, and have obtained very similar results. Quartz indeed does not happen to be one of the substances I have examined,—I rather dreaded the complexity of crystalline substances,—but my observations have led me to the conclusion that most likely *every* substance possesses some trace of permanent magnetisability or retentivity.

The set of experiments were not indeed begun with the object of looking for permanent polarity, but with a wholly different object, viz. this:—According to the Ampère-Weber theory of magnetism and diamagnetism, wherein magnetism is explained by means of specific molecular currents flowing in channels of no resistance, and diamagnetism by induced currents excited in those same channels by the magnetic field, it is obvious that the permeability of a magnetic body ought to become negative when the magnetising force applied oversteps a certain amount. Because an increasing magnetising force must weaken the specific currents, even though it is unable to excite contrary ones and so cause diamagnetism.

This result of the theory is pointed out by Clerk-Maxwell (vol. ii. § 844, 1st edit.), who further says: "If it should ever be experimentally proved that the temporary magnetisation of any substance first increases and then diminishes as the magnetising force is continually increased, the evidence of the existence of these molecular currents would, I think, be raised almost to the rank of a demonstration."

There are many circumstances now known which point more or less distinctly to such a maximum, but my ambition has been to not only establish a falling off of induced magnetism, but actually to reverse it; to convert, in fact, a feebly-magnetic substance into a diamagnetic substance by immersing it in a sufficiently intense magnetic field.

Accordingly, in October last, I set up a fairly large magnet, with specially-pointed pole-pieces about a centimetre or less apart, and arranged that various strengths of current, ranging from very weak to very strong, might be sent round its coils; the weakest current being given by a Leclanché or two, an intermediate strength by 3 or 4 secondary lead cells, a strong current by 24 such cells, and the greatest strength by about 40 secondary batteries, some of them zinc-lead with $2\frac{1}{2}$ active volts apiece between their terminals, kept charged in two batches by a dynamo.

I then instructed my workshop-assistant, Mr. Benjamin Davies, to fill up his odd time by cutting ellipsoids of all manner of substances (axes about ·6, ·3, ·3), to finish them off with glass-paper, when practicable to boil them in acid, and then to examine their behaviour between the poles of the magnet in a specified way.

The dimensions of the magnet were:—

Diameter of iron core ... ... 5 centims.
Length of each leg ... ... 21 ,,
Distance from centre to centre ... 15 ,,
Total number of turns of No. 12 B.W.G. wire, 1868, on both legs together.
Resistance of wire 1·1 ohm.
Usual strengths of current, from $\frac{1}{4}$ ampere to 50 amperes.

The thing intended was to discover by trial some substance so feebly magnetic that, though it could just set itself axially with the weakest current, it might lie equatorially with the strongest. But failing this actual change of property it was thought that the rate of oscillation between the poles might diminish for some (non-conducting) substances when the highest powers were applied, instead of increasing.

And meanwhile the behaviour of all the substances was to be noted and carefully recorded, whatever it might be.

In this way a large number of substances, various kinds of wood, all sorts of metal, glass, coke, charcoal, wax, chalk, cardboard, ebonite, &c., have been passed under review; and some one or two of them seemed to behave exactly in the way hoped for. One piece of coke, for instance, vibrated in the intense field more slowly than it did in the feeble one; while another, which vibrated axially in a weak field, set itself nearly equatorially in the strong one. Its behaviour was thus sufficiently like what we wanted to justify a more careful examination.

Soon after this, however, Davies of his own accord inserted a reversing key into the circuit of the Leclanché, and thus made an important observation.

When the *strong* current was reversed, the deportment of the substance remained unaltered, as is natural enough; but directly the *weak* current was reversed, the little suspended piece turned in the magnetic field through 120° or so, and pointed in a symmetrically situate direction on the other side the magnetic axis. The piece of coke, for instance, which may have been pointing some 60° on the one side of the magnetic axis, changed its position when the magnet was reversed, and pointed some 60° on the other side. The suspending thread was not wholly devoid of torsion though it was extremely minute. A piece of electrolytic copper, and a piece of boxwood with the grain longways, were soon afterwards found, which set themselves almost exactly equatorially, and on reversing the magnet turned through very nearly 180°.

I was a little excited about this result at first, because I thought it meant a permanent diamagnetic polarity, that is to say, "*a diamagnet*," which seemed an incomprehensible result. My suspicions were at once aroused, however, as to the possibility of a transverse ordinary magnetisation; and subsequent experience, on the whole, confirms this explanation.

All the substances were then tried over again for permanent magnetic polarity, and not one of them has failed to show it. A piece of wood, for instance (or any other substance), which points axially between the poles, instantly reverses its position, turning through 180°, when the magnet is reversed. But the reversal must be done with the weak current only: anything like a strong current, *e.g.* that from two or three secondary cells, instantly destroys and reverses the permanent magnetism, and no abnormal behaviour is then detected. Some substances, however, retain it better than others. The permanent magnetism requires a strong current to excite it, and a very weak reverse current to detect it. Without these conditions it would certainly have been overlooked. It does not seem to matter whether a substance is magnetic or diamagnetic, it always reverses its position or nearly reverses it when the weak reverse current is applied.

The piece of copper was next *held* long-ways in the field, and a strong current applied. On now hanging it at 45° in the field, and testing it by a weak current, it at once returned to its axial position (though the copper was electrolytically "pure" and decidedly diamagnetic); on reversing the weak current, it at once turned through 180°, setting axially the other way, thus behaving exactly like a weak magnet. When a strong current was applied this behaviour was lost, the piece set itself nearly equatorially again, and the residual axial magnetism was either masked or lost. The reaction of induced currents naturally makes the examination of conducting masses rather troublesome.

During Christmas week Sir Wm. Thomson happened to pay the laboratory a hurried visit, and I showed him a piece of pitch-pine between the poles behaving exactly like a weak compass-needle; "a wooden magnet," as he at once called it. He was good enough to suggest a better mode of arranging the experiment for my original purpose of looking for the conversion of magnetism into diamagnetism: an arrangement which I have since adopted. So far, however, the results in this direction are very preliminary.

In all these experiments there is one flaw; and it is partly owing to this flaw that I have regarded them as unfit for publication. Indeed, I only send this note now because of the publication of Dr. Tumlirz's result. His experiment with quartz is very like one of mine, and it is very clearly and neatly described in his paper. But the same flaw, or what appeared to me to be such, seems to extend to his case also. What guarantee is there that no trace of iron is present,—perhaps as mere dirt, more likely as an infinitesimal ingredient of the substance? Several of the pieces of coke I used had been boiled for weeks in several lots of hydrochloric acid, and the last few washings gave no ferrocyanide coloration; but I have no doubt the coke yet contains iron. Possibly the other substances do too.

Suppose, now, a substance contains a trace of iron, which iron is susceptible of permanent magnetism, no matter how feeble: then, no matter whether the substance itself be paramagnetic or diamagnetic, in an intense field its own properties will altogether overpower those of the trace of iron, for this trace may be considered as magnetically saturated and done for at once. But suppose the substance next finds itself in a very weak field: the induced magnetism and the force depending on it, since they vary as the square of the field, are vanishing quantities; any trace of residual or permanent magnetism has it all its own way.

What way is there of proving that not a trace of iron exists in a body? Chemical tests are surely futile compared with the test of a magnet. I see at present no way out of the difficulty.

And would not the same difficulty recur in connection with my original notion? I believe it would. Suppose I succeeded in finding a substance, paramagnetic in a weak field, diamagnetic in a strong one; it would be open to any one to object that the paramagnetism was due to a trace of magnetic impurity: that this impurity, being intrinsically highly susceptible, causes all the observed action in a weak field, but that it soon becomes saturated as the field increases in strength, and that then its force is altogether overpowered by the main bulk of less susceptible substance, whose saturation-point, if existent at all, is miles higher up. This substance then regulates the behaviour of the body, and, according as it is diamagnetic or magnetic, the whole body behaves diamagnetically or magnetically.

Notwithstanding the prevision of this difficulty, I determined to try the experiments, not knowing what might come of them, and thinking that a body which could be made magnetic or diamagnetic at pleasure would be of some interest, however its behaviour might be explained. I even thought of artificially constructing such a body by incorporating a trace of iron in a lump of bismuth, or by using semi-purified commercial bismuth. I have not done this yet, however, and accordingly do not know if it be possible.

That which has come, so far, of these experiments, viz. the apparent existence of magnetic retentivity in all matter, is in itself not an improbable result; rather, one might say it is a probable one; and although it may be possible to explain it by a trace of iron impurity, it by no means follows that this disappointing sort of explanation is the correct one.

The singular fact which most strongly suggests the need for some such explanation is that diamagnetic bodies are capable of ordinary permanent magnetism. It is true that on the Weber-Ampère theory the specific molecular current of a diamagnetic substance need not be zero but may have a small positive value, which is easily destroyed and reversed by a powerful field, but which yet may endow the substance with magnetic properties in a weak field. But the worst of it is that I have never been able to detect any trace of paramagnetic property, in a diamagnetic substance, other than this permanent or residual polarity excited by immersion in a strong field.

The only suggestion I can make is the following.

Let the molecular channels in a diamagnetic substance be not wholly free from resistance, though their resistance must be very small; let induced currents be excited in these channels by immersion in a magnetic field, and let them have time to dissipate a little energy and begin to die away before the field is removed. On now destroying the field, the inverse induction will more than destroy the previously induced currents, and will leave a residue of opposite current in the molecules; the body will therefore behave as a weak magnet, until these residual currents die away.

I must examine more carefully the excitation and decay of the permanent magnetism with time. With wood it seems to be a question of hours.

These dissipation experiments are very important and should be seriously attempted in several directions with proper appliances and funds. Thus: gas molecules appear to be perfectly elastic, or rather their impact coefficient of restitution is supposed to be unity, but if a box of gas be shut up in infinitely adiabatic cotton-wool for a century, will it have gone colder?

Again, iron molecules are supposed to be infinitely conducting, and their Ampère currents seem permanent; but if the moment of a bar were measured from time to time against gravity, when a given current circulated in a given helix round it, would it be found that age impaired its strength?

Once more, bismuth is supposed to be diamagnetic by reason of its non-resisting channels; but suppose a piece of bismuth is left in a constant magnetic field for a year, will it have lost some of its diamagnetic property? and when taken out will it be found magnetic for a time?

It may be remarked that, whereas it is certain (on Ampère's theory) that iron molecules are almost infinitely conducting, we have no similar assurance for bismuth; it is even possible to surmise that a body may tend to become diamagnetic in proportion as it chokes off its own molecular currents, while magnetic bodies are such as retain them perennially without apparent loss. If such were the case, diamagnetism would sometimes improve with age.

I am, of course, aware that there is another, and merely differential, theory of diamagnetism, but this leaves magnetism itself wholly explained; whereas, directly the Ampère theory of magnetism is even provisionally accepted, the Pruth of infinite molecular conductivity is already crossed, and the Weber theory of diamagnetism follows as a natural and indeed inevitable consequence.

OLIVER LODGE

University College, Liverpool, March 15

Dissociation and Contact-Action

IN a recent issue (NATURE, vol. xxxiii. pp. 350-51) you drew attention in your "Chemical Notes" to some recent researches of M. Konovaloff on "contact-actions," and to the suggestion made by him that "the dissociation (in the cases referred to) was a consequence of the contact-action of the solid body." On referring to the abstract of M. Konovaloff's paper in the *Journal* of the Chemical Society for January, 1886, I meet with the following:—"As an explanation of this contact-action phenomenon it is asked whether it is not possible that the bombardment of the molecules on the solid matter causes the kinetic energy of the molecules to be transformed in part into the internal work required for their decomposition."

Perhaps some of your correspondents will kindly furnish me with references to original memoirs (or other sources of information) in which I may find this question competently treated. The idea here put forward by M. Konovaloff is surely not new. It might be extended, as I conceive, to such cases as, for example, the combination of SO_2 and O_2 to form SO_3, the formation of ammonia from a mixture of NO and H_2 in the proportion of $5H_2 + 2NO$, the formation of NO from a mixture of NH_3 with an excess of O_2, in each case when the gaseous mixture is passed over heated platinum-sponge or platinised asbestos. For some years past this explanation of such contact-action phenomena has appeared to me much more reasonable than such explanations as are generally suggested. The high temperature required in such cases seems to point rather to something in common with the initial dissociation caused by the intense heat of the electric spark, when oxy-hydrogen gas is fired. In such cases as those referred to above the lesser intensity of the heat applied from without may easily be compensated by intra-molecular results of the increased energy with which the impact of individual molecules must take place at high temperatures, and the great extension of the heated solid surface exposed to their bombardment. Under this view (with which my pupils have been familiar for some years past) combination is brought about through the atoms of some of the molecules of the mixed gases being brought into the *quasi-nascent state*. A. IRVING

Wellington College, March 10

Variable Stars

IN NATURE for March 11 (p. 440) Dr. Mills, in criticising Prof. Seeliger's *collision hypothesis* of the blazing forth of *Nova*, advances a theory of his own as a presumably original and novel explanation of the phenomena of variable stars. It may be of interest, therefore, to point out that practically the same explanation was suggested in 1878 by Prof. R. Meldola in a paper published in the *Philosophical Magazine* for July of that year.

In this paper the author states: "It is conceivable that in certain cases the composition of a star's atmosphere may be such as to permit a considerable amount of cooling before any combination takes place among its constituents; under such circumstances a sudden catastrophe might mark the period of combination, and a star of feeble light would blaze forth suddenly, as occurred in 1866 to τ Coronæ Borealis. In other cases, again, it is possible that the composition of a star's atmosphere may be of such a nature as to lead to a state of periodically unstable chemical equilibrium; that is to say, during a certain period combination may be going on with the accompanying evolution of heat, till at length dissociation again begins to take place. In this manner the phenomena of many variable stars may perhaps be accounted for."

It will be seen that these hypotheses are essentially identical, although it would appear that Dr. Mills limits his explanation to the formation of polymerides (presumably of some primordial matter), these constituting our chemical "elements." I cannot see, however, that he has any reasons for excluding the formation of true compounds, or why he should consider a variable star as necessarily one that is engaged *only* in "making elements." This last process would, no doubt, be the first to take place on the hypothesis of cooling from a state of complete dissociation, but there would surely come a period when the more stable chemical "compounds" could exist, and their formation would also be attended by the evolution of heat and possibly of light also. JNO. CASTELL-EVANS

London, March 13

The Iridescent Clouds and their Height

COL. TENNANT is mistaken in supposing that the only peculiarity of the clouds which appeared in December 1884 and 1885 is in their being fringed with coloured spectra, though these were, I believe, much more vivid than those of ordinary clouds, as described by him; besides which, my impression was that the colours were more varied than is usually the case. Col. Tennant, with his experience, will be better able to say than I am whether there is generally as much blue in the clouds he describes as in those under discussion. I stated in my letter of Dec. 29 last (p. 199) that there was no special amount of blue in the clouds seen the previous day, but on the 31st there was a good deal. However, I do not insist on this as being any important difference; but, by referring to the numerous letters this year and last about the clouds, he will see there were several other characteristic points.

These clouds are not like any ordinary clouds; if they can be referred to any of the usual classes they are cirrus, but decidedly different from any cirrus we generally see. Their usually very smooth texture was striking, though some on December 28 (1885) had the ordinary appearance of rippling, but in most cases this was too slight to be visible without optical aid, even when the clouds were broken up into narrow wisps, and in such a position that no colour was produced there was still something in their appearance which struck me as different from ordinary clouds. The frequently rectangular shape was very singular also, though they had not always this form. I said I had not observed this shape in the clouds of December 28, but other observers noted it on that occasion (see pp. 219, 220), and on the 31st I saw many of the clouds with this outline. It is shown indistinctly and with the corners cut off in Mr. C. Davison's sketches (pp. 292, 293). The form is generally described in the letters you have published as rhomboidal, but this is an effect of perspective; no doubt if the clouds were seen overhead they would appear rectangular. Their great height, too, must have been unusual, though perhaps not greater than that of the singular coloured clouds seen last summer in Bavaria by myself and in this country by others, as described in NATURE, and which differed from the clouds I am now describing in some important particulars. One patch of cloud was observed both here and at Shields on December 28, and a calculation from a comparison of the position as seen from the two places gives its height as 23 miles; while making the utmost allowance that seems permitted for the roughness of the observations only reduces its elevation to 11 miles. That it was the same patch of cloud observed from both places is undoubted, for one observer of it (H. R. Procter) was travelling from Shields to Sunderland, and he saw that it was the same patch all the time, and the one I had been observing here. The fringes of colour were distinctly visible on this cloud up to 4h. 25m., and feebly so till 4h. 27⅜m. I concluded that the sun had not ceased shining upon it till that time; if so, its height would be between 11 and 12 miles. At 4h. 28½m. it was pink with sunset colouring; but the sun need not have been shining on it then.

The iridescent colours have no connection with halos, as supposed by Mr. Stone (p. 391), no particular colour appearing at any particular distance from the sun, but every colour being seen at any distance, though more vividly at perhaps from 15° to 30° off the sun. THOS. W. BACKHOUSE

Sunderland, March 12

Forms of Ice

A CURIOUS formation has lately occurred on the surface of a sheet of ice in a tub. Being under a tap, the ice became submerged below several inches of water. Fresh ice then formed as thin vertical plates upon, and at right angles to the submerged sheet. These plates meeting each other in all directions, produced a spongy mass, 3 or 4 inches thick. I do not know if it is a common production, but the special interest attached to it is that it would seem to suggest how "spongy" quartz has arisen, of which I have a specimen consisting of thin and nearly parallel plates; as well as the well-known form of thin crystalline plates in which calcite may occur. It is just this form of calcite which gives rise to "hacked" quartz, when silica has coagulated or crystallised over a mass of such thin crystals, and then these latter have been subsequently dissolved out.

Why a sheet of ice should increase regularly in thickness by additions to its lower surface, and form this spongy mass on its upper, is a question I should like to hear solved.

Another form of ice I lately noticed on a wall consisted of minute prisms standing in little depressions in the bricks. The circumference of the prism partook of the irregular form of the cavity, giving the appearance of an upward growth.

While speaking of ice, I should like to venture a suggestion to account for its lighter specific gravity than that of water, namely, that water crystallises in macles of complex form; the consequence being that the molecules cannot possibly fit together into a compact mass, as, for example, the rhombohedra of calcite do; for ice really resembles compact snow.

