THURSDAY, JANUARY 21, 1886

THE EAST ANGLIAN EARTHQUAKE OF 1884

Report on the East Anglian Earthquake of April 22, 1884. By Raphael Meldola, F.C.S., &c., and William White, F.E.S. Drawn up by R. Meldola, and read in abstract at the meeting of the Essex Field Club, February 28, 1885. (London: Macmillan and Co.; and the Essex Field Club, Buckhurst Hill. 1885.)

FORTUNATELY for this country we have not been called upon to notice a report of such an earthquake as that which is chronicled in the volume before us since this journal came into existence. Indeed, the authors state that no shock approaching it in intensity has been experienced in the British Islands for at least four centuries. A brief notice of the occurrence was given in our columns (vol. xxx. pp. 17 and 60) by Mr. Topley, and we now have a complete scientific account drawn up by Prof. R. Meldola and presented to the Essex Field Club as a special memoir embodying the results of his investigation in conjunction with his colleague, Mr. William White. The book consists of about 225 pages of readable matter with four maps and numerous illustrations, and the Essex Field Club has certainly earned the gratitude of scientific men in enabling the authors to give publicity to this final result of their labour.

Earthquakes may be considered from three distinct points of view: dynamical, geological, and meteorological or cosmical. The first deals with the purely mechanical aspect of earthquake motion, the second with the immediate cause or causes of these disturbances and their effects as determined by geological conditions, while the last, which is at present the most obscure branch of the subject, deals with the periodicity of earthquakes and their connection with other natural phenomena. The present shock is dealt with from each of these standpoints.

Of the eight sections into which the Report is divided the first is entirely historical, and the authors give a catalogue of all the British earthquakes which have produced structural damage, the records commencing in A.D. 103 and ending with the Nottingham shock of 1881, which slightly damaged a building at Tackley. This list comprises about sixty records, and the authors acknowledge their indebtedness to Mallet's British Association Catalogue, which has greatly facilitated their work of compilation. One very interesting circumstance brought out by this part of the inquiry is that the seat of the present earthquake has been exceptionally free from seismic disturbance since the beginning of authentic history, and it further appears that there have been altogether only about half-a-dozen shocks in Britain since this period which can be compared in their destructive effects with that of 1884.

The second section gives a brief description of the preparation of the Report and the methods adopted for securing the most complete and trustworthy information as soon as possible after the event. Amongst those to whom the authors express their obligation are Mr. G. J. Symons, F.R.S., who had himself made a personal inspection of the scene of damage the day after the shock, and Mr. J. C. Shenstone, of Colchester, who appears to have supplied much valuable local information.

Under the third section, which is headed "General Characters of the Disturbance," we have a statement as to the extent of the shock, which brings out very forcibly the unpleasant fact that our little island is not quite so "tight," as the popular song would have us believe. It seems that the sensible vibrations extended over at least 50,000 square miles of country. An estimate of the intensity is also given which is compared with that of the great Lisbon catastrophe of 1755, the authors arriving at the conclusion that the present shock was about one-twentieth the intensity of the former. In support of the statement that "the earthquake occurred during a period of general seismic activity throughout the world" we have a list of all the British and the more violent of the European earthquakes which have occurred since the beginning of the year 1881. We need only remind our readers that during this period occurred the disasters in Ischia and Chios, the cataclysm in the Sunda Straits, and, more recently, the great Spanish earthquakes, all of which have already been noticed in our columns. With reference to the meteorology we are informed very explicitly that "the evidence is conclusive that no special meteorological conditions preceded, accompanied, or succeeded the disturbance of last April in direct relationship to that event."

In treating of the nature and duration of the movement, and other points of importance which find place in this third section, the authors give a concise account of the general characters of earthquake motion as derived from the observations of modern seismologists, and especially from those made in Japan by Profs. Milne and Ewing, to whose labours constant reference is made throughout the Report. The following conclusion, supported by observations made at Heybridge and Ipswich, is arrived at:—

"There is every reason to believe that the earthquake with which we are dealing was precisely similar in character to those frequent shakings which have been so thoroughly studied in the Plain of Yedo. As in the case of the latter, if our earthquake had been made to trace the story of its own movement on a series of seismographic plates, we should no doubt have seen the gradually commencing tremor increasing in amplitude and complexity till the 'shock' and destruction occurred, and then again dying gradually out."

In the fourth section we have a discussion of the nature and amount of the structural damage, from which it appears that in an area of fifty to sixty square miles damage was caused to 1213 houses and cottages, twenty churches, and eleven chapels.

The "Descriptive Report," which comprises the next section, occupies over 100 pages of the volume, nearly one-half of this portion being devoted to a detailed description of the observations in the area of structural damage made on the ground by Prof. Meldola, Mr. T. V. Holmes, F.G.S., President, and Mr. W. Cole, Secretary, of the Essex Field Club. Many illustrations of peculiar forms of damage are given, and there can be no doubt that the observations recorded in this section will be not only of local interest but also of use to engineers and others who occupy themselves with the important question of construction in earthquake countries.

In summarising this portion it is stated that "the main axis of disturbance extends on each side of a line about five miles in length, having a direction north-east and south-west from Wivenhoe to Peldon. Along this axis the greatest intensity was manifested, as shown by the large percentage of dislodged chimneys, dismantled roofs, &c., and more especially by the fracturing of solid masonry." Following this summary there are the complete records from other parts of Essex and all the other counties over which the disturbance extended. Among the former we notice a very full report from Bocking, furnished by Mr. E. B. Knobel, Sec.R.A.S. It is of interest also to observe how widely the shock was felt over London; records are given from every quarter of the town, and we can but feel thankful that the "axis of disturbance" was not nearer home, or the destruction to life and property would have been most disastrous. A glance at the map, giving the general distribution of the shock, shows that the vibrations were felt as far off as Altrincham in Cheshire, at Sidbury in Shropshire, Street in Somersetshire, Exeter, the Isle of Wight, and across the Channel at Boulogne and Ostend.

The next section will be of special interest to geologists. It is headed "The Earthquake in Relation to Geological Structure," and the first portion deals with the effects of the shock upon underground waters. These effects are, briefly, the raising of the water-level in deep wells near the origin, the falling off of the supply to surface wells, and the rendering turbid of the water derived from the Chalk at Canterbury and in surface wells nearer the centre of the disturbance. The records kept by the Underground Water Committee of the British Association have enabled the authors to give a most valuable series of measurements made at Bocking on behalf of this Committee by Mr. D. Radford Sharpe.

One of the most important practical considerations in connection with earthquake damage is the effect of the subsoil and the position of buildings with respect to the general physical features of the district. This branch of the subject is fully dealt with in the present geological section of the Report, and the authors point out that, owing to the circumstance of the shock having originated beneath a district consisting entirely of London Clay and drift deposits, no very definite conclusions can be drawn as to the effects of the superficial geology in determining the distribution of the damage. They incline to the view that the damage was increased in some cases by the situation of buildings at the junction of different formations, where, in accordance with well-known dynamical principles, the earth-wave undergoes reflection and refraction. A considerable amount of evidence is given to show that both in this and other earthquakes there is a tendency for the shock to make itself felt with special distinctness along "free margins, such as coast-lines, river-valleys, and lines of outcrop, because in these cases there is no resistance offered in one direction to the vibrating particles in their outward movements."

In connection with other geological considerations the authors state that their seismic axis corresponds in direction with the coast-line at this part of Essex, and this fact appears to be in harmony with the theory first put forward by Prof. J. P. O'Reilly. Several pages are devoted to a critical discussion of the evidence furnished by the records from beyond the London Basin, from which it distinctly appears that the shock was spread outwards along the older rocks, owing to the superior "seismic conductivity" of these beds.

In speculating upon the cause of the earthquake the authors display great caution. Having dismissed the view of the shock having been due to volcanic agency they go on to say:—

"The most feasible explanation, in so far as it is safe to hazard any explanation at all, appears to be that of the sudden rupture of deep-seated rocks under a state of strain, the snap and shock accompanying such a fracture being quite competent to produce the effects observed. The precise formation in which this rupture may have occurred cannot even be conjectured; but the great extent of the shock, on the one hand, and on the other the absence of any perceptible change of surface-level, appear to point to a tolerably deep-seated origin."