GEORGE HENSLOW

Sunrise-Glows

ON the morning of the 7th inst. a curious form of sunrise-glow was observed on Ben Nevis. The sky at the time was covered by a uniform thin sheet of stratus-cloud lying just a little above the hill-tops all round. About 7 a.m., shortly after sunrise, the sun was shining downwards through this cloud, and the valleys to the eastward of Ben Nevis were filled with a "glow" exactly similar in colour and general appearance to the upper glow so often observed before sunrise and after sunset. The temperature at the time was very low—$9^{\circ}.2$ F.—and at 7.16 a portion of a vertical halo passing through the sun's disk was seen. This "under-glow" would seem therefore to have been due to the presence in the air of ice-crystals, rather than of dust, whether cosmic or otherwise.

R. T. OMOND

Ben Nevis Observatory, March 8

A Horrified Cat

LAST week, in connection with a study of Carnivora, I obtained a cat from an acquaintance at a distance, and carefully dissected it in a room above our stable. When I had finished, the cat was, as may be supposed, hardly to be recognised. I cleaned the scalpels, placed them in the case, and took them to the house. No sooner had I put them down than I observed our own cat go and sniff all around the case with a peculiar look of intense wonder. I took the instruments away, and thought no more about it; but a short time after I returned to the remains of the dissected cat in order to prepare the skeleton, when I saw our cat standing at a distance of about a foot from the dissection, and presenting an appearance of most helpless terror. She was trembling from head to foot, and in such a condition of evident horror that my presence had no effect upon her. After some moments she noticed me, and then darted away with a scared look such as I have never before seen. She did not return to the house that day—a thing quite unusual; but on the next day she returned and entered the house with a fearful caution, as though realising the probability that she herself might become a victim to science, and her whole conduct has changed.

This suggests that the country custom of using dead birds, weasels, &c., as a scare to the like is not entirely unreasonable, and it would be interesting to know whether others have noticed similar effects.

E. J. DUNGATE

Horton Kirby, Dartford, March 23

Nocturnal Hymenopteræ of the Genus *Bombus*

AS no one has replied to Mr. Doria's letter in NATURE for February 25 (p. 392), I may say, in response to his inquiry, that I have heard in England a number of bees on a species of Tilia, at dusk, when it was probably much darker than the "very bright moonlight" referred to by Mr. Doria. It was too dark to watch them, but their "hum" was very audible, and on my dragging down a bough of the tree I saw one bee fly away. In Herman Müller's "Fertilisation of Flowers," English translation, p. 67, it is stated that a social wasp (*Apoica pallida*) in Brazil seeks honey "*only by night*," sitting still in its nest by day.

Query. Might not the "very bright moonlight," and not habit, be the cause of the bees appearing at night, as described by Mr. Doria? I should hardly think a bee could discern between moonlight and twilight. I have several times seen bees rapidly on the wing, and apparently making for home *in the twilight*.

JNO. C. WILSON

Fairfield, near Manchester, March 13

A LINGUISTIC REVOLUTION [1]

JAPAN, in modern days, is the land of revolution and of change. The systems and habits of centuries are rapidly disappearing; the old order is being dissolved by contact with the West, and every year produces some reform which brings the country more and more into line with Europe and America. There may sometimes be haste, but there is no rest, in Japanese movements; there is little swerving to the right or left, and now for about sixteen years the country has been, on the whole, steadily moving along towards one goal, viz. equality with Western nations, politically, socially, and intellectually. But of all the wonderful changes which the present generation has witnessed in that country, perhaps not one has been so strange or widely beneficial as that the commencement of which is described in the pamphlet before us. And as the first who will profit by it, should it prove ultimately successful, will be the rising generation which has to study Western science in all its branches, it deserves special description in these columns.

It will be known to many of our readers that the Japanese language, which, in its genius and structure, is wholly different from that of China, is nevertheless written by means of the Chinese ideographic or pictorial signs, aided by two alphabets or syllabaries, themselves based on Chinese characters. The object of the new movement, shortly stated, is to sweep away these signs altogether, so far as Japan is concerned, and to use Roman letters only in writing the language. The Association, which has been formed to carry out, as far as a private body can, this reform, has issued the present pamphlet by the advice of Her Majesty's Minister in Tokio, with the view of making known abroad a movement "which its authors believe to be an important step in the intellectual progress of their country." We cannot do better than follow this official statement of the evils of the present system, which is an incubus on the intellect of the nation, and which adds incalculably to the mental toil, more especially of its scientific youth, at the most important stage of their lives. It may be well, however, to say at the outset that the reform is no mere craze of a few misguided enthusiasts. The Society numbers amongst its most active and sympathetic members not only Japanese scholars of eminence who have studied their own as well as Western languages, but also Europeans and Americans who have devoted their lives to the study of the Japanese language and literature, and Western diplomatists who are most unlikely to participate in any visionary movement of this nature. When men drawn from these various classes, with the best means of studying the question on the spot, join together with the object of carrying the reform into practice, we, who have not the same opportunities of becoming acquainted with the local circumstances, may be excused from discussing its practicability any further. We may take that for granted, or we should not find the names supporting the reform that we do. Another point to be noticed is, that hitherto the Government has officially held aloof from the Association, preferring, no doubt, to allow private effort to prepare the soil beforehand. To return, however, to the pamphlet issued by the Society.

The object of the Romajie Kai, it states in the first sentence, is to introduce the use of Roman letters, instead of Chinese ideographs, for writing the Japanese language; when a language can be adequately represented to the eye by twenty-two signs indicating sounds, why (it asks) waste time and effort by continuing to represent it by many thousands of symbols pictorially representing objects and ideas? It is a labour of years to learn to write the Japanese language as at present written, viz. with Chinese characters supplemented by syllabaries invented by Japanese scholars a thousand years ago. The number of Chinese characters is not their only disadvantage. Upon their introduction (we here employ for the most part the exact words of the pamphlet) into Japan, it was early found impossible to restrict the employment of them to the expression of purely Japanese words of corresponding signification. The Chinese sounds, or, rather, a more or less inaccurate approximation to the Chinese

[1] "A Short Statement of the Aim and Method of the *Romajie Kai*" (Roman Alphabet Association of Japan). (Tokio, 1885.)

sounds, was imported gradually into the language of Japan along with the written symbols. It has therefore come to pass that, in Japanese books, one and the same character is at times used as the equivalent of a Japanese word, and at other times of the synonymous Chinese word. But, besides this source of confusion when the characters are used with their proper ideographic values, there is a further element of doubt and difficulty imported into written Japanese by the circumstance that many of the characters are occasionally employed as merely phonetic signs, irrespective of their meaning; sometimes to represent the mere sound of a Japanese word, at other times the mere sound of a Chinese word. Thus the difficulty of the ideographs arising from their numerical superabundance is aggravated by ambiguities in the modes of using them. Another disadvantage of the Chinese characters is the complexity of their form and structure. Although some scores of them are written with no more than three or four strokes of the pen each, there are thousands of others requiring each as many as ten, twenty, thirty, and sometimes even more than forty distinct movements of the hand for their formation. To write these complex combinations of lines, curves, and points always at full length was a task too much even for Chinese patience, and at least two distinct varieties of abbreviated handwriting came into general use both in China and Japan, namely, the "cursive" and the "grass" script. In most cases, however, these contracted forms of the characters are so destitute of any likeness to the original forms as to afford no aid whatever to the eye or to the mind in detecting their identity. To acquire the quicker modes of writing involves, therefore, a further considerable expenditure of time, and fresh demands upon the already over-burdened memory.

Nothing can be added to this clear and succinct account of the difficulties which lie at the threshold of knowledge in the Japanese language; but there is a serious aggravation of these difficulties, not referred to in the statement, when we come to the Western sciences, with the large and special vocabularies attached to most of them. If we take chemistry, for example, the Japanese student of this science is compelled to learn the translations into his own language of technical chemical terms and the Chinese characters which have been invented or adapted to represent these translations. Under the rational system proposed by the Society there is no reason why oxygen should not be written "oxygen" at once in Japanese, instead of by a couple or three fanciful symbols which may either be an attempt at translation or description, or an attempt to reproduce the sound, or arbitrarily selected to represent the word. The Japanese student would begin his work much where the English student does; he would learn the word "oxygen" once for all, and then learn its properties, combinations, &c., in the Japanese tongue, as the latter does in the English tongue.

The writers of the pamphlet then observe, with much force, that the excessive expenditure of mental power in learning by heart thousands of intricate symbols of sounds and ideas must diminish the stock available for use in other directions. The memory indeed is exercised, but at the expense of some of the other intellectual faculties. To this they are inclined to attribute in a large measure the comparative backwardness of the Chinese mind, and its deficiency in the powers of abstraction and generalisation—a very interesting observation which it would lead us too far to discuss now. Japan partially emancipated herself from the thraldom of the Chinese script when the syllabaries were invented a thousand years ago; but no complete deliverance is possible, they think, otherwise than by wholly discarding it in favour of a purely alphabetic system. So long as the literature of China formed the sole staple of education in Japan, little inconvenience arose from the multiplicity and intricacy of the Chinese ideographs, but now that European science is being eagerly studied and assimilated by the rising generation, the need of a simpler and easier script for the expression and propagation of the new ideas becomes every day more evident. The most convenient course is, clearly, to adopt the new terms as well as the new ideas bodily into the language, and this cannot properly be done unless the writing used be alphabetical. Amongst the subsidiary advantages of employing the alphabet in which the languages of the leading nations of the world are written is that the acquirement of any other European language will be much facilitated. Europeans, too, will find it much easier to learn the Japanese language when the principal stumbling-block is thus removed, so that, as the writers properly conclude, from both ends at once the channel of communication between Japan and the Western world will be widened and deepened by the employment in common of the Roman alphabet.

Very few words will suffice to explain the broad features of the scheme of transliteration produced after much consideration by a Committee of the Society, and now universally adopted. First, in using the Roman alphabet the consonants have been taken at their usual English values and the vowels at their values in Italian; secondly, the actual pronunciation of the words regardless of their spelling in the syllabaries, the latter in many cases being so totally different from the pronunciation that even Japanese themselves are frequently at a loss to write words in the syllabaries; and, thirdly, the standard of pronunciation chosen is that of educated people in the capital at the present day. Of the twenty-six letters of the Roman alphabet, four, viz. *l*, *q*, *v*, and *x*, are not used in writing Japanese, and are therefore omitted; in regard to capitals and punctuation the ordinary English method is followed. Nineteen rules, most of them too technical for special mention here, are laid down: they are all simple enough to those acquainted with the syllabaries, and can be readily applied in practice. Finally, the pamphlet gives examples of the various styles—literary, epistolary, &c.—in the present mode of writing, and under the Roman system according to the rules laid down.

Such being the objects to be attained and the method of attaining them, it is satisfactory to observe that almost universal assent has been given to the work of the Society. Some of the principal journals of the country set apart a certain portion of their space for articles printed in the Roman letters; a journal wholly printed in this way is published by the Society itself; the number of members is increasing by leaps and bounds, and many of the most learned and influential men in the country have already joined the ranks of the reformers. On the other side, of course, there are the rooted habits of a thousand years; but the Japanese have already succeeded in changing so many of their old habits and modes of thought that they may be trusted ultimately to succeed in this reform also. Moreover, it should not be forgotten that the present method of writing Japanese by means of Chinese ideographs is itself and imputation, a graft on Japanese civilisation, and, it may properly be urged, that what the nation has done once it may do again. The letters of the future may not be so artistic and beautiful as those of the present day; but this æsthetic objection will be counterbalanced by the fact that several years, at the most sensitive and valuable portion of life, will be added to the work of each generation, and a crushing obstacle will be removed from the gateways of knowledge for the Japanese youth of the future. Those who have technical and local knowledge speak of the perfect feasibility of the reform, and the outer world may accept their verdict with reasonable confidence; we may all, with a clear conscience, wish Japan success in one of the most arduous and beneficent reformations ever undertaken for a nation.

Since the above has been in type we have received the report of the annual general meeting of the Society, held in the great hall of the Engineering College of Tokio on January 23, amongst those present being some of the most prominent members of the Japanese Government, and many representatives of foreign Powers in Japan. The annual report stated that the Society now numbers over 6000 members, scattered over the various provinces of the Empire. A proposition having for its aim the retention of the old syllabary system of spelling, was rejected by a large majority in favour of phonetic simplicity, as above described. The Minister for Foreign Affairs, Count Inoue, delivered a speech, in which, viewing the aims, methods, and probable future of the Society from a great variety of standpoints, he expressed his complete sympathy with the movement. The British Envoy, in describing the objects of the Association, said:—"We aim at nothing less than one of the greatest changes ever yet made in the history of literature, or indeed, I may say, of the world. We hope to bring the thoughts of a nation of 37,000,000 into closer communion and intercourse with the thoughts of the rest of the world, and by freeing memory from the task of learning many thousands of characters, the sense of which can be satisfactorily rendered by a couple of dozen letters, to give the intellect some leisure to acquire the many and varied branches of learning which the necessities of modern civilisation render so important to us all."

THE SURVEY OF INDIA [1]

II.

In our first notice we reviewed the principal topographical and cadastral operations. We have now to review the interesting information regarding the physiography of the localities of operation and other subjects which is scattered over the Report, but chiefly in the appendixes.

The Andaman Islands were being brought under survey for the first time; they form a portion of the belt of islands extending from the south-west point of the Burman mainland to the north-west point of the great Island of Sumatra, which are all that is now left of what was probably once a long, tapering off-shoot from the Asiatic continent, such as we still have in the Malayan Peninsula. These islands became of interest to the Government of India only of late years, when a convict settlement was established at Port Blair, on the South Andaman Island; but as yet little intercourse has been established with the inhabitants, who are wild and barbarous aboriginal Negritos with very dark skins and of very small stature. They are said to consist of nine distinct tribes known as Akas, which occupy separate islands and speak different dialects. Our influence has been most operative on the Aka-Bojigngiji, who are settled nearest Port Blair, and our relations with some of the other tribes are said to be on a fairly friendly footing, but very little is known about them, and nothing of the interior of the islands which they inhabit.

The Aka-Járawas, who occupy the Little Andaman, have ever been openly hostile; they are professional wreckers whom it has been necessary to punish on more than one occasion for barbarities perpetrated on shipwrecked crews, but they still retain their reputation for treachery and cruelty, and hold aloof from friendly intercourse; of late years they have been visited annually by the Chief Commissioner, and presents have been made to them with a view to bringing about more amicable relations, but they have been known to accept the proffered presents and then attack the bearers on their way back to their boats; their language is said to be unintelligible to the anglicised or tamed Andamanese, who are employed as a go-between. The Survey officers landed on the island and deposited presents on the beach, and then retired to their boats; the Járawas advanced and appropriated the presents somewhat sulkily and retired into their forests, and consequently nothing could be done with them; but their dwelling-places were entered and examined by the surveyors in their absence. These were found to be substantial, well-built huts, affording shelter for from 30 to 40 people, circular, dome-shaped, about 60 feet in diameter, and rising to a height of some 35 feet in the centre; the dome was thatched, and supported on long poles set up in three concentric circles within the hut. Small cots and a rocking-cradle were found inside; and all round the interior pigs' skulls, beautifully cleaned and neatly bound up, were closely arranged about three feet from the ground.

Barren Island (lat. 12° 15′ by long. 93° 50′) and the Island of Narcondam (13° 26′ by 94° 16′) were visited and surveyed by Capt. Hobday, whose exquisitely shaded maps of these interesting volcanic islands are published with his report. Barren Island is circular in shape with a diameter of 2 miles and an area of 3·07 square miles. Its principal features are a main crater and an inner cone. The main crater is elliptical in shape, with axes of 1½ and 1 mile, the walls rising to a height of 1158 feet above the sea-level on the south-east, and sinking down to the sea on the north-west; the cone is about half a mile in diameter at its base, and rises 1015 feet above the sea, terminating in a small elliptical crater, with axes of 300 and 190 feet and a maximum depth of 74 feet. Steam and smoke were issuing from the highest point of the cone; sulphur was found in large quantities near the vent, at a temperature sufficiently high to be felt through the boots. There was evidence of three distinct outbursts of lava on the sides of the cone, half-way up; the slopes were coated with fine volcanic ash, which made the ascent very laborious; loose cinders and scoriæ of various sizes lay heaped together in confused masses around the base, amid which occasional tongues of alluvial soil, overgrown with thick grass, were found jutting from the inner slopes of the main crater; the outer slopes were covered with thick vegetation, the principal tree being a species of fig. The island was infested with rats, which had not yet learnt to become shy of man, and were readily knocked over with sticks; bats and large crabs were found on the summit of the main crater. The outer slopes of the main crater would, if prolonged, meet in a point immediately above the present apex of the cone; thus it is conjectured that the crater was originally a true cone rising to about twice its present height, and that the upper portion has been carried away by a violent eruption, such as recently occurred at Krakatão, leaving the present truncated crater. The volcano is known to have been in an active state towards the end of the last century; since then it has been gradually cooling, and the temperature of a hot spring on the beach was found to be considerably less than it had been when measured by previous visitors.

The Island of Narcondam is about 2½ miles in length by 1¼ in breadth, and rises to a height of 2330 feet above the sea; it is composed of trachytic lava, but no trace of any crater was discerned. The slopes were covered with dense forest, but water was not found anywhere; flocks of hornbills or toucans, uttering a peculiarly shrill note, followed the surveyors on their way to and from the summit; and a large iguana, with long prehensile claws, was captured and sent to the Museum at Calcutta.

In Assam a raid of the semi-savage Akas who inhabit the hills on the borders of Tezpur and Lakhimpur, led to the acquisition of some new geography by Colonel Woodthorpe and a party of surveyors who accompanied the troops which were sent to recover the British subjects who had been captured by the Akas and carried away into their hills. The country of the Daphlas was crossed, when a river, never before heard of, the Kaneng, was discovered

[1] "General Report on the Operations of the Survey of India Department, administered under the Government of India during 1883-84." Prepared under the direction of Col. G. C. De Pree, S.C., Surveyor-General of India. Continued from p. 444.

and proved to be the most important of all the affluents of the Baroli; it drains much of the area which has hitherto been assigned to the Khru. Colonel Woodthorpe maintains that some confusion appears to have existed in the public mind as to the proper application of the names Abor and Daphla, for whereas it is believed that "the Daphlas always tattoo but the Abors never," just the reverse is the case. "Abor" is, however, a very vague appellative, and among the Assamese themselves means only a "foreigner." It is applied equally to tribes in the Aka, Daphla, Miri, Mishmi, and Naga Hills, and is only acknowledged by the so-called Abors themselves out of deference to the ignorance of those who, they believe, would fail to recognise them under any other name.

The survey of Independent Sikkim, in which Captain Harman's life was nobly sacrificed, has now been completed by his quondam assistant Mr. Robert. Returning from the northern frontiers of Sikkim, Mr. Robert has brought the unlooked-for intelligence that there are no great glaciers in the valleys to the north-east of Kinchinjinga, though situated on the shady side of peaks and ridges ascending as high as 28,000 feet, and nowhere under 20,000 feet; masses of glacial ice and *névé* skirt the lower slopes of the mountains, but without protruding into the valleys, and as a rule the enormous mass of snow deposited on these mountains—which are among the highest on the surface of the earth—is either evaporated where it falls or is melted and carried off by the Lachen and other feeders of the Teesta, without having first passed into the state of glaciers such as pervade the entire length of many of the valleys of the North-West Himalayas, near the junction with the Hindu Kush Range, where the mountains are lower, but the annual rainfall is much less.

The Survey operations confirm the general accuracy of the admirable sketch-map constructed by Sir Joseph Hooker upwards of thirty years previously, which has been our only reliable map of Sikkim up to the present time, and which still represents the limits of the geographical knowledge acquired by Europeans beyond the frontiers of Sikkim; the officers of the Survey have not been able to penetrate further north than he did, nor do more than see, as he saw, without fixing, the peaks of the great Tibetan ranges beyond; all new geography in Tibet is wholly due to the native explorers.

Colonel Tanner gives an interesting account of the journey of one of these explorers, "the Lama," through portions of Southern Tibet and the northern borders of Bhutan; an excellent map is attached in illustration. The Lama travelled round the entire circumference of the famous Yamdok Lake—lat. 20° by long. 90° 45′—which was visited by D'Anville in 1735 and by Manning in 1811, and forms such a prominent object in all maps of Tibet; he found it considerably larger than has hitherto been conjectured, the circumference being 120 miles excluding and 180 miles including the bends of the shore. There are numerous towns and villages on its banks, a large population, and much cultivation. It is sometimes called Piahte, or Pálti, after a neighbouring town, but most commonly the Yamdok-tso or Scorpion Lake, because its shape resembles that of a scorpion; the tail points eastwards towards the Kár-má-sing, "the starry plains," or "plains of heaven," a delightful and far-reaching extent of sward on which graze thousands of cattle, horses, and beasts of the chase; the two claws point to the west, and almost encircle a peninsular mountain tract, on which there are some villages and an important monastery. The south claw partially encircles an inner lake—the Dumu-tso—which is 500 feet higher than the main lake, and has a circumference of 24 miles, and is regarded by the Tibetans with great awe, fear, and superstition. There is an idea that some day Tibet is doomed to be flooded and all animal life destroyed by the overflow of this lake, and prayers are constantly being offered up in the surrounding monasteries to avert the catastrophe. Earthquakes, landslips, and convulsions, accompanied by subterraneous noises, are said to be of constant occurrence, and the waters are reputed to be steadily rising, notwithstanding the prayers constantly offered by the monks to turn away the wrath of the demon of Dumu-tso, who is believed to be confined below the waters.

The Yamdok Lake drains westwards into the Yaru-sanpo or Upper Brahmaputra River, through a valley which lies parallel to the river but slopes in the opposite direction. Colonel Tanner points out that this is a general feature in the drainage of Southern Tibet, all the principal feeders of the Sanpo running for the greater length of their courses in a contrary direction to the great river itself. The Lama was informed that the lake occasionally falls to so low a level that it receives water from the Sanpo, but this seems scarcely possible, for on the occasion of his visit it stood 1600 feet above the Sanpo at the point of junction with the drainage channel—as shown by his boiling-point observations—and even then the flow of the current in the channel was not particularly remarkable. It not unfrequently happens in analysing the work of the native explorers that the facts deducible from their own observations, which they are taught to make accurately but not to reduce, prove some of the tales they have been told by the people of the country to be fictions.

To the south of the Yamdok the Lama discovered a new lake, called the Pho-mo-chang-thang (*lit.* man and wife of the high plain), at a height exceeding 16,000 feet, embosomed in lofty mountains and having no outlet. The range to its south is a portion of the great water-parting between India and Tibet; the Lama crossed it by the Menda Pass, 17,450 feet high, and then descended the north-west branch of the Lhobra River to Lhá-khâng Jong (lat. 28° 5′, long. 91° 5′, height 9500 feet), where he saw the Lhobra River flowing to the south towards Bhutan through a deep gorge. Colonel Tanner says this river must be one of the largest, if not the very largest, feeder of the Monas, but we know so little of Bhutan that it is hard to say which of the streams crossed lower down by Pemberton is the Lhobra. Leaving Lhá-khâng Jong the Lama ascended the north-east branch of the Lhobra River, and again crossing the great water-parting—at the Shar-kha-leb Pass, 16,800 feet—returned to Tibet, his *détour* to the south having taken him over much ground that was entirely new to geography. Our limits do not allow us to devote more space to his travels, which are very interesting and valuable,—a satisfactory evidence of the advantages which the Indian Survey derives from its utilisation of Asiatic *employés* to explore regions into which Europeans are not allowed to penetrate.

Colonel Tanner is an artist as well as a geographer, and his reports contain much picturesque description, in addition to necessarily dry detail. He was employed for some years in the Western Himalayas, around Gilgit, and in the neighbourhood of several very high mountains, including the great Nanga Parbat and the sharp-pinnacled Rakiposhi; and he gives an interesting comparison of the aspects of these mountains with those of the Eastern Himalayas, showing that the latter are less striking, though they are the higher, and include Everest, 29,000 feet, the highest peak yet measured on the surface of the globe; their bases are more elevated, and thus the surfaces of snow which they expose to view rise into the sky to a less height above their surroundings. He says of Everest that the outline is rather tame than otherwise, and that Makalu—27,890 feet high, and 12 miles south-east of Everest—is the finest peak yet fixed in the Eastern Himalayas, with the exception of Kinchinjinga, 28,160 feet. The fact is that Everest lies some distance to the north of the main line of peaks, and the view of it from the south-east, south, south-west, and west-south-west is shut out by more prominent peaks which, though lower in height, are nearer the point of view accessible to Europeans, and are also less lowered by the earth's curvature than the more distant pinnacle. These peaks are frequently mistaken for Everest; thus in the atlas accompanying the "Results of a Scientific Mission to India and High Asia" there is a large chromolithographed plate from a drawing by Hermann Schlagintweit of a mountain which he believed to be Everest; but the mountain is undoubtedly Makalu, as has recently been pointed out elsewhere.[1] The best view of Everest from British territory is obtained at Sandakphu, a well-known hill on the boundary between Nepal and Darjeeling; but even there it is partly shut out from view by Makalu, which being exceedingly bold and picturesque in appearance generally comes in for more attention than its higher neighbour.

The pillars and posts marking the line of boundary between the Nepalese and the British territories, having in many instances been destroyed by wild animals or carried away by floods, survey operations have been undertaken, at the request of the Nepalese Government, with a view to relaying the line. This has afforded an opportunity of surveying the Sameswar Hills, the water-parting of which constitutes a portion of the boundary. A strip of the Nepalese territory which skirts the boundary has been sketched as far as circumstances would permit, and large errors in the topography of the tract, as laid down hitherto from native information, have been discovered and corrected. The Sameswar Hills are said to be very similar to the Siwalik Ranges, which the palæontological discoveries of Falconer, Cantley, and Baker have made so famous, excepting that the peaks are generally of less altitude, and the *Pinus longifolia* is almost entirely absent.

Major Holdich gives an account of the first ascent ever made by Europeans of the famous Takht-i-Suliman, or Throne of Solomon, the highest portion of the range of mountains on the western border of the valley of the Indus, which separates the highlands of South-Eastern Afghanistan from the plains of the Punjab. Viewed from these plains the Takht has the appearance of a ridge some 8 miles in length, much elevated above its surroundings, and with two culminating peaks at its northern and southern extremities,—apparently admirable points from whence to make a survey of the tract of country extending westwards almost as far as Candahar and Ghazni, of which very little is known. Lieutenant James Broadfoot, of the Bengal Engineers, travelled across it in 1839, by the route from Ghazni to Deva Ismail Khan *viâ* the Ghwaleri Pass, of which he made a hurried sketch under great difficulties; and the Zhob Valley to the south has been roughly mapped by a native explorer. But much more knowledge of the country was wanted, and this it was expected might be obtained by observations from the two great peaks of the Takht, the ascent of which had for many years been an object of laudable ambition on the part of the Survey officers; they were greatly gratified when the Government authorised a survey expedition to be sent to the summit of the mountain, with a sufficient escort of troops to overcome any possible opposition. On reaching the summit the Takht was found to consist, not of a single ridge, but of two parallel ridges, with a plateau between, the highest point at the northern extremity (11,300 feet) being on the western ridge, while that on the southern extremity (11,070 feet) is on the eastern ridge, and is unfortunately shut out by the other from all view of Afghanistan. Thus the Takht was disappointing as a basis for distant geographical exploration; but a good deal of valuable topography was secured of an important but little-known portion of the Sulimanī Range, which constitutes the primary base for the defence of India from western aggression.

In Biluchistan Lieutenant the Honourable M. G. Talbot, R.E., and Lieutenant Wahab, R.E., made a valuable reconnaissance to the south-west of the little-known region which lies between Kelat, the capital, and the town of Gwadur, on the Persian Gulf; they worked over the Raskoh Ranges across the great plain of Kharan to the Lagar Koh and Koh-i-Sabz Ranges, and down to Panjgur. Much of the country traversed was a desert, and the scope of the operations had to be carefully adjusted to the limited available supplies of both food and water for men and animals.

The systematic tidal observations with self-registering tide-gauges, which were instituted under the superintendence of Major Baird, R.E., F.R.S., by the Government of India, in accordance with the recommendations of the British Association, have been continued at sixteen stations —including the ports of Aden, Kurrachee, Bombay, Madras, Calcutta and Rangoon, and Port Blair—completed at two stations, Kárwár and Pámban, and commenced at three new stations, of which two are on the Island of Ceylon, more under the direct influence of the Indian Ocean than the stations on the coasts of India. Good progress has been made with the lines of spirit-levels which are carried between the tidal stations, both along the coast lines and across the peninsula from coast to coast. So far as yet completed the operations indicate that the mean sea-level may be regarded as practically identical at all points on the open coast.

The Calcutta International Exhibition has necessitated a considerable extension of the operations of the lithographic and photographic offices under Colonel Waterhouse; the processes of heliogravure and collotype were found very serviceable in reproducing the delicate objects of Indian art-work which were exhibited. In the first of these processes a valuable improvement has been effected; originally the engraved copper plate was obtained by developing a positive pigment print, or relief in hardened gelatine, on a silvered copper plate, and then depositing copper upon it so as to form a new copper plate, bearing the design in intaglio, from which prints can be taken in the usual way. In the new process a *negative* pigment print is developed on a copper plate, and the intaglio image is obtained directly on the plate by biting in with a chemical solution, which penetrates the gelatine film comparatively easily in those parts representing the shadows of a picture or lines of a map, where there is little or no gelatine, biting the copper to a considerable depth; whereas in the parts representing the light of the picture or the ground of the map, where the gelatine is thicker, it penetrates with more and more difficulty as the thickness of the gelatine increases, and in the highest lights should leave the copper untouched. The operation of biting does not take more than five minutes, and the engraved images are said to be marvellous in their delicacy of gradation and richness of effect. The great advantage of the process is its rapidity, a day or two being sufficient to prepare the etched plate, whereas from three weeks to a month are required to "deposit" a printing plate of sufficient thickness by photo-electrotyping; on the other hand, it is difficult to get etching of sufficient depth to stand much printing without the loss of the finest tints.

The Report contains many other items of interest which our limits do not allow us to notice. It has evidently been compiled with much care, though there are occasional slips, as at page 3, where the country of Kafiristan is referred to as "an explorer in the service of the Educational Department," and the scale of the survey of that country is said to be "confidential." J. T. W.

[1] See "Notes on Mount Everest" in the *Proceedings* of the Royal Geographical Society for February 1886.

SCIENCE SCHOOLS AT HOME AND ABROAD

IN this volume Mr. Robins has collected together a series of communications which have appeared at various times in the *Journal* of the Society of Arts and

[1] "Papers on Technical Education, Applied Science Buildings, Fittings, and Sanitation." By Edward Cookworthy Robins. (London, 1886.)

in the *Transactions* of the Royal Institute of British Architects. The republication of these papers coming so soon after the last Report of the Commission on Technical Education is most opportune. We have here, brought as it were to a focus, a mass of detail relative to the planning, construction, and mode of equipment of the most noteworthy schools of science of Europe. To the teacher of applied science, and especially also to the many bodies of public-spirited men who are engaged both in London and in our midland and northern towns in the erection of buildings for applied science and art instruction, the work must be in the highest degree valuable. The mere collection of the facts themselves could not fail to prove of the greatest service to the cause of technical education in this country; but when the facts are, as it happens, arranged, co-ordinated, and criticised by one who has himself had no inconsiderable experience in designing buildings of this class, the collection becomes simply indispensable.

In the first paper, on "English and Foreign Technical Education," Mr. Robins seeks as it were to clear the ground. In this matter, as in so many others, it is the houses which obscure the view of the village. Mr. Robins therefore attempts to state precisely what it is that technical education aims at, and how we may reasonably hope that the aim may be attained. It is of course only after the lines have been laid down upon which the teaching of technology should proceed that the question of appliances and buildings can be properly approached. It is necessary therefore to carefully analyse the results which have been obtained abroad, for we have at present little to appeal to at home, and even that little has been too recently in operation to afford a basis for sound conclusions. We have as yet no system. That is, of course, characteristic of us, for we are continually reminded that we are, in some respects, the most illogical people in the world. Nothing in our whole educational history is more characteristic of us—of our energy, public spirit, and independence—than the way in which with much effort, laborious and occasionally ill-directed, and with no inconsiderable expenditure of money, we are hammering away at this question of teaching technology. In Yorkshire alone there is at the present moment probably every type of technical school more or less imperfectly developed, which the ingenuity or perversity of man could devise,—from the school which does nothing but handicraft pure and simple, up to that which concerns itself mainly with the science of practice, and relegates practice itself to the workshop. The men who are struggling with this problem of grafting a high-class scientific education upon the daily work of our towns are the manufacturers, the engineers, and merchants of our great commercial centres. These men —the men who build the big bridges, bore the big tunnels, sink the deepest mines, set up the highest blast-furnaces, and gauge their power for civilisation, as Liebig said, by the size of their vitriol chambers—have a silent horror and tolerant contempt for *doctrinaires*. Mr. Froude may say of the age of patriotism—as Burke said of the age of chivalry—that it is dead. But England owes a debt of gratitude to those who are thus struggling to keep her in the forefront of the battle for industrial supremacy among the great producing peoples of the world, and who are unstintingly spending time, energy, and money in the determination that their sons and the generations to come shall reap some of the benefits of knowledge that were denied to them.

In Mr. Robins's first paper, published in 1882, there is much relative to the Continental systems which has been supplemented by the Report of the Commission, but regarding it simply as introductory to the purely professional papers which constitute the most valuable feature of the book, it would be necessary to modify it in but few and comparatively unessential details.

In the next paper, on "Buildings for Applied Science and Art Instruction," Mr. Robins gives a detailed account, mainly compiled from personal visits, of the most distinctly representative buildings of this class to be met with in Germany, Austria, Sweden, and in our own country. In this paper we have the first attempt to formulate the general principles which should govern the planning of buildings intended for technical instruction. All technical education does not need special accommodation. Mr. Robins points out that the ordinary class-rooms attached to school-buildings may be appropriated to certain kinds of technical instruction provided that they are properly lighted and ventilated. But there are many subjects which can only be efficiently taught in specially-designed buildings, as, for example, chemistry and physics, mechanics and engineering, architecture, &c.,—in fact, all involving the provision of laboratories, lecture-theatres, work-rooms, modelling-rooms, &c., which have to be grouped in a certain order and contiguity, and which must be specially floored, lighted, heated, and ventilated, and arranged for particular furniture and fittings or special apparatus. It is with buildings of this class that we are at present more particularly concerned.

In Germany, and in the German-speaking part of Europe generally, the system of working the different subjects in separate buildings is now almost universally regarded as the most convenient arrangement. Thus at Berlin, Prof. Helmholtz's physical laboratory and its associated class-rooms and lecture-rooms are in one grand building, and Prof. Du Bois-Reymond's physiological laboratory is in an adjoining building—worthy companions of the handsome structure erected for Prof. Hofmann so long ago as 1865. At Leipzig is a street full of separate and distinct buildings for these subjects, supplementing the old University provisions. At Geneva, Prof. Graebe has designed and superintended the general arrangement and fittings of the new chemical laboratory, also situated apart from the University proper. Profs. von Pebal and Toepler at Gratz, Prof. Landolt at Aachen and Berlin, Prof. Baeyer at Munich, have each worked out, with the respective architects, the details of their new and remarkably well-fitted laboratories. At Strasburg the new University buildings are also constructed in separate blocks. In addition to the main building for classical studies and general literature, distinct blocks are arranged for physics, chemistry, botany and forestry, mineralogy, &c., each block costing from 30,000*l.* to 40,000*l.*, built in the classic style, faced with stone from the Harz Mountains, and together covering several acres of ground.

In addition to these Mr. Robins adds, as types of less ambitious places, an account of the chemical and physical laboratories of the Royal Trade School at Chemnitz, of Prof. Kohlrausch's physical laboratory at Wurzburg, of the Technical High School at Hanover, of the Royal Technical High School at Stockholm, and of the Chalmers Industrial and Technological School at Gottenborg.