It is then pointed out as a very significant fact that the axis of the present earthquake corresponds in direction with known faults or other disturbances in the Chalk beneath Essex, Suffolk, and Cambridgeshire, and with that of the well-known Deptford fault.

In the seventh section there are collected a number of miscellaneous observations which could not well find place in the preceding portions of the Report. Mallet's method of determining the "angle of emergence" by the cracks in buildings has been found useless in the present earthquake, and the authors wisely state:—

"We have not thought it advisable to give any calculations of the depth of the origin of the disturbance, being convinced that under the present circumstances such determinations would only give a fictitious semblance of certainty to the results."

A full discussion of the time-records is then given, and the mean velocity of propagation of 9183 feet per second deduced from the most trustworthy. The remainder of this section contains "Observations on Direction," "Personal Experiences of Direction," "Order of Succession of Phenomena," the "Direction as given by Clock-stoppages," and an important sub-section on the twists of chimneys.

The eighth and last section gives a general summary of the whole work. In a postscript, two observations of considerable interest are recorded, the first being the registration of the shock and subsequent earth-tilt at Leeds by a barograph, and the second the displacement of Mr. C. L. Prince's equatorial at the Crowborough Observatory in Sussex. The volume concludes with a short appendix, which relates to the list of British earthquakes.

SYSTEMATIC SMALL FARMING

Systematic Small Farming. By Robert Scott Burn. (London: Crosby Lockwood and Co., 1886.)

THIS volume may be divided into two parts. In the first few chapters the author shows, with considerable clearness, the disadvantages under which small farmers or peasant proprietors are placed. The topic is one which has recently been discussed in connection with legislative projects looming upon the political horizon, and Mr. Scott Burn has contributed towards its elucidation. "While he would be glad to see a limited extension—and which he believes would for natural reasons, after all, be indeed but limited—of small farming, with true peasants or agricultural labourers as the farmers, we must unhesitatingly deprecate any extension based upon the system we have heard so persistently propounded by certain politicians, through the platform or press, and this we do, if for no other reason than in the true interests of the nation" (p. 98). This sentence gives a fair idea both of the literary style of the author and of the tendency of his teaching. With the general conclusion we agree.

While Mr. Robert Scott Burn is, so to speak, "sound" upon the "impracticalness" of the idea of a great extension of small farms in England as a means of improving our agriculture or the well-being of our population, he sees in the small farm an amusement and healthful occupation for those who can afford the luxury of losing a little money. It is apparently with a view to enabling such persons, if not to make more, to lose less, that the second part of the volume is specially designed. Leaving "the wild and revolutionary scheme," he therefore proceeds leisurely to examine the methods and conduct of the small farmer upon his small farm of some half-dozen acres in extent. Into details it is not for us to follow Mr. Burn. He informs us in the preface that the basis of the present volume is a former one which appeared some years ago under the title of "The Lessons of My Farm." That work "was designed to convey to persons interested especially in the subject of small—or, as they are frequently termed, amateur—farms, a general yet a sufficiently practical notion of what the work of such farms was." On reading through the chapters devoted to his practical instruction of the small farmer we are struck with the evidently large proportion of the "basis."