It would be quite impossible, with the space at our disposal, to attempt to follow Mr. Robins in his analysis of the distinctive features of these various institutions. He has treated the mass of material thus brought together in a remarkably clear and lucid manner. There is necessarily much in every chemical laboratory which is common to all, and the same remark applies to every other laboratory or workshop in which technology is taught. Nothing more certainly indicates the trained professional eye than the manner in which characteristic differences are detected and commented upon, and it is the evidence of this diagnostic faculty which constitutes one of the most valuable features of the book.

But perhaps the most generally interesting portion of Mr. Robins's work is that relating to the applied science buildings which have been erected in this country. These consist of the Central Technical Institution at South Kensington and the Technical College at Finsbury, both erected by the City and Guilds of London; the Owens

TECHNICAL COLLEGE, FINSBURY.

E. N. Clifton Archt.

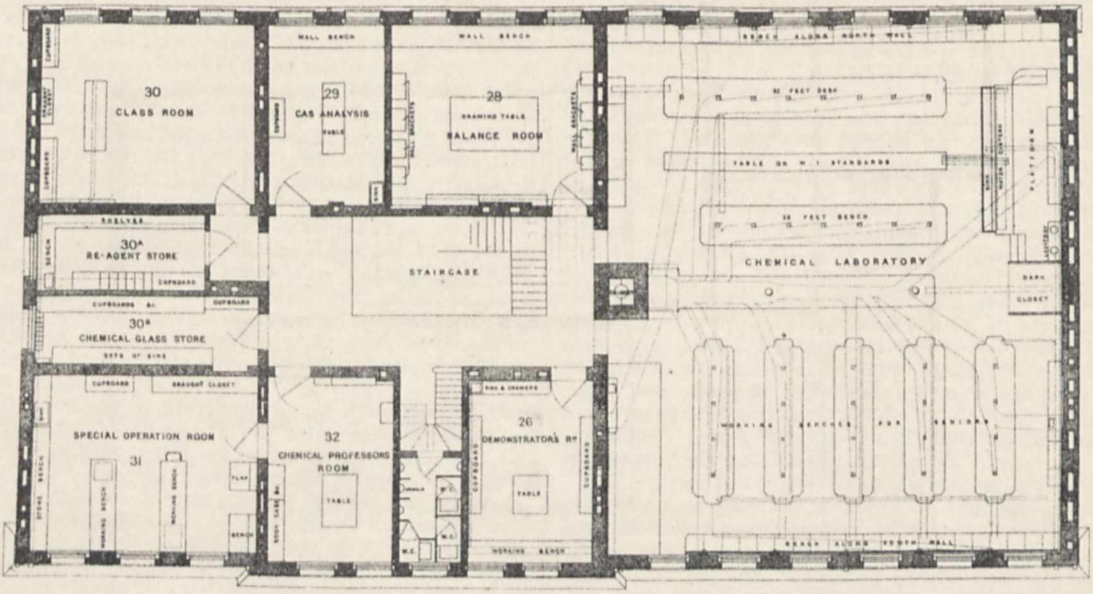


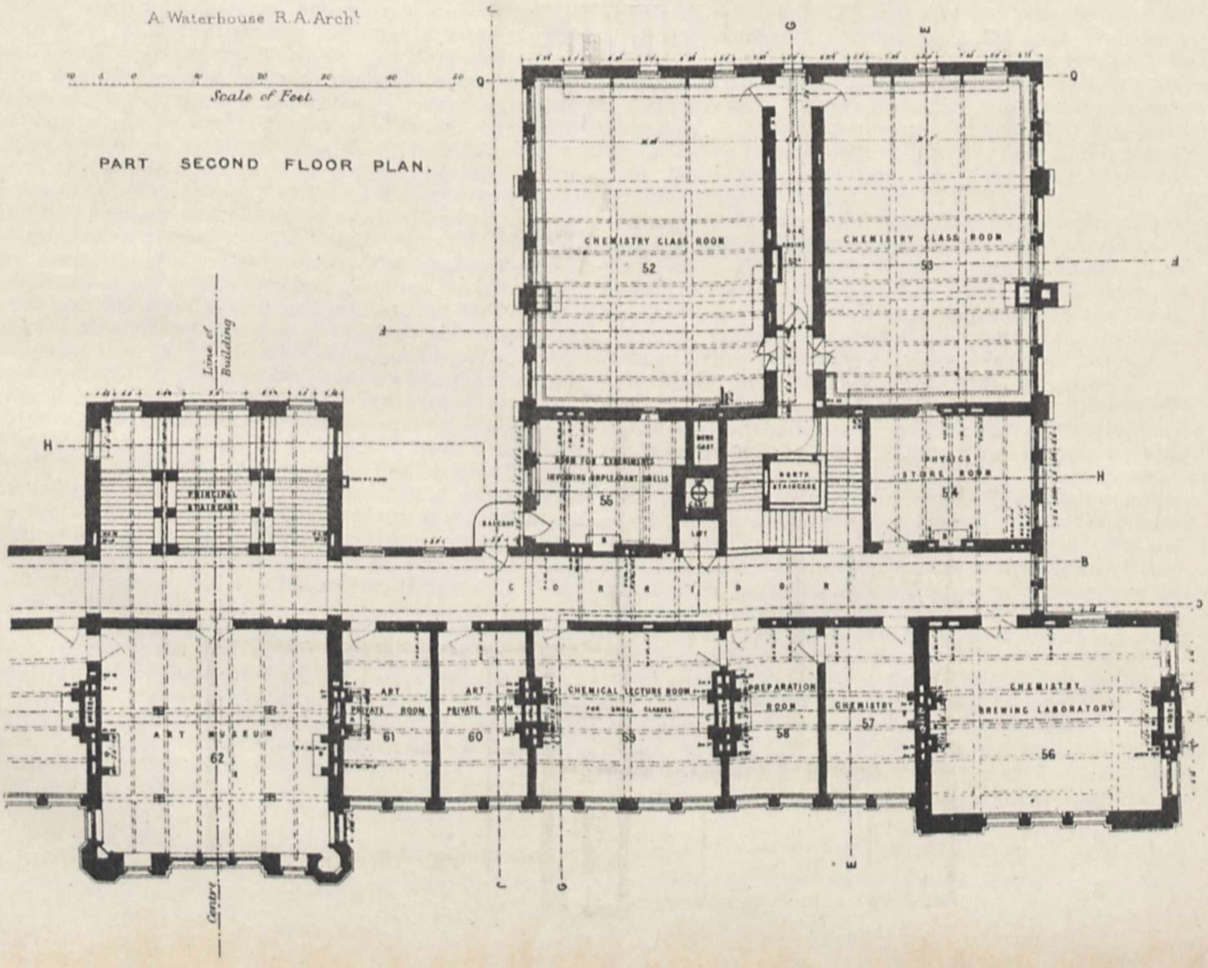
FIG. 18. SECOND FLOOR PLAN.

THE CITY AND GUILDS OF LONDON CENTRAL TECHNICAL INSTITUTION, SOUTH KENSINGTON, LONDON.

A. Waterhouse R.A. Archt.

Scale of Feet

PART SECOND FLOOR PLAN.



THE MERCHANT VENTURER'S TRADE & MINING SCHOOL, BRISTOL.

E. C. Robins, F.S.A. Archt.

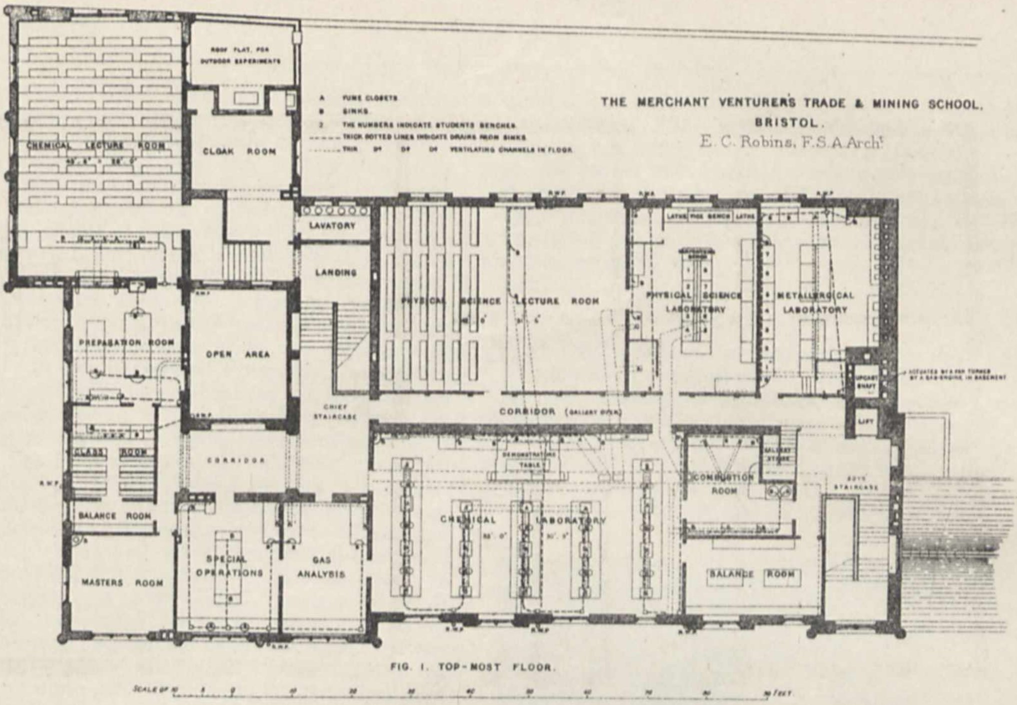
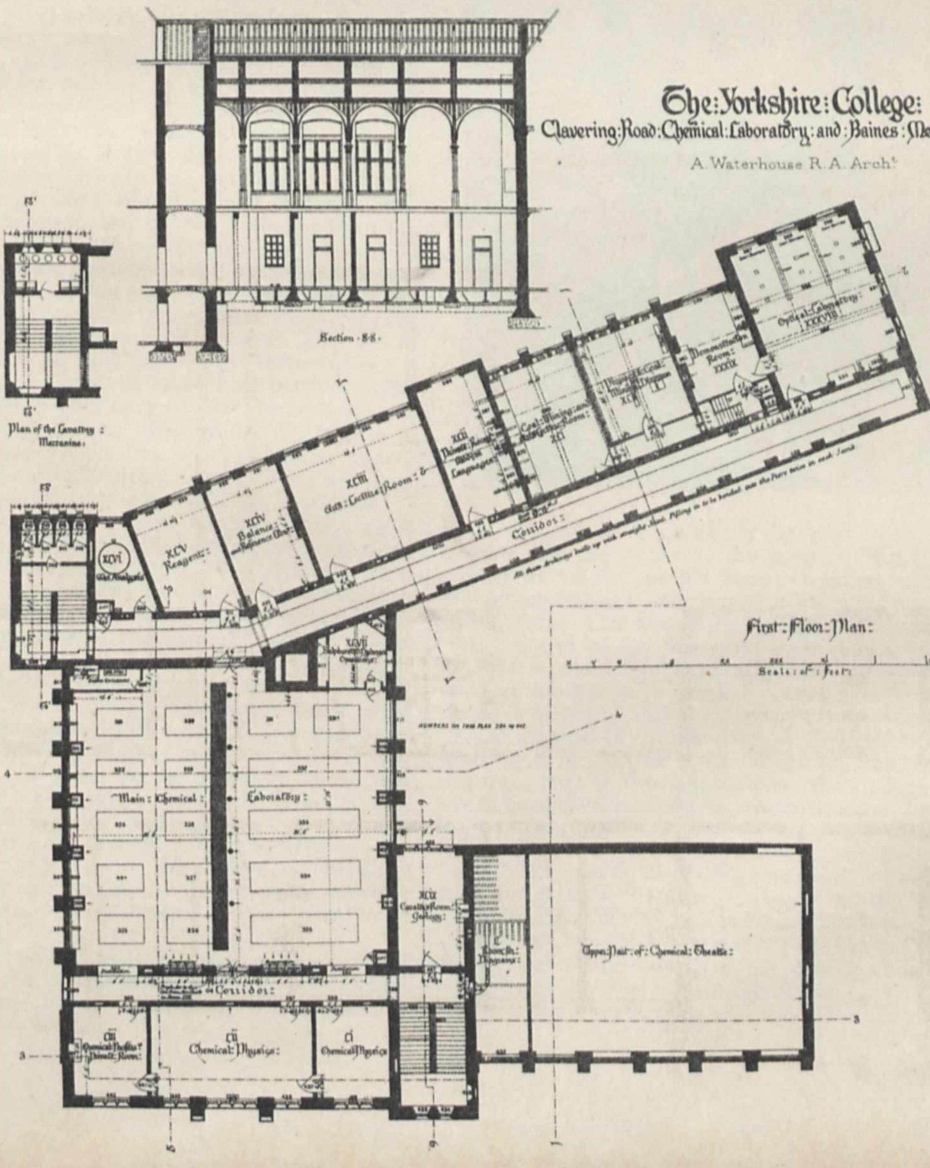


FIG. 1. TOP-MOST FLOOR.

The: Yorkshire: College:

Clavering: Road: Chemical: Laboratory: and: Baines: Memorial: Blocks:

A. Waterhouse R.A. Archt.



First: Floor: Plan:

College, Manchester; the Yorkshire College, Leeds; University College, London; the Mason College, Birmingham; and the Merchant Venturers' School at Bristol. As a typical school laboratory Mr. Robins has very judiciously chosen that of the Manchester Grammar School. We have selected for reproduction here, from among the many sheets of plans with which Mr. Robins's papers are illustrated, portions of the plans of the Central Institute, the Yorkshire College (Leeds), and the laboratories of the Merchant Venturers' School at Bristol, as types of institutions engaged in the work of teaching how science is to be brought to bear upon the industries of this country. In the Merchant Venturers' School we have a building specially constructed for teaching science to large classes of boys; in the Yorkshire College the arrangements, as regards science, were designed with reference to the requirements of students receiving specialised teaching, and who intend to pass into manufactories or workshops, or to become professional chemists, physicists, or engineers; in the Central Institute we have the most highly developed type, designed for selected students coming from the Finsbury College or from the provincial colleges, and who already have a basis of sound scientific knowledge, and are thereby fitted to receive special and advanced instruction in various branches of technology. A careful comparison of the plans of Mr. Waterhouse's buildings, viz. the Yorkshire College and the Central Institute, with that of Mr. Robins erected for the Merchant Venturers, will serve to show how the particular requirements of each class have been met in the case of chemistry. It will be seen that the number and relative size of the various rooms, their mutual position, and internal arrangement of work-tables, &c., are very different in the several buildings, and that these differences are primarily dependent upon the special type of instruction which is contemplated.

In the next paper Mr. Robins deals with the fittings for applied science instruction buildings. Strictly speaking, the two questions of fittings and structure cannot be considered apart, for, as Mr. Robins very truly remarks, "it is of the utmost importance in a truly economic aspect of the question that the architect should possess from the very outset a clear preconception of the structural provisions involved in the particular system of fittings intended." The paper has especial reference to the fittings of chemical and mechanical laboratories; it is singularly full and complete, and admirably illustrated. The fittings of every laboratory of note have been well studied, and the facts are so detailed that the merits of any particular arrangement can be readily determined. It is certain to be of the greatest service to any architect engaged in the erection of this special kind of building.

The last paper which we have space to notice deals with the important question of the heating and ventilation necessary for applied science instruction buildings. It is principally based upon details of the means adopted in four of the most modern erections in this country, viz. the Finsbury Technical College, the Central Institute (South Kensington), the Yorkshire College, and the Merchant Venturers' School. These buildings are characterised by very wide differences in compactness and in the relative proportions of inside and outside walls; and the particular modes of heating, that is, whether by steam or hot water, are also different. In some of the buildings the vitiated air is extracted by a chimney, or by a fan; in others the fresh air is forced into the buildings by a fan. Each system has its merits and defects, and most of these are pointed out in the paper, or in the appendix containing the remarks made during the discussion which followed the reading of Mr. Robins's paper at the Institute of British Architects.

It will be seen therefore that Mr. Robins has treated this question of the provision of buildings for applied science instruction in a remarkably comprehensive manner. The collection of papers is certain to be of the greatest service to any architects engaged in the erection of buildings of this class; it constitutes, indeed, a sort of *vade mecum* to the building committees who may be responsible for the selection of the architect's plans. The cause of technical education in this country is under a debt of gratitude to Mr. Robins for the service which he has thus rendered to it.

T. E. THORPE

JULES JAMIN

A SHORT time ago we announced the death of the eminent French physicist, Prof. Jamin.

By the courtesy of the editor of *La Nature* we are enabled this week to give an excellent portrait, to which we add a brief sketch of his scientific career, for the details of which we are indebted to the same source.

Jamin was born, in 1818, in the village of Termes in the Ardennes. He was the son of Anthony Peter Jamin,

who engaged as a volunteer in 1795, was appointed Captain and decorated at the battle of Friedland, and afterwards retired to his native country. Jamin was brought up first in a little school in the village of Vouziers, and his father sent him to the College at Reims.

At the end of the first year there Jamin had gained nine prizes, and in 1838 his work was crowned with the prize of honour in a general competition between the Colleges of Paris and the Departments. In the same year he entered the École Normale Supérieure, and three years after, in 1841, he came out first prizeman in physical science. He was then appointed to the College at Caen, where he succeeded Desains, whom he found later as colleague at the Sorbonne, and survived only a few months. At the end of two years he was called to Paris as Professor of Physics at the Collège Bourbon. The following year, in 1844, he became Professor at the College of Louis-le-Grand, where he continued his researches commenced at Caen, and he received in 1847 his Doctorate of Physical Science for a thesis, now a classic, on the reflection of light on the surface of metals.

The precision, elegance, and solidity of his instruction, the value of his scientific work, all designated him for some superior professorship; so, in 1852, he was elected Professor of Physics at the Polytechnic School. He lectured there with success for twenty-nine years—till 1881, when he resigned.

In 1863 he was appointed Professor at the Sorbonne, where, till his death, he attracted a great number of eager listeners. In this position he displayed his admirable talent of exposition, his great power of simplifying the most difficult questions, and of indicating by most striking apparatus the methods of solving many intricate problems.

The qualifications that Jamin displayed in his oral teaching are found in the "Traité Général de Physique," which reproduces his course at the Polytechnic School, and in which masters as well as pupils find exact descriptions of the actual state of science.

Jamin was not only a physicist; his mind was open to all manifestations of intelligence. At the Normal School, in preparing for his degree in physics, he found time to obtain one in natural sciences also. At Caen he went with his pupils on Sundays on botanical and geological excursions. But it was only on his return to Paris that his great power, elevated ideas, distinguished tastes and his fine intelligence could find a free scope. He remembered always with pleasure how at the age of twenty-five he found himself at once surrounded by an intelligent and enlightened society. He dined in a *pension* with several of his colleagues, who have left names either in science or at the University: with Lefebvre, the eminent professor at the Collège Rollin, with Saisset, Barni, Suchet, La Provostaye; with Faurie, who often brought his friend Sturm. The dinner was followed by long chats, dissertations on science, philosophy, music and art, in which Jamin took an active part. He loved music; he was a painter. He was an early riser, and on Sundays he went with one or two of his colleagues to study the works of the great masters at the Louvre. He painted an admirable portrait of Lefebvre; his family preserve several of his paintings, and the church at Termes possesses a picture of his composition.

But art and literature only occupied his leisure; he produced at that period his most important scientific works—works which procured for him in 1868 admission into the Academy of Sciences.

His researches embrace the most varied subjects. Besides his optical, magnetic, and electrical researches, which remain his best titles to fame, his studies on the compressibility of liquids, on capillarity, hygrometry, specific heats, the critical points of gases, prove the originality and versatility of his genius.

By their historical order and succession his memoirs indicate the progress of physics in France since the middle of the century to the present day. A pupil and admirer of Cauchy, it was by his optical experiments that he made his debut, and it was also to this subject that he most frequently returned.

He took great pains to invent methods of measurement delicate enough to control the analytical results of Cauchy, and his first memoir is a beautiful study of reflection of light by the surfaces of metals. He discovered afterwards the elliptical polarisation of light reflected by vitreous substances near the polarising angle, anticipated by Cauchy's theory; and discovered at the same time the negative elliptical polarisation of fluorine, which no one suspected. He published a long memoir on coloured rings, and invented interference-apparatus utilising the light reflected on opposed faces of thick transparent plates.

When in 1868 M. Durny, then Minister of Public Instruction, founded the École Practique des Hautes Études, and endowed a research laboratory, Jamin profited by the powerful aid thus placed at his disposal. The rapid and so unlooked for progress in electricity supplied a new field for his activity. Assisted at first by inexperienced workers, he thought, and worked for all; he undertook ten different researches, of which one would have absorbed all the time and power of one less indefatigable.

Cruelly touched by family affliction, he found in the midst of his workers, who needed continually his aid and assistance, some relief for his great grief. During some time before his death he seemed to have mastered his sorrows and to have regained his usual activity. He had succeeded his illustrious master, M. Dumas, as Perpetual Secretary of the Academy of Sciences, and no one was more fitted to have filled this delicate office. He had replaced Milne Edwards as Dean of the Faculty of Sciences, and at the time of his death he was at the height of his reputation.

His death leaves a large gap in Parisian scientific society, and those English men of science who had the privilege of knowing him and admiring his genial and powerful nature and his admirable private life will long mourn his loss. R.

THE U.S. NAVAL OBSERVATORY[1]

IN 1880 a site was purchased for a new Naval Observatory a short distance beyond Georgetown, in the district of Columbia; but no appropriation has yet been made for erecting the necessary buildings and removing the instruments from the present location. On account of this delay the Secretary of the Navy, in April 1885, called upon the National Academy of Sciences for an expression of opinion as to the advisability of proceeding promptly with the erection of a new Naval Observatory; and the reply of the Committee of the Academy is contained at length in a letter from the Secretary of the Navy, just published as Executive Document No. 67. The conclusions of the Committee we give in the language of the Report. This Report is signed by F. A. P. Barnard, A. Graham Bell, J. D. Dana, S. P. Langley, Theodore Lyman, E. C. Pickering, C. A. Young. (1) It is advisable to proceed promptly with the erection of a new Observatory upon the site purchased in 1880 for this purpose. (2) It is advisable that the Observatory so erected shall be, and shall be styled, as the present Observatory was styled originally, the "National Observatory of the United States," and that it shall be under civilian administration. (3) It is advisable that the instruments in the present Observatory, with the exception of the 26-inch telescope, the transit circles, and the prime vertical transit, shall be transferred to the Observatory at Annapolis, with such members of the astronomical staff as may be required to operate them; also that such books of the library as relate chiefly to navigation shall take the same destination; the instruments above particularly specified, with the remainder of the library, being reserved as part of the equipment of the new National Observatory, to which also the remaining officers of the astronomical staff shall be assigned for duty. (4) It is advisable that the Observatory at Annapolis shall be enlarged, if necessary, and adapted to subserve as effectually as possible the wants of the Naval Service, whether practical, scientific, or educational; that it shall be under the direction of the department of the Navy, and shall be styled the "Naval Observatory of the United States." The grounds upon which this decision is based are set forth in the document to which we have referred; and numerous letters are appended, from astronomers and others, in regard to the administration of the Observatory, and from physicians of Washington, upon the healthfulness of the portion of the city in which the Observatory is at present situated. It will be seen immediately that this report is intended to favour the establishment of an Observatory worthy of the country, and the

[1] From *Science*.

placing its control in the hands of those who have made astronomy their life-work. The Navy will be provided, if the recommendations are carried out, with an Observatory well suited to its special needs, and would be relieved from the task of supervising work in which it has no interest aside from that felt in scientific work in general.

NOTES

WE learn with much regret of the death of Dr. Spencer Cobbold, F.R.S., the well-known authority on parasites and parasitic diseases, at the age of fifty-seven years.

WE understand that it is proposed to award the Founder's Medal of the Royal Geographical Society to Major Greely, the leader of the late United States Arctic Expedition to Grinnell Land, and the Patron's Medal to Cavaliere Guido Cora, Professor of Geography at the University of Turin, and founder and conductor of the geographical journal known as *Cosmos*. The Back Grant will probably go to Sergeant Brainard, who did such admirable work on the Greely Expedition.

MR. J. Y. BUCHANAN, who is in charge of the *Buccaneer*, telegraph surveying ship for the India-rubber Construction Company, writes home from St. Thomas, under date February 1, giving some account of his doings up to that time. When the survey to Loanda was completed, Mr. Buchanan was to be free to take any soundings he pleased and any route he pleased through the Atlantic, so long as he is home by the beginning of April. He has reached Loanda and visited Ascension, and expected to be at the Azores on the 24th. The following was to be Mr. Buchanan's programme after leaving Loanda:—"Stop at 6 a.m. Sound, then take temperatures, water-bottles, tow-net, and possibly dredge. This will take till noon, or perhaps longer; then on again. Next day stop and sound at noon, and take any observations which can be made during the sounding. This may detain us two hours; then on again, and next morning stop at 6 a.m., and make a station again. In this way the time divides itself into periods of 48 hours. Say from 4 p.m., when we set on after finishing a station, we run till 11 a.m. next day; this is 19 hours, or 200 miles; then stop 2 hours; then on again till 6 a.m. of next day, making 17 hours, or 175 miles; then stop till 4 p.m. In this way we get 36 hours' steaming and 12 hours' work in the 48, and cover 375 miles." "We have got very interesting results so far," he goes on, "and a perfect plethora of material. We made a most delightful excursion yesterday," he continues, "to a cinchona plantation up in the high ground in the interior of this island (St. Thomas). They grow very good coffee, and there is no leaf-disease, and they are planting everything up with cacao, which at present prices pays enormously. The island lies only twenty miles north of the equator, and both St. Thomas and Principe are perfect examples of the luxuriance of equatorial vegetation. In Principe the jungle is more dense; in St. Thomas the trees are on a larger scale, and there is magnificent timber. With the exception of Accra and Gaboon, these two islands are the only places where we have landed. All along the so-called *West* Coast the surf is at all times bad and frequently dangerous, so that communication is only kept up by native surf-boats, and Europeans pass through it as rarely as possible. . . . The African rivers are quite stupendous, and have much to do in giving the Gulf of Guinea its peculiar character. The drainage of quite 90 per cent. of the whole continent empties itself into a very restricted area of the sea, the formation and the conditions of which it has profoundly modified."

THE Colonial and Indian Exhibition, which opens in May, besides its wide general interest, will evidently have many points of special interest to men of science. The flora and fauna of almost all the colonies will be represented more or less completely. Thus, Mrs. Blake, the wife of the Governor of the Bahamas, has sent a series of beautiful paintings of the flora of that archipelago for the West Indian section; British Guiana sends specimens of all its woods, to the number of 74. Each block is about 3½ inches wide, 15 inches long, and 3 inches deep. The several pieces are labelled with the colonial name of the wood, its botanical name wherever possible, the height to which the tree grows, and its use. Dr. Schomburgk, the Director of the Botanic Gardens of South Australia, is sending a very comprehensive dried collection of the flora of that colony. It consists of four volumes, and contains 1100 different specimens. A similar collection was sent to the last French Exhibition, and is now in the Paris Herbarium. It is proposed after the Exhibition is over to present this collection to Kew Gardens, or to one of the Universities. Visitors to the South Australian Court will also have an opportunity of examining the magnificent fern-trees of the colony, four of them having been despatched to London for the Exhibition. The trunk of one of these weighed 500 lbs. The Canadian Geological Survey will send a large collection of the minerals of the Dominion; while there will also be collections of Canadian fauna and flora. The animal kingdom of Manitoba and the North-West Territory will be represented with particular care; while the entomological collection will be very comprehensive. Indeed, mineralogy and natural history will form two of the four main departments of the Canadian section. Similarly the mines and the flora of New South Wales will be amply represented. From Victoria comes a large natural history collection, including two young Australian aborigines, and a number of specimens of ferns, which will be arranged in a kind of natural fern-tree gully. The tropical and sub-tropical flora of Queensland will be shown, as will also specimens of the mineral wealth of the colony. From New Zealand comes a large collection of mineralogical and geological specimens, including castings of gigantic fossil reptiles. There will be about 500 specimens of the forest woods of South Africa, and the medical, meteorological, and natural history departments of the Straits Settlements section are receiving special attention from Dr. Rowell. In the West Indian section will be collections o tropical plants from the various islands—pine plants from Antigua, cabbage palms from St. Kitt's, lime-trees from Montserrat, and tree-ferns from Dominica. The process of hatching the ova of turtle will be displayed in this section, which, in addition, will contain a collection of stone implements and relics of the Carib race. There will therefore be no lack in the forthcoming Exhibition of objects deserving of the attention of students in most branches of science.

THE new aquarium which is now being constructed for colonial and Indian fishes, to be shown at the forthcoming Exhibition at South Kensington, is rapidly approaching completion. The building contains twelve tanks in addition to a colossal habitat for turtles, capable of accommodating fifty specimens. In juxtaposition to the latter a hatchery has been erected for incubating the ova of turtle, which will be effected through the medium of heated sand. The hatchery is formed of glass, and contains a grotto arranged in an attractive manner by means of rockwork, over which water will flow into a pool beneath, forming a cascade. The entire aquarium will be heated according to the climatic exigencies of the various fish. Those of India require a temperature of 92°, which is the normal state of their native waters. All the fish will be fresh-water specimens, and on this account great difficulty will attend their transmission to this country. The turtles, however, will be those indigenous to the sea, and comprise chiefly the green turtle (*Chelonia midas*), which will be sent by the West Indian Commissioners in large numbers. The Australian, New Zealand, and Victorian authorities have announced their inability to forward specimens from their respective colonies. This is to be regretted, especially in regard to Australia, from whence some interesting fish could be sent.

THE Japanese Government has decided to erect a meteorological observatory on the Loochoo Islands. The necessary apparatus for this purpose was sent there at the beginning of the year. From the geographical position of the archipelago this observatory should be able to render important services to meteorological science.

WE have received a pamphlet on "The Present Position of the Museum and Art Galleries of Glasgow," published by order of the Town Council, and containing an indictment of that body for its neglect to provide adequately for these two institutions. After sketching their vicissitudes and their present somewhat doleful condition, the writer states what they actually are and what they should be. With regard to this latter it needs only to be said that his observations are, in our judgment, perfectly accurate. He complains that the Kelvingrove Museum has been placed haphazard in an inconvenient and unsuitable position, that no permanent character has been given to the collection, the arrangement being only temporary and provisional, and that its main characteristic at present is its miscellaneous nature. "There is much to excite the attention and to stimulate the curiosity of the ordinary visitor, but the museum displays little which serves to draw the attention of the investigator or the man of special knowledge." He insists on the function of the museum as an educational element in the town rather than a mere show or place of public resort, and on the special duty—not to say necessity—of a city like Glasgow, with vast commercial and industrial interests, to be adequately equipped in this respect. There can be no question as to the justice of the writer's concluding observation: "It is open for the municipality to elect whether a museum shall be established or not; but, having made the choice, it has no right to found such an institution on an insufficient basis, nor to maintain it on a scale which deprives it of its most important and useful function." It may be hoped that the publication by the Council of this sharp attack on itself is a sign of compunction for its shortcomings in the past and a promise of better things in future.

WE have already referred to the anxiety which exists in Japan with regard to the fate of the Imperial Engineering College at Tokio, now that the department under which it was founded and organised has been abolished in recent administrative changes. The institution was a peculiarly English one; it was established and worked by an English principal and a staff of English professors, and the names of many of the latter, past and present, are well known in the scientific world. In a recent article in the *Japan Mail* on the subject of University education in Japan, the editor (himself, we believe, a former professor in the College) writes thus:—"The threatened absorption of the College of Engineering, with its admirable organisation and its complete buildings, into the University (of Tokio), is an event to which enlightened men, and all the friends of Japan, can look only with grave dread. That these buildings, the result of so much thought and care and high ambition, should be divorced from their original purpose, and that the only institution in Japan which might well be called first-class should be ruthlessly uprooted, would be a blow to the higher education in Japan which would make her detractors laugh and her friends hold down their heads in shame." No doubt grave warnings such as these from a writer of experience, whose general sympathy with Japan is recognised, will cause the Japanese authorities to reflect carefully on any step they may take with regard to the College.

PETROLEUM-WELLS are reported to have been discovered at the peninsula of Jemsah, on the west coast of the Red Sea, 170 miles south of Suez, at the foot of the mountain known as Jebel Zeit, or Oil Mountain. M. Deboz, the Belgian engineer, who was sent to search for petroleum in January last, commenced boring at a distance of thirty miles from the sea. After penetrating successively through gypsum, containing veins and nests of sulphur, shale, green and blue clay, limestone, and sandstone, the drill on February 28 fell suddenly 40 centimetres, and petroleum rose to a point 2 metres above the sea-level.

THE Italian Government have lately deposited 500,000 fry in Lake Como, with the view of replenishing the stock of fish. It is the intention of the Government to adopt similar measures in regard to other important lakes. They also have resolved to undertake the propagation of lobsters artificially, thus reviving a branch of fish-culture which previously existed in Italy.

AT the stated meeting of the Royal Irish Academy, held on the 16th inst., Prof. Frankland and Lord Rayleigh were elected as Honorary Members in the Department of Science. The President, Sir S. Ferguson, nominated as Vice-Presidents for the ensuing year, Dr. Ingram, Rev. Dr. Haughton, Sir R. Ball, and Prof. J. P. O'Reilly.

A SOURCE of mineral water was discovered a few days ago in the very centre of St. Petersburg. In the yard of one of the houses situated on the Maika Embankment, close by the Winter Palace, a boring 560 feet deep was made in order to reach the source. In composition this water is said to be like that of Staraya Russa, or Kreuznach, while in taste it is quite similar to genuine seltzer water.

ACCORDING to the communication of the mining engineer, L. P. Dolinski, to the Society of Natural Science of Odessa, a very important discovery of cinnabar mines has been recently made in the mining region of the Don in Russia. The ore contains from 69 to 80 per cent. of pure mercury.

ACCORDING to a medical report just published, the cattle plague continues to ravage various parts of Russia. Within a period of five years, from 1876 to 1880, the loss is estimated at no less than 1,208,500 head of horned cattle; but even these figures, based upon official information, are considered far below the real value.

WE notice in the last issue of the *Izvestia* an interesting paper, by M. Stephanoff, on the religious beliefs of the Chersonese people. Although all Christians, they still adhere to their beliefs in good and evil spirits, and worship them—the good spirits in forests and groves, where coniferous trees are mixed with foliaceous ones; and the evil spirits in purely coniferous forests. Every god is represented by a special tree, and served by a separate priest, who is not hereditary, as with the Siberian Shamanists, but elected by lot. The sacred groves are preserved with great care, and some trees are two and three hundred years old. From time to time, according to orders given by some prophets to whom the gods appear in dreams, thousands of Chersonese, coming from different districts and provinces, meet together in sacred groves to sacrifice hundreds of horses, cows, sheep, and fowls, and to share in a general feast. These considerable expenses are covered by voluntary taxation of all villages taking part in the feast. The paper of M. Stephanoff is accompanied by an interesting illustration of worship.

IN regard to the electro-magnetic rotation of light, Herr Kundt (*Wied. Ann.* 2) notes the fact that all simple substances hitherto examined, be they strongly magnetic or strongly diamagnetic, show positive electro-magnetic rotation. Negative rotation is shown only by chemical compounds, and such as contain atoms of strongly magnetic elements (as iron salts). Positive rotation has been proved in the case of eleven elements, viz. Fe, Co, Ni, Br, Se, S, P, C (diamond), O, N, H.

THE question whether electro-magnetic forces may not have demonstrable action on natural, as well as polarised, light, has been lately taken up by Herr Sohncke (*Wied. Ann.* 2). His guiding idea was this:—It is known that two polarised light-rays from the same source, meeting at a sufficiently acute angle, interfere most if they are polarised parallel, and not at all if polarised at right angles, to each other. Now, natural rays of light from the same source behave, in regard to interference, quite like parallel polarised rays; and it seemed likely that two such rays would lose their power of interference if the direction of vibration (or greater ellipse-axis) of one of them were turned round by electro-magnetic forces 90° relatively to the other, for in this case the two rays would behave like two polarised at right angles to each other. This was effected (in a way he describes). It appears that the same thing was done some years ago by Prof. Abbe, using with natural light the natural rotation of a right and left quartz instead of electro-magnetic; and this before-unpublished method is also developed by Herr Sohncke, who describes a new interference-experiment with natural light.

SINCE Graham's time it has been generally accepted that thin parchment paper is the best material for a dialyser. A variety of substances have been experimented with lately by Herr Zott in Munich (*Wied. Ann.* 2), and he pronounces goldbeaters' skin the best; it has always at least twice the separative effect of parchment paper, and sometimes much more. In a list of relative permeability, goldbeaters' skin being valued as 1, we have next, sow-bladder 0·77, parchment paper 0·5, 2 mm. leather 0·025, and so on to the fifteenth, caoutchouc, 0·0001. For solutions which injure organic membranes, common earthenware cells (like those in Grove's battery) are best; but their effect is sixty to seventy-five times less than that of goldbeater's skin. All phenomena of diffusion are intensified, if the diaphragm is first evacuated in an air-pump; and the more quickly a substance diffuses itself through a diaphragm, the greater is the accelerative effect of evacuation. This evacuation should be renewed after each experiment. It induces endosmose in diaphragms which did not previously show it; and even colloids show a considerable endosmose, even surpassing that of most crystalloids if the time of diffusion is prolonged enough. Solution-mixtures of two substances are more easily and fully separated the further apart their relative velocities of diffusion; and dialytic separation is more rapid the oftener the external water is renewed.

IN a recent communication to the Erlangen Physical-Medical Society Prof. Gerlach describes a successful method he has devised for watching the embryo-growth in birds' eggs through a small glass window made at the sharper end. After detaching the end with a bent pair of scissors, a little albumen is taken out, so that the germinal disk of the yolk turns upwards; then the liquid is put back. Gum-arabic solution is spread on the opening, and wadding put round it; then a small (ladies') watch-glass is fixed on it with gum; collodion and amber-lac being afterwards added. The eggs must lie horizontally in the incubator; development then goes on normally, and may be observed till the fifth day (thus comprising the time most interesting to the embryologist), the egg being taken out and the window-end turned up.

THE French language in Canada, according to M. Demanche n a French review, presents no *patois*, owing to fusion of accents by the well-educated teachers in schools, &c., in the seventeenth century, who came from all parts of France. Further, the Canadian peasant is better educated than the French; and all French-Canadians speak English as well as French (an elevating factor). In France, while foreign words are often adopted without scruple, such as *rail*, *waggon*, *sleeping-car*, *tramway*, *ticket*, *square*, the French-Canadians generally translate, saying, *e.g.*, *lisse*, *char*, *char-dortoir*, *char-urbain*, *billet*, *carré*. The preservation of the French tongue on the banks of the St. Lawrence has been greatly favoured by the prodigious increase of the French-Canadians. Of a total population of 4,324,819 by the last census in 1881, there were 1,298,929 French. The total increase since the beginning of the century gives an annual rate of 21 per cent., while the increase in the United States for the same period is only 15 per cent. annually. In the province of Quebec the French form four-fifths of the population. Celibates are rare in Canada; and families number, on an average, eight to ten children, but sometimes one pair will give birth to twenty-five children. A twenty-sixth child is educated at the cost of the parish.

A NUMBER of workmen were entombed in a subterranean gallery at Chanulade (Dordogne) some time since. The work for their recovery was so unfortunately protracted that all hope of finding them alive was lost for a long period. But it was deemed necessary to continue the excavation in order to procure them a decent burial. This sad part of the programme could not be executed with success. Then it was decided to excavate a small hole and to use it for sending below an electric light and a photographic apparatus to ascertain what was the condition of the wrecked galleries. This operation was delayed by difficulties, but at last executed with complete success. A plate was procured showing the likeness of a young man who had not been crushed but who had evidently died of hunger. It is greatly feared this fate has been shared by others of his unfortunate companions.

ALTHOUGH scientific researches on the habits of the herring on the coast of Norway have been prosecuted almost without interruption since 1861 (at the instance of the late Dr. Axel Boeck), and some valuable results have been obtained therefrom, it is generally felt by those interested in this industry in Norway that there still remains a great deal to be done in this direction, as for instance has been the case in Scotland and Prussia. This is chiefly applicable to the "summer" herring visiting the shores of the provinces of Nordland and Tromsö, where hardly anything is known of the habits of the fish. It is, therefore, proposed, in order to promote this important industry, to prosecute scientific researches on the spawning of the fish, the localities or fiords preferred by it for that purpose, the time of the fish's coming inshore, and the climatic conditions most advantageous to its existence. Considerable fresh light is also expected to be thrown on this subject through the sea-water fish-hatching establishment recently started at Arendal, in the Christiania fiord.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. L. H. G. Morgan; two Azara's Opossums (*Didelphys azaræ* ♂ ♀) from Rosaria, La Plata, presented by Capt. G. W. Freeman; three Striated Finches (*Munia striata*), a Nutmeg Finch (*Munia punctularia*), two Black-headed Finches (*Munia malacca*) from India, presented by Mr. L. B. Lewis; a Thunder Fish (*Misgurnus fossilis*) from Austria, a Ground Loach (*Cobites tænia*) from Russia, presented by Mr. Alban Doran; two Tasmanian Wolves (*Thylacinus cynocephalus* ♂ ♀) from Tasmania, two Red Kangaroos (*Macropus rufus* ♂ ♀), a Great Kangaroo (*Macropus giganteus*) from Australia, a Yellow-footed Rock Kangaroo (*Petrogale xanthopus*), two Hairy-nosed Wombats (*Phascolomys latifrons* ♂ ♀), two Vulpine Phalangers (*Phalangista vulpina*), two King Parrakeets (*Aprosmictus scapulatus*), a Bauer's Broadtail (*Platycercus zonarius*), two Swainson's Lorikeets (*Trichoglossus novæ-hollandiæ*), a Roseate Cockatoo (*Cacatua roseicapilla*) from South Australia, deposited; a Bay Antelope (*Cephalophus dorsalis* ♂) from West Africa, a Green-billed Toucan (*Ramphastos discolorus*) from

Guiana, a Sun Bittern (*Eurypyga helias*) from South America, a Thick-necked Tree Boa (*Epicrates cenchris*) from West Indies, purchased; three Long-fronted Gerbilles (*Gerbillus longifrons*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

AN OBSERVATION OF NEPTUNE OCCURRING IN LAMONT'S ZONES.—Mr. Hind pointed out in the *Astronomische Nachrichten*, No. 712, two cases of observations of Neptune occurring in Lamont's zones, in which the planet was mistaken for a star. The dates of these two observations are respectively October 25, 1845, and September 7, 1846. Prof. Schönfeld, in No. 2716 of the same publication, draws attention to a third instance in which an observation of the planet occurs in these zones. The date of this observation is September 11, 1846. It will be remembered that Neptune was optically discovered by Galle on September 23, 1846. Prof. Schönfeld thinks it advisable to give publicity to his discovery, lest at any time an astronomer should be led to think that this object, which is entered as No. 3818 in the Catalogue in the Munich Supplementband xii. (generally designated Lamont 5), was a "temporary" star.

THE ARMAGH OBSERVATORY.—We are glad to learn from a report recently issued by Dr. Dreyer, that an equatorial refractor by Mr. Grubb, having an excellent object-glass of 10 inches aperture, and 10 feet focal length, has been installed in the "Robinson Memorial Dome," erected by the same artist. The instrument has already been brought into use, and a series of micrometric observations of nebulæ has been commenced. We trust therefore that, under Dr. Dreyer's superintendence, the Armagh Observatory is now entering on a career of observational activity which will restore it to the position which it has formerly held as one of the foremost institutions of its kind in the British Isles.

DISTRIBUTION IN LATITUDE OF SOLAR PHENOMENA.—M. Tacchini, in a note appearing in the *Comptes rendus*, vol. cii. No. 11, gives a table showing the distribution in heliographic latitude of the various classes of solar phenomena in 1885. The table is remarkable as still further accentuating the difference seen at the present time in the behaviour of sunspots and prominences (NATURE, Feb. 25, p. 398). Not only have the prominences shown little or no diminution in dimensions or frequency during the past year, whilst sunspots and faculæ have notably declined, but the prominences are still detected in every latitude from pole to pole, whilst spots, faculæ, and metallic eruptions are confined almost entirely, the spots entirely, to latitudes lower than 40°, and in the great majority of instances to latitudes lower than 20°. The zones showing the greatest frequency for prominences are placed considerably further from the equator. There is also a difference in the proportionate distribution of the different classes of phenomena between the two hemispheres, as the following table will show:—

	Northern hemisphere	Southern hemisphere
Prominences	0·478 ...	0·522
Faculæ	0·367 ...	0·633
Sunspots	0·336 ...	0·664
Metallic eruptions	0·325 ...	0·675

Thus whilst the southern hemisphere has been about twice as prolific in the last three classes as the northern, there has been a much smaller difference between the hemispheres in the matter of prominences. The result of the comparison, on the whole, tends to show that, whilst there is a close connection between spots and metallic eruptions, ordinary prominences are to a great extent independent phenomena; indeed whilst, as already mentioned, sunspots have declined during 1885, prominences have actually been more frequent in the zones in which sunspots have not been seen.

PROMINENCES AND MAGNETIC DISTURBANCES.—The connection between sunspots and magnetic disturbances having been clearly established, it would seem natural to infer from the preceding and other similar indications of the independence of sunspot and prominence activity that but little connection would be traced between individual prominence displays and terrestrial magnetism. A note by M. H. Wild, presented by M. Mascart, appearing in the *Comptes rendus*, vol. cii. No. 9, seems, however, to favour the idea of a somewhat close connection, four remarkable observations of prominence-changes made by M. Trouvelot having been found to synchronise fairly closely with magnetic disturbances. An examination of the magnetic traces at Greenwich has, however, shown that in only one case out of the four was there anything like a sharp disturbance, the movements in the other instances being of a very ordinary character. Further, M. Trouvelot has recently published a series of prominence-observations in the *Bulletin Astronomique* for January, and in no one of these instances was there anything like a magnetic disturbance to correspond to the great and remarkable prominence-change M. Trouvelot was observing in the sun.

DISPLACEMENT OF LINES IN SOLAR PROMINENCES.—The observations of M. Trouvelot above referred to deserve a very careful and detailed examination, as, if confirmed, they will go far to utterly overthrow the views at present held as to the significance of the displacement of lines in the spectra of sunspots and prominences. M. Trouvelot records displacements so extraordinary, that an entire prominence more than 3′ in height was rendered visible when wholly outside the (tangential) slit, which was nearly closed! Other similar phenomena are also recorded, only less astonishing. It is of the utmost importance that, if other spectroscopists have witnessed similar phenomena, they should not delay to publish their experiences, as it seems impossible that displacements of so peculiar a character can be due solely to the motion in the line of sight of the gases under examination. In the meantime it would seem more reasonable to suppose that M. Trouvelot had made some extraordinary error in his observations.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 MARCH 28—APRIL 3

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

At Greenwich on March 28

Sun rises, 5h. 46m.; souths, 12h. 5m. 6·6s.; sets, 18h. 24m.; decl. on meridian, 3° 4′ N.: Sidereal Time at Sunset, 6h. 48m.

Moon (one day after Last Quarter) rises, 2h. 19m.; souths, 6h. 48m.; sets, 11h. 19m.; decl. on meridian, 17° 54′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury ...	5 53 ...	13 0 ...	20 7 ...	12 13 N.
Venus	4 11 ...	9 30 ...	14 49 ...	8 45 S.
Mars	15 16 ...	22 20 ...	5 24* ...	11 41 N.
Jupiter... ...	17 27 ...	23 38 ...	5 49* ...	1 23 N.
Saturn... ...	9 33 ...	17 45 ...	1 57* ...	22 49 N.

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

March	h.	
30 ...	2 ...	Mercury stationary.

Variable-Stars

Star	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·2 ...	81 16 N. ...	Mar. 28,	19 14	*m*
R Sculptoris ...	1 21·7 ...	33 8 S. ...	,, 29,		*M*
S Ursæ Majoris ...	12 39·0 ...	61 43 N. ...	,, 30,		*m*
R Bootis	14 32·2 ...	27 14 N. ...	,, 28,		*m*
δ Libræ	14 54·9 ...	8 4 S. ...	,, 28,	5 10	*m*
			Apr. 1,	20 52	*m*
U Coronæ	15 13·6 ...	32 4 N. ...	Mar. 30,	0 11	*m*
W Herculis... ...	16 31·2 ...	37 34 N. ...	Apr. 3,		*m*
U Ophiuchi... ...	17 10·8 ...	1 20 N. ...	Mar. 29,	5 26	*m*
			and at intervals of	20 8	
X Sagittarii... ...	17 40·4 ...	27 47 S. ...	Mar. 31,	0 0	*m*
			Apr. 2,	21 30	*M*
W Sagittarii ...	17 57·8 ...	29 35 S. ...	,, 3,	2 20	*m*
U Sagittarii... ...	18 25·2 ...	19 12 S. ...	Mar. 30,	4 50	*m*
			Apr. 2,	4 50	*M*
β Lyræ	18 45·9 ...	33 14 N. ...	Mar. 31,	21 30	m_2
R Lyræ	18 51·9 ...	43 48 N. ...	,, 28,		*m*
η Aquilæ	19 46·7 ...	0 7 N. ...	Apr. 1,	2 20	*M*
R Sagittæ	20 8·8 ...	16 23 N. ...	,, 1,		*m*
δ Cephei	22 24·9 ...	57 50 N. ...	Mar. 28,	4 50	*m*

M signifies maximum; *m* minimum; m_2 secondary minimum.

Meteor Showers

Meteors from the following radiants may be looked for:—Near δ Ursæ Majoris, R.A. 180°, Decl. 60° N.; near β Bootis, R.A. 223°, Decl. 40° N.; near β Libræ, R.A. 226°, Decl. 8° S. Fireball date, April 2.

THE SUN AND STARS[1]

IV.

Changes of Wave-Length

THE spectroscope not only enables us to détermine the chemical constitution of the spots, but it allows us, by the alteration in the refrangibility in the various lines, to determine the rates of motion at which each of the vapours is descending. The hydrogen lines are not thickened as the other lines are in the spots; they are at times thickened on one side only, that is to say, they are what is called contorted. The line suddenly changes its position in the spectrum towards the less refrangible part of the spectrum, which is the red end. Now the amount of change towards the red along the spectrum measures exactly for us the rate of downrush, and we learn generally that the hydrogen is rushing down at the rate of 30 or 40 miles a second. These changes are associated with brightenings of the line, which we shall have to refer to afterwards.

The fact that we get those extraordinary inversions above referred to of the various lines in the spectrum of a substance is simply explained by the assumption that the substance is an exceedingly complicated thing that is broken up into simpler things at the temperature of the sun, and that some of these things exist in some sunspots, while other constituents exist in others. The changes of wave-length come to the support of this argument. If a chemical element is one thing, it cannot be doing two different things at the same time; if its vapour in a spot is homogeneous, one set of lines cannot tell us that it is going up and another that it is going down; but that is exactly what the sun does tell us.

Those results, like the previous ones relating to the inversions, of course are simply and sufficiently explained by the assumption that we are not dealing in any one vapour with one set of molecules only, but that we are really dealing with various constituent molecules, and that some of the molecules may be in one stage of simplicity, some of them may be in another; some may be at rest, while the others may be in very violent motion. These observations of the relative movements of the vapours have been made at different times and in different parts of the spectrum. We get, in all of them, contorted lines, showing us that a particular vapour is moving; while other lines in the spectrum of the same substance indicate that there is no movement whatever in the vapour in that particular spot.

This problem, however, has a very great difficulty connected with it, because it will be readily understood that the slit of the spectroscope has to be kept absolutely on the same part of the sun. It would not do, it would not be fair, for instance, to have the slit of the spectroscope resting on one part of the sun, and then make an observation of a line of any particular substance indicating motion, and then to let it, even by accident, travel on to another part of the spot and find out that the next line of the same substance indicates rest. The answer to that would be—You are dealing with two different parts of the spot. The observations must be made contemporaneously. I may tell you parenthetically that we have a new instrument now which I think will help us very considerably in these inquiries. This is a spectroscope having a diffraction-grating with 17,000 lines to the inch, which gives us, therefore, a very considerable dispersion. What has been done has been to cut the grating in two. If the two parts of the grating are absolutely in the same plane, of course the whole grating will be receiving the light which comes from the sun direct into the spectroscope, and will send a definite part of the spectrum to the eye; both parts of the grating then will be building up a spectrum of the same part of the sun, and will give us the result in the same part of the spectrum. But now that we have split the grating we have the power of altering the inclination of one half of it, while the other half remains rigidly in its first position. Hence we can make any part of the spectrum overlap any other part, and in this way, instead of being limited to observations of parts of the spectrum sufficiently close to each other to be visible in the same field of view, we can compare lines in the red part of the spectrum thrown to the eye by one part of the grating with lines in the blue part of the spectrum thrown by the other. In this way we are able to make comparisons from one end of the spectrum to the other, when there is no doubt whatever that the slit is lying on the same part of the spot; this will be an enormous safeguard against error.

We have taken several photographs of the spectra of sunspots at Kensington; nearly all of them indicate that two lines of calcium in the ultra-violet spectrum—two lines it is difficult to see with the eye—are always bright, while all the rest remain dark. Another important fact is that in addition to the downrush, the velocity of which has been already stated as something like 40 miles a second on the average; there are in the neighbourhood of the spots, in consequence of the disturbances produced, violent movements of the lower parts of the solar atmosphere which we should call *winds;* that is to say, instead of being up and down they are really horizontal along the surface of the sun. Now 140 miles a second is no uncommon velocity for these winds, and we may imagine, therefore, that the heated gases of the photosphere, and the cooler gases of the spots, are very often arranged in layers. When this is so it is easy by the appearance of the widened absorption-lines to determine the existence of a hotter layer above or between cooler ones. We get what is called a double reversal of the lines.

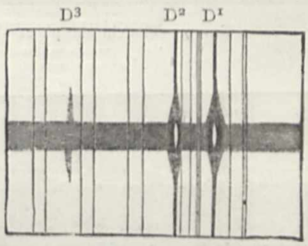


FIG. 8.—Spectrum showing the double reversal of the D lines due to hotter sodium vapour overlying cooler sodium vapour in the sunspot.

Prof. Young, of America, has been fortunate enough to detect one case with, I think, no less than three strata of incandescent sodium vapour inter-layered between three strata of relatively cool sodium vapour. When we wish to consider the phenomena of spots in their entirety therefore, we must not consider the downrush on the photosphere merely, but must also bear in mind the lateral currents which are produced by the disturbances it has set going.

Conclusions

I will now state the conclusions at which we have arrived touching sunspots by means of the work which I have brought before you. You will see they are all of them important with regard to the structure of the lower part of the solar atmosphere.

(1) The spot spectra are very unlike the ordinary Fraunhofer spectrum.

(2) We get as much inversion of lines in the case of one element as we do between the lines of different elements; by which I mean that the lines of nickel, say, are just as much varied in different spots as the lines of iron, nickel, and calcium would be in spots in which the proportions of these substances very greatly varied.

(3) Very few lines indeed are strongly affected at the same time. A great many lines of the same substance are affected of course besides those included in the twelve which have been recorded at South Kensington as most widened every day; but a small number of the lines altogether are affected in this manner.

(4) There is a change depending on what I shall afterwards have to refer to as the sunspot period; that is to say, day after day, month after month, year after year, the lines of any particular substance thickened in the spots are not the same. In fact towards the end of the year 1881 (we began our observations in the year 1879) the iron lines which were strongly affected at first died out altogether.

(5) Many of the lines seen in the spots are lines seen at low temperatures, and none of them are brightened or intensified when we pass from the temperature of the electric arc to that of the electric spark.

(6) In the first 200 spots observed 101 lines were recorded which have never been mapped in any laboratory; that is to say, they do not correspond with lines seen in the emission-spectrum of any substance with which we are familiar.

(7) Many of the lines widened are new solar lines; that is to say, they are not visible among the Fraunhofer lines at all.

[1] A Course of Lectures to Working Men delivered by J. Norman Lockyer, F.R.S., at the Museum of Practical Geology. Revised from shorthand notes. Continued from p. 472.

(8) Many of the lines most frequently seen widened are common to two or more substances when low dispersions are employed.

The Chromosphere

In what has gone before we have been chiefly occupied with a discussion of the various chemical materials which we can trace in those cavities in the photosphere which we call spots. We have now to begin the consideration of the chemical materials which can be traced in that solar envelope which lies immediately over the photosphere, I mean the chromosphere: so that eventually we may endeavour to make a comparison between

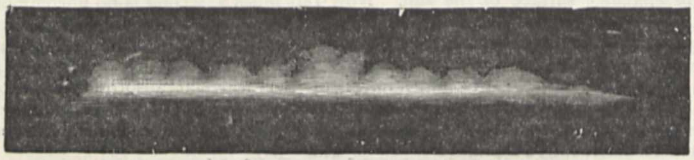


FIG. 9.—The chromosphere—billowy.

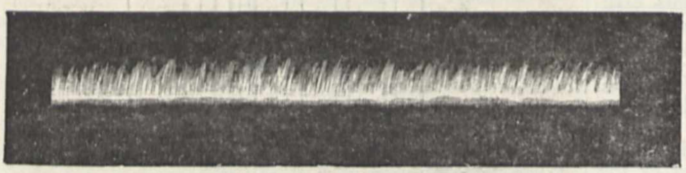


FIG. 10—The chromosphere—spikey

the chemical materials in the spots and in the chromosphere, which are supposed to lie, and which in fact really do lie, at about the same height in the solar atmosphere, with, however, the enormous difference that we know the spots are caused by the descent of materials coming down from above, and we do not know at present that that is true with regard to the substances in the chomosphere.

Now, the chromosphere we will take roughly, as it varies in height from year to year, and from latitude to latitude, to be between 5000 and 10,000 miles high. It is not only bright at the bottom—so bright, very often, that in eclipses, when the bottom is seen, observers imagine that the sun has reappeared—but it is exquisitely coloured at the top, the colours very often being scarlet, crimson, green, yellow, and so on. As ordinarily observed, the simple chromosphere varies very considerably.

The first distinction that we have to draw is that in some parts its surface seems to be billowy, in other parts prickly; some have likened the latter condition to grass, some have likened it to flames; but at all events the distinction is that in many cases it is serrated, and in other cases its saw-like appearance gives way to a much softer billowy outline. These spikes, or grass blades, or whatever we may liken them to, really want very much more study than they have received, for the reason that if they are studied they will give us some ideas on a very important subject. What one wants to know now, I think, almost more than anything else, is the direction in which the currents on the surface of the sun flow; a careful study of the direction of these flames may eventually give us some very material aid in that direction.

The chromosphere, taken most generally, is chemically a sea of hydrogen, *plus* something that we do not know. Above the photospheric level, and for some distance above it, the chief substance which we see in the sun is incandescent hydrogen gas. Now, on our earth we have at the present moment no free hydrogen whatever; all the hydrogen we have is locked up in combination with other substances. At the same time it is fair that I should point out that hydrogen is a very considerable constituent of water, which seems to play the same part with regard to the solid crust of the earth as the chromosphere plays with regard to that shell of the sun which we call the photosphere.

Its Spectrum

What one sees when one immerses the slit of the spectroscope in an image of the sun so that only half the slit is covered by the disk is shown in the accompanying diagram of a part of the spectrum. You must imagine that the slit is, as I said before, half on the sun, and half off it. We have the Fraunhofer lines in the red part of the general spectrum of the sun. We see what the spectroscope picks up outside the sun altogether. It picks up one line, and one line only, coincident with a dark line in the ordinary solar spectrum. That we know is a line due to hydrogen. In the chromosphere, this line appears as a bright line because it has not behind it waves of greater energy, and therefore it gives us its own light. You understand in a moment that the height or length of the line depends upon the depth of what I have ventured to call the sea

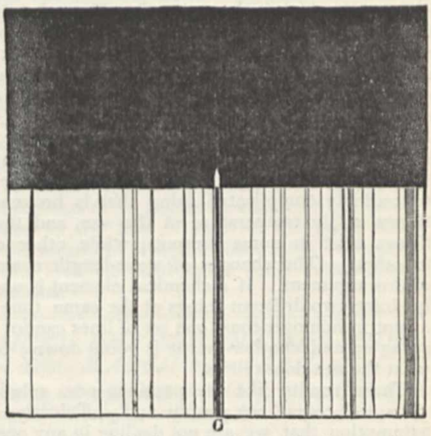


FIG. 11.—One of the hydrogen lines of the chromosphere.

of hydrogen. If this sea is shallow, the line will be short; if the sea is deeper, the line will be longer.

I have said that it is a sea of hydrogen. It is not, however, merely a sea of hydrogen. Of the spectrum of five lines generally thus seen, one of them we do not understand at all. This line is in the orange part of the spectrum, and is called D^3, because it is near to D^1 and D^2; it is a line, I am sorry to say, which has never yet been seen in any terrestrial laboratory.

This, then, is the most simple and the most constant spectrum of the chromosphere.

It has already been pointed out that if the old view that the various substances were assorted in the solar atmosphere according to their atomic weights were correct, then we should have in

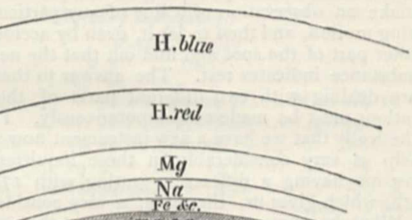


FIG. 12.—Early hypothesis of the arrangement of materials in the Sun's atmosphere. H = hydrogen; Mg = Magnesium; Na = sodium; Fe, &c. = iron and the other elements of high atomic weight.

the chromosphere a spectrum very rich indeed in the lines of the substances with which we are perfectly familiar, and especially in the lines of those substances which are of high atomic weight. The condition which it reveals is just about as opposite as can be imagined.

Amongst those who have most closely examined this chromosphere is Prof. Respighi. From his observations we gather that its brilliancy is exceedingly variable in different parts of the sun; that as a rule it is greatest near the spots; that its height, or its depth, if we like that expression better, is greatest at the poles; that it is always shallow near the spots.

Injections

Occasionally the level of this sea over a very large region is gradually, peacefully, and quietly raised, and when that happens we get short lines—shorter than those of hydrogen —of other substances, and the indications afforded by the observations show us that this welling up is due to the intrusion of other vapours. There seems to be a gradual distillation from out the photosphere, or a gradual heating of slowly falling material, and these lines appear delicately over large regions, pushing up the upper level of the sea of hydrogen, so that the spectrum of the portion of the atmosphere near the photosphere gets richer and richer; we get, in fact, layers of different substances.

I give a table showing the lines which have been thus most constantly seen, in addition to the five lines above referred to. The wave-lengths given are from Thalèn and Ångström.

Table showing Lines of Chromosphere

1869	Hydrogen	All lines	
	D^3		
	1474 (5315·9)	Unknown	
	b^1 b^2 b^4	Magnesium	3 out of 7 (T)
	b^3	Nickel	1 ,, 34
	D^1 D^2	Sodium	2 ,, 8
	4933·4 } 4899·3 }	Barium	2 ,, 26
⦶	4923·1 }	Iron	2 ,, 460 (Å)
⦶	5017·6 }		
	5275 } 5233·6 } 5179·9 } 4921·3 } 5014·8 bright }	Unknown	
After 1869			
	f 4471 }	Unknown	
⦶	4924·5 }		
	B—C } B—*a* }		
⦶	5019	Titanium	1 out of 201 (T)
	H } K }	Calcium	2 ,, 74

Some remarks on this table may be permitted. The first new line is called in spectroscopic language 1474, for the reason that when this work was begun the only maps at the disposal of investigators were those made with great care by Prof. Kirchhoff. He gave a scale of such a nature that this particular line fell at 1474 on that scale. Since then these artificial scales have been discarded in favour of the natural one, which is given us by the actual wave-lengths of light. In this the actual number of that line is 5315·9, which represents the actual wave-length in ten-millionths of a millimetre of that particular quality of light. After this we observe three lines of magnesium—only 3 out of 7. Next, a line of nickel, one only, however, out of 34. Then two lines of sodium. We might naturally expect to get all the 8 lines of sodium, but we do not. Then come two lines of barium out of 26, and so on. For the rest, we see that almost all the other lines have origins which are absolutely unknown, that is to say, we never get them in our terrestrial laboratories, and never, therefore, are able to match the bright lines in this envelope of the sun which we are now discussing with any chemical substance. In the year 1871 we got other lines added to those first observed, because, as we shall see by and by, the sun was then more active, and this activity resulted in the addition of new lines, all of them, however, as you see, absolutely unknown to us, except one which represents a line which we observe in the spectrum of titanium; but in that case we get one line out of 201 in exactly the same way as we get two only of iron out of 460.

The latest constant addition to the lines of this envelope are H and K, two lines so named among the Fraunhofer lines, which we have already seen brightened in spots. Here, again, as in the case of iron and titanium, we only get two lines out of a large number.

Now, over certain reaches of the sun these injections, as we may call them, have been seen to last for a fortnight, quite independent of any spot in the locality, and while the rest of the periphery of the sun has been more or less tranquil.

Here is a drawing showing two gentle wellings up of the chromosphere to which I have referred. The distance from the horizontal line shows the depth of the strata indicated by the lengths of the various lines. The stratum which reaches highest up has a spectrum containing a certain line of magnesium. The next, which is shallower, consists of a substance about which we know nothing, except that its line is called "1474." Then, again, we get other shallower strata giving us still shorter lines. These, again, are of unknown origin. The lower we go the deeper does the mystery become.

The next point it is important to notice is that none of the lines which we have in the table as representing the spectrum of the chromosphere, and those special lines to which reference is now being made as representing the usual commencement of an injection into the chromosphere below, are among those which are widened in the spots. That is an important point to make, and we shall have to refer to it again by and by.

The announcement that iron existed in the sun, an announcement made by Kirchhoff a good many years ago now, was

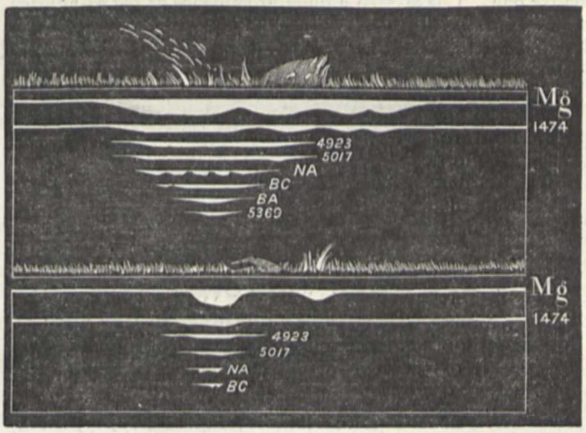


FIG. 13.—Wellings up of vapours.

made because he found, or said he found, that all the lines which we see in our laboratories agreed absolutely, both in position and relative strength, with the lines which can be seen in the spectrum of the sun. If that reasoning is good for the general spectrum of the sun, and if we assume it to be equally good for the spectrum of this special part of the sun—viz. the chromosphere—you will see that if we accept Kirchhoff's line of argument we have no right whatever to say that any of the chemical substances that we are familiar with here exist in this part of the sun, which, as I have told you, is the very hottest part to which we can direct any inquiries.

So much, then, for a general statement with regard to the chemical nature of the chromosphere.

The Chromosphere Disturbed

These injections are at times the first beginnings of an apparent disturbance of the temperature equilibrium, or at all events of the chemical equilibrium of the chromosphere, for, soon after they make their appearance, we frequently get another indication that there is a disturbance going on by the formation of what is called a prominence—a *quiet* prominence; and when we are familiar with those forms of prominences the distinction between a quiet prominence and one of the other kind is a very decided one.

As a rule they need not be very high. By very high I mean 40,000 miles. And also these quiet prominences may last for a very long time. Many of them resemble trees. I was fortunate enough to be one of the early observers of these exquisite forms which one never gets tired of looking at, and the first time I saw one I wrote down in my note-book that the chromosphere and prominences in that place reminded me of an English hedge-row with luxuriant elms. The lower part of the chromosphere, of course, represented the hedge, and the prominences the elms. The simile of a hedge with trees in it was not at all a bad one, but some years afterwards I found a very much better one, and one perhaps nearer the truth of Nature. It was my duty in the year 1878 to go to America to look at an eclipse. I crossed the Atlantic in the high summer, and we naturally had to pass through a considerable amount of fog. We were three days in a dense fog, and one of the delightful things about that fog was this, that one day we were steaming through an opening, and we saw the edge of the fog, which was apparently upright and solid, about a mile off, and we coasted along it. I found that that fog was fed by what I at once called fog-spouts. You know what water-spouts are, and you have all seen drawings of them, and the drawings of water-spouts that I have seen represent the reality very well. If you imagine a bank of fog about 50 or 60 feet high filled with little fog-spouts, you get exactly what I then saw, and you get exactly what one often sees in these quiet prominences on the sun, and I really believe that what I and others have likened to the trunks of trees may be really somewhat akin to these fog-spouts, with the enormous difference, however, that we are dealing with water and aqueous vapour in one case, and with the photosphere of the sun and incandescent hydrogen gas in the other.

These quiet prominences, when we come to examine them with the spectroscope, seem to be built up entirely of hydrogen. When I say quiet you must understand that the word is a relative one. I have seen a quiet prominence as big as a dozen earths born and die in an hour. That is not at all an uncommon thing. And there are several facts which indicate that when such a prominence disappears, it does not mean that the stuff

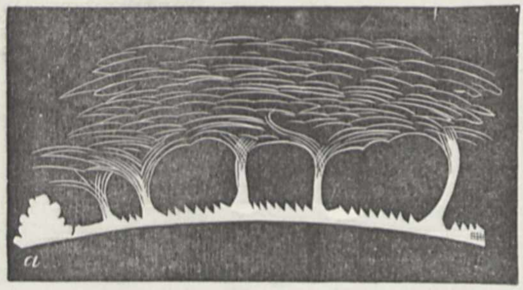


FIG. 14.—Tree-like prominences.

disappears; it means that it changes its state, that is to say, it chiefly changes its temperature. We can understand that these prominences, if they are excessively hot, will be very much more brilliant than if they are cool. If, therefore, they cool more or less suddenly, we may lose sight of them, but it may be that the hydrogen is there just the same, although it is no longer in a condition to radiate so much heat, and therefore light, to us. There is also evidence that these prominences are really, the quietest of them, due to up-rushes of gas from below.

When we watch the growth of a prominence it expands from below, close to the photosphere. First the prominence is of small height, then it gets higher and generally broader, and after a certain time we may see a kind of cloud formed at the top of it, but we never see the prominence coming down, as we have imagined the cooler materials of the sun must come down, to form a spot.

It happens very rarely indeed that any very large horizontal motion is indicated in such prominences as these. Drawings of prominences indicate very clearly the extraordinarily curious forms which these masses, which consist chiefly or entirely of hydrogen gas in the sun's atmosphere, put on.

J. NORMAN LOCKYER

(*To be continued.*)

SOCIETIES AND ACADEMIES

LONDON

Geological Society, February 19.—Annual General Meeting.—Prof. T. G. Bonney, F.R.S., President, in the chair.—The Secretary read the Reports of the Council and of the Library and Museum Committee for the year 1885. In the former the Council stated that they had the pleasure of congratulating the Society upon an improvement in the state of its affairs, both from a financial point of view and on account of an increase in the number of Fellows. The number of Fellows elected during the year was 54, and the total accession amounted to 51; while the losses by death, resignation, &c., amounted to 46, making an increase of 5 in the number of Fellows. The number of contributing Fellows was increased by 15. The balance-sheet showed an excess of income over expenditure during the year of 347*l.* 18*s.* 2*d.* The Council's Report further announced the awards of the various medals and of the proceeds of the donation funds in the gift of the Society. In handing the Wollaston Gold Medal to Mr. Warington W. Smyth, F.R.S., for transmission to Prof. A. L. O. Des Cloizeaux, the President addressed him as follows:—Mr. Warington Smyth,—In the absence, which we much regret, of Prof. Des Cloizeaux, I must request you to transmit to him this medal. Geology is the child of two parents—mineralogy and biology. If we look to the latter to bid the dry bones and buried relics of organisms once more live, we appeal to the former to disclose the nature and constitution of the earth's framework whereon they flourished. It is therefore only just that our Society should seek opportunities of acknowledging the aid which we receive from mineralogists; and it would be difficult to find one on whom this Wollaston Medal could be more fitly conferred than on Prof. Des Cloizeaux. To enumerate the papers which he has written would be a formidable task; they numbered 141 so long as fourteen years ago; what, then, must be the present total? I may, however, point in passing to his admirable "Manuel de Minéralogie," and allude, as more directly bearing on the work of this Society, to his papers on the classification of hyperites and euphotides, on the geysers of Iceland, on the action of heat upon the position of the optic axes in a mineral, and the numerous memoirs on the distinction of minerals by their optical properties, especially those relating to microcline, and to other species of feldspar, of the importance of which students of microscopic petrology are daily more sensible. I esteem it a great honour to be the means of carrying into effect the award of the Council by placing in your hands, to be transmitted to Prof. Des Cloizeaux, the Wollaston Medal, founded "to promote researches concerning the mineral structure of the earth."—The President then presented the balance of the proceeds of the Wollaston Donation Fund to Mr. J. Starkie Gardner, F.G.S., and addressed him as follows:—Mr. Starkie Gardner,—The small number of students and the paucity of memoirs seems to indicate that fossil botany is one of those subjects of which the difficulties repel rather than fascinate the neophyte. If these are in some respects less formidable in the plant-remains of the earlier Tertiary period, if, in studying them, recent research throws some light on fossil botany, yet the practical difficulties of obtaining, developing, and preserving specimens are so great that no little ardour and patience are demanded from one who devotes himself to the subject. For years this has been your special work: after thoroughly exploring the flora of the Eocene Tertiaries on the coast of Hampshire and in the Isle of Wight, you are now, and have for some time been, engaged in communicating to us the fruits of your labours through the medium of the Palæontographical Society, thereby earning the thanks of students. Your researches also of late years have been extended to Antrim, Mull, and even Iceland, and their results cannot fail to be of the highest interest in regard to the age of these floras, and their relation to those which occur in the Hampshire district. In recognition of past, and in aid of future, work the Council has awarded to you the balance of the Wollaston Fund, which I have much pleasure in handing to you.—The President next presented the Murchison Medal to Mr. William Whitaker, B.A., F.G.S., and addressed him as follows:—Mr. William Whitaker,—To many members of the Geological Survey of Great Britain since the date of its constitution we are indebted for work freely done—beyond the sphere of their more strictly professional duties. Its chiefs, from the days of Sir H. de la Beche to the present distinguished Director-General, Dr. A. Geikie, have been among the most valued contributors to our *Journal*, and have enriched geological literature by their longer writings; while among its other members, few have done more than yourself in following the example of its leaders. On the present occasion I will only allude to the various memoirs of the Geological Survey, especially that on the London Basin, in which you have taken so large and important a share, and will dwell rather on your contributions to our own *Journal* and to other publications. Your papers on the western end of the London Basin and on the Lower London Tertiaries of Kent deserve to be ranked with the classic memoirs of Prestwich as elucidating the geology of what I may call the Home District; and your last contribution to its deep-seated geology is still too fresh in our memories to need more than a mention. We do not forget your varied and valuable contributions to the *Geological Magazine*, especially those on the Red Chalk of Norfolk, on the water-supply from the Chalk, on the formation of the Chesil Bank (written jointly with Mr. Bristow), a paper, as it seems to me, of remarkable suggestiveness; and last, but by no means least, on sub-aërial denudation, in which, as remarked by the late Mr. C. Darwin, you had "the good fortune to bring conviction to the minds" of your fellow-workers by means of "a single memoir." We are also greatly indebted to you for your labours in reference to the history of the literature of geology, a task involving not a little labour, which, though of the greatest value to students, is to all unremunerative, and would be, to many, exceptionally toilsome. Of this, your care for several years of the *Geological Record*, and the lists of books and memoirs relating to the geology of various counties in England, are conspicuous instances. There is a peculiar appropriateness in the award to you of this medal, founded by Sir Roderick Murchison, one of the illustrious chiefs of your Survey, and I have the greatest pleasure, on behalf of the Council of the Geological Society, in placing it in your hands, together with the customary grant from the Fund.—In presenting the balance of the proceeds of the Murchison Geological Fund to Mr. Clement Reid, F.G.S., the President said:—Mr. Clement Reid,—The later Pliocene and the Pleistocene deposits of East Anglia offer to geologists a series of problems as difficult as they are attractive. We are indebted to you for much valuable information on the exact distribution and the fossil contents of these varied deposits, which owing to peculiar local circumstances often present exceptional difficulties, and demand exceptionally patient study on the part of the investigators. Your memoir on the Forest Bed of Norfolk is a contribution of especial value to students as affording them fuller and more precise information than could previously be obtained, while the pages of our *Journal* and of the *Geological Magazine* testify to the zeal and thoroughness with which you have applied yourself to these and kindred questions. In conferring upon you this award from the Murchison Fund, which I have great pleasure in placing in your hands, the Council of the Geological Society hopes that it may aid you in prosecuting your studies in this department of geology and extending them to localities which could not be visited by you in the discharge of your professional duties as a Member of the Geological Survey of Great Britain.—The President next presented the Lyell Medal to Mr. William Pengelly, F.R.S., F.G.S., and addressed him as follows:—Mr. Pengelly,—The Council of the Geological Society has awarded you the Lyell Medal and a sum of twenty guineas from the Fund in recognition of your life-long labours in the cause of geology, and more especially, of your investigations in those caverns of the south-west of England by means of which our knowledge of the condition of Britain during the latest epoch of geological history has been so largely augmented. To exhume the contents of a cavern, not only the lair of wild beasts, but also an abode of men in those ages when, to quote the words of the old Greek tragedian,

"Like tiny ants they dwelt in sunless caves,"[1]

requires the exercise of unwearied patience and, in addition, of extensive knowledge and critical acumen. By the labours of the Committee, of which you were the hands and the eyes, and at least a fair proportion of the compound brain, Mr. MacEnery's long-neglected discovery in Kent's Hole was placed beyond all dispute, and the contents of that cavern, its succession of deposits, its relics of extinct animals, and its tools of stone and bone, denoting more than one stage of civilisation, have been made known to the world. In like way the virgin ground of the Brixham cave was investigated, and its valuable contents have been rendered accessible to students. All this you have done, not as the fruit of secured leisure, but in the intervals of a busy life, of which, in the full sense of the words, time was money; and you began this work at a period when, owing to mistaken prejudices, you incurred no small risk of obloquy and personal loss. Your work at Bovey Tracey and your papers on the later geology of Devonshire and Cornwall are too well known to need more than a passing allusion; the Torquay Museum and the *Transactions* of the local societies will be a lasting monument of your zeal in stimulating scientific researches in the neighbourhood of your home. There is a peculiar fitness in the award to you of this Medal, a memorial of the fearless and illustrious author of the "Principles of Geology" and of the "Antiquity of Man." I esteem myself exceptionally fortunate in being commissioned to place it in your hands, and being thus enabled to testify my regard for so valued and genial a friend.—In handing the balance of the proceeds of the Lyell Donation Fund to Dr. Henry Woodward, F.R.S., F.G.S., for transmission to Mr. D. Mackintosh, F.G.S., the President addressed him as follows:—Dr. Woodward,—I have much pleasure in placing in your hands, as representing Mr. Mackintosh, the balance of the Lyell Donation Fund awarded to him by the Council of the Geological Society. In him we have a second instance of the way in which, through an untiring zeal for science, the rare intervals of a hard-worked life may bear fruit so largely augmenting the common stock of geological knowledge. There are few problems more interesting than that of the physical condition of our native land during the period commonly designated the Glacial epoch; but for its solution an exact knowledge of the distribution of erratics and an identification of their points of departure is absolutely necessary. Those who, like myself, have attempted to adjust the rival claims of glacier and floe, of the ice-chariot *versus* the ice-ship, as vehicles of boulder-transport, can hardly speak too highly of the value of the papers on British erratics which he has contributed to our *Journal* and to other publications. I trust that this award may not only be gratifying to him as a mark of our appreciation, but also help him in continuing his labours in a field where, notwithstanding them, much still remains to be done.—The President then handed the award from the Barlow-Jameson Fund to Dr. W. T. Blanford, F.R.S., for transmission to Dr. H. J. Johnston-Lavis, F.G.S., and addressed him as follows:—Dr. Blanford,—I will ask you to transmit this award to Mr. Johnston-Lavis. In this country happily the volcanic fires have long ceased to glow, and the earthquake seldom causes more than a transient tremor. It is otherwise on the shores of the Bay of Naples, where again and again during the last eighteen centuries Vesuvius has rained down ruin; and of late years the earthquakes of Ischia have wrought destruction on the works, and desolation in the homes, of men. It is true that these phenomena of the darker side of nature have not been unobserved by the many illustrious men of science to whom Italy has given birth; but "the curse of Babel" has debarred some of us from access to their works. This alone gives an exceptional value to the elaborate studies which Mr. Johnston-Lavis has undertaken of the various eruptive products of Vesuvius and of the Ischian earthquakes. There is yet another advantage, that natural phenomena should be studied by men of different nations, diverse training, and varied habits of mind. In recognition of his past labours and in furtherance of future work in the vicinity of Naples, the Council has awarded to him a grant from the Barlow-Jameson Fund, which I have much pleasure in placing in your hands.—The President then read his Anniversary Address, in which, after giving obituary notices of some of the Members lost by the Society during the year 1885, he referred to the principal contributions to geological knowledge which have been made during the past year, both in the publications of the Society and elsewhere in Britain. The remainder of the address was devoted to a discussion of the principles of nomenclature which should be followed in regard to the metamorphic rocks. After describing the nature and relations of the various metamorphic rocks in certain parts of the Alps, Canada, Scotland, &c., the effects of the intrusion of igneous rocks, and the results of pressure in producing changes, both mechanical and chemical, upon rocks originally crystalline, he pointed out that these last could generally be distinguished from anterior foliation, otherwise produced; that many rocks in the metamorphic series appear to have originated in stratified deposits, but that the evidence at present in our possession pointed to the very great antiquity of all these, and to the probability of their having been produced under conditions which have not recurred since the beginning of the Palæozoic period.—The ballot for the Council and Officers was taken, and the following were duly elected for the ensuing year:—President: Prof. J. W. Judd, F.R.S.; Vice-Presidents: H. Bauerman, John Evans, F.R.S., A. Geikie, F.R.S., and J. A. Phillips, F.R.S.; Secretaries: W. T. Blanford, F.R.S., and W. H. Hudleston, F.R.S.; Foreign Secretary: Warington W. Smyth, F.R.S.; Treasurer: Prof. T. Wiltshire, F.L.S.; Council: H. Bauerman, W. T. Blanford, F.R.S., Prof. T. G. Bonney, F.R.S., Thomas Davies, Prof. P. Martin Duncan, F.R.S., John Evans, F.R.S., A. Geikie, F.R.S., Henry Hicks, F.R.S., G. J. Hinde, Ph.D., J. Hopkinson, W. H. Hudleston, F.R.S., Prof. T. M'Kenny Hughes, M.A., Prof. T. Rupert Jones, F.R.S., Prof. J. W. Judd, F.R.S., R. Lydekker, B.A., J. E. Marr, M.A., J. A. Phillips, F.R.S., Prof. H. G. Seeley, F.R.S., Warington W. Smyth, F.R.S., J. J. H. Teall, M.A., W. Topley, Prof. T. Wiltshire, F.L.S., Henry Woodward, F.R.S.

PARIS

Academy of Sciences, March 15.—M. Jurien de la Gravière, President, in the chair.—On the authenticity and exact value of the Peruvian unit of measure preserved in the Paris Observatory, by M. C. Wolf. The French legal metre being defined as a determined fraction of this standard taken at the temperature of 13° Réaumur, the importance of ascertaining

[1] Æschylus, Prom. Vinct., 491.

its exact value and state of preservation is obvious. As the same standard was used for the measurement of an arc of the meridian in Peru, it forms the connecting link between the older and more recent geodetic operations. It thus becomes an object of the highest interest, not only for France, but for the whole scientific world, and the author here replies in detail to the doubts and objections that have been raised by Peters and others in Germany against its authenticity and state of preservation. At his request the whole question will be submitted to a Commission appointed for the purpose by the Academy, consisting of MM. Faye, Mouchez, Janssen, F. Perrier, and Wolf.—Memoir on the order in which the first vessels in the leaves of the Cruciferæ make their appearance: mixed formation, and morphogeny, by M. A. Trécul. The leaves of all the plants here treated belong to one of the two types of mixed formation described by the author in 1853, that in which the lobes or teeth of the lower part of the leaf are formed from above downwards, while those of the upper part are developed in the contrary direction from below upwards.—Theoretical considerations on the principles affecting the roll of vessels at sea, in connection with M. de Burry's recent communication (*Comptes rendus* of January 4, 1886), by M. A. Ledieu. It is shown that M. de Burry's conclusions cannot be accepted because based on de Benazé and Risbec's formulas, which are applicable only to ships in smooth water, account being taken of the resistance of the keel.—Remarks in connection with the *Bulletin* of the Society for the Encouragement of National Industry, presented to the Academy by M. Haton de la Goupillière.—Note on the hurricane that swept the Gulf of Aden in June 1885, by Vice-Admiral Cloué. The cyclone, in which five large vessels foundered, including the German corvette *Augusta*, and the French aviso *Le Renard*, both with all hands, and in which probably over 800 lives were lost, was especially remarkable for its sudden appearance. As it penetrated up the Gulf, it contracted from a diameter of 150 miles 250 miles east of Socotra to 50 miles at Obock, increasing in velocity from 8 to 15 miles an hour. The diameter appears to have continued to contract towards the interior of the continent, where it overtook a caravan proceeding from Sangallo in the direction of Shoa.—Remarks on the first botanical collections that have reached the Paris Natural History Museum from Tonquin (continued), by M. Ed. Bureau. Although collected exclusively in the delta of the Red River and surrounding hills, this flora includes no less than 407 species, distributed over 95 families. It comprises probably not a fourth of the whole flora of Tonquin, which thus appears to be one of the richest in the world.—Note on the ephemeris of Fabry's comet, by M. Lebeuf.—Complementary note on the barometric depressions observed by M. Perrin on board the *Galissonnière* in the Red Sea, by M. Mouchez.—Simplifications which may be effected in the numerical calculation of perturbations of planets, by M. O. Callandreau.—On the latitudinal distribution of the solar phenomena observed during the year 1885, by M. P. Tacchini. The general conclusions arrived at are—(1) In 1885 the solar phenomena were more frequent in the southern hemisphere; (2) while the protuberances appear in each zone, the spots, faculæ, and eruptions are confined almost entirely to the regions between the equator and $\pm 40°$, one eruption and one facula alone being recorded in higher latitudes; (3) the maximum of eruptions, spots, and faculæ occurs in the same zone of the southern hemisphere; (4) eruptions were less frequent in 1885 than in 1884, which was also true of the solar spots, showing the connection between these two phenomena; (5) the protuberances, on the contrary, were more frequent in the zones where no spots occurred.—On the theory of diversities in mathematical analysis, by M. Lipschitz.—Note on the construction of the tangents to plane curves, and determination of the point at which a movable straight line touches its envelope, by M. René Godefroy.—On the determination of the coefficient of self-induction; application of the Deprez d'Arsonval aperiodic galvanometer, by M. Ledeboer.—Application of the colour-diagram to experiments made on a colour-blind person, by M. Feret.—Description of a new apparatus for the quantitative analysis of oxygenated waters (one illustration), by M. Maurice de Thierry.—On selenides of sodium and of potassium, by M. Charles Fabre.—On the formation and dissociation of manganates of baryta and strontian, by M. G. Rousseau. The author had already shown that, under temperatures increasing from dark red upwards, the manganates of baryta and strontian become dissociated at a maximum of 1000° to 1100°, the limit being marked by the formation of a diamanganate, which at a still higher temperature returns to the state of a monomanganite. He now finds that, by raising the temperature to a white heat, this manganite disappears in its turn, passing to a maximum of oxidation and becoming integrally transformed to manganate.—On the various degrees of solubility possessed by certain chlorides in the presence of hydrochloric acid, by M. R. Engel.—Description of various processes for the separation and quantitative analysis of copper, cadmium, zinc, nickel, &c., by M. Ad. Carnot.—On the existence of the elements of sugar of milk in plants, by M. A. Müntz. Although hitherto rarely detected, it is shown that these elements are found in great abundance in plants, and that the vegetable products yielding galactose are very numerous.—On the decomposition of the sodico-ammoniacal and sodico-potassic racemates, by M. G. Wyrouboff.—On the seat of the organ of taste in the coleopterous insects, by M. J. Gazagnaire.—On the labrum of the Hymenopteræ, by M. Joannes Chatin.—On the processes of fructification in the fossil calamodendrons, by M. B. Renault.—Complementary observations on the origin of the diamantiferous sands of South Africa, by M. Stanislas Meunier.—On the eruptive rocks and stratified formations of the Serrania de Ronda system, south of Spain, by MM. Michel Lévy and J. Bergeron.—On the optical properties of grünerite, withamite, and some other minerals destitute of determinable crystalline forms, by M. A. Lacroix.—On the spectrum of the $Y\alpha$ earth, by M. W. Crookes.—On the mosandrine earth of Lawrence Smith, by M. Lecoq de Boisbaudran.

BOOKS RECEIVED

"Turkestan," by J. Mochketon (St. Petersburg).—"The Statesman's Year-Book, 1886," edited by J. S. Keltie (Macmillan and Co.).—"Scientific Memoirs by Medical Officers of the Army of India," part i., 1884 (Calcutta).—"Minutes of the Sixth Annual Convention of the Provincial Educational Association of Nova Scotia, July 15 and 16, 1885" (Macnab, Halifax).—"Existing Glaciers in the United States," by J. C. Russell (Washington).—"L'Evolution et la Vie," by D. Cochin (G. Masson, Paris).—"Hourly Meteorological Readings, 1883," part iii., July to September).—"Christy's Guide to Poultry Rearing," new edition, by T. Christy.—"Annales del Museo Nacional de Buenos Aires, Entrega Décimacuarta," Segunda del toma iii., by German Burmeister (Buenos Aires).

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