Bearing the date of 1886, the illustrations, examples, and quotations are chiefly borrowed from sources extending from 1830 to 1860, that is, with the exception of the chapters devoted to *ensilage*. Most farmers would elevate their eyebrows at the suggestion to raise their mangel in seed-beds, and plant them out like cabbages. The result would no doubt be a greatly diminished crop. Yet Mr. Burn says: "I would recommend the reader to try the method." It appears that it was in 1830 that a M. Kœchlin, who cultivates weeded plants, asked why beetroot was not raised upon a seed-bed. But mangel-wurzel is *not* beet, and as well might it be proposed to transplant swedes because they are allied to cabbages as to recommend for mangel what may have been found suitable for beet. This love of the practices of 1830, 1855, 1860, beyond which latter date Mr. Scott Burn rarely ventures except with reference to ensilage, is accompanied by a curious ignoring of the newer literature bearing upon the feeding-stall, the dairy, and the field. Mr. Horsfall and Mr. C. Lawrence, long since retired, if not dead; contributions of Dr. Lyon Playfair, long overgrown with mould; Liebig and Anderson, both long since passed away—these are the authorities quoted. On the other hand, Sir John B. Lawes, although once, in an appendix, obscurely mentioned as Mr. J. B. Lawes, is never quoted or cited on any of the numerous subjects handled. In treating of dairy cattle we are instructed from the experience of M. Lejeune of a Belgian agricultural school obtained in the years 1855 and 1856. At p. 347 we are presented with illustrations of dairy implements and utensils. They consist of three crocks, a milk-strainer, two "butter-sticks" (Scotch hands), and a cream-skimmer. No churn, cheese-tub, curd-breaker, butter-tub, vats, presses, butter-worker, curd-mill, &c., are even mentioned. A cream-raising machine is alluded to, but we are quite at a loss to know what is meant—perhaps a cream-separater. A cream-raising machine strikes us as fantastic. In the present day we are, perhaps, too liable to forget past experiences; but when the results of recent experiments, conducted with modern precision and modern apparatus, lie around us in almost reckless profusion; when the values of foods, the effects of dietaries upon cows and their produce, or in promoting increase in carcass weight, may be seen in the full reports constantly appearing of State Colleges in America, Experimental Stations in Germany, in the Rothamstead and Woburn papers, &c., &c., it seems scarcely necessary to go back to 1855 for examples and results, while at the same time modern work is simply ignored.

OUR BOOK SHELF

North Borneo: Explorations and Adventures on the Equator. By the late Frank Hatton; with a Biographical Sketch and Notes by Joseph Hatton. (London: Sampson Low, 1885.)

MR. FRANK HATTON, whose life and labours form the subject of this volume, was the scientific explorer and mineralogist to the North Borneo Company for the magnificent territory now under its sway. After only eighteen months in the island, he was killed by the accidental discharge of his own rifle on his last journey prior to his return to Europe, on the Segama River, whither he had gone in the course of his duties to search for traces of gold. Short as his period of service had been, he had succeeded in exploring a large part of British North Borneo, and the newness of this region as well as the lack of information about the interior will render the second part of this volume, containing Mr. Hatton's own diaries and official reports, of special interest. He was evidently of the stuff of which explorers are made: he had abundant readiness, resource, patience, energy, and a cheery good humour which helped him through many difficulties with native tribes who are all but unknown even to officials of the Company. His first journey from Sandakan, the capital, was to Sequati, for the purpose of reporting on the resources of the petroleum oil shale there: this was succeeded by an adventurous journey up the Labuk River. After arriving at the upper waters of this great stream he struck across the country to the north to Kudat, carrying on explorations in all directions on the way, including a visit to the great mountain of Borneo, Kina Balu. With Kudat as head-quarters, he spent some months around Marudu Bay, at the extreme north point of Borneo, engaged in mineralogical investigations, and discovered samples of copper and copper pyrites, coal, and other minerals. After a short rest, he again left Sandakan, this time going south to the mouth of one of the greatest—perhaps the greatest—of Bornean rivers, the Kinabatangan, which he ascended to the borders of Province Dent. On the way he made several plucky attempts to penetrate south from the course of this river to that of the Segama, but failed on account of the rainy season, and the swamps created in consequence. On the map the lines marking two gallant attempts, which can now be seen to have been almost crowned with success, stop in districts marked "large swamps." Failing in this way to reach the Segama, he was forced to return to the mouth of the Kinabatangan and go down the coast to the Segama, where his mission was to search for gold. The accident which brought his life to an end took place a considerable distance up this river, while he was still ascending it. This, in the barest outline, represents Mr. Hatton's geographical work in Borneo; his mineralogical work was carried on simultaneously. The difficulties of all kinds which he succeeded in overcoming—and they were neither few nor small—are recorded in his diaries and letters. These represent an amount of work rarely done by young men who have barely reached their majority; and this was only the earnest of what he would have accomplished had his life been spared. It is interesting to notice that, according to the latest official reports from North Borneo, gold had been found in small quantities on the Segama River at several places after Hatton's death. The peculiarly painful circumstances under which he died have led to the publication of much of a personal, and perhaps somewhat temporary, interest, but his journals and reports contain solid matter enough on this new British possession to render the volume worth publishing on wider and more general grounds.

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.*]

On "Seter," "Strandlinjer," or Parallel Roads in Central Norway

I SEND you a copy of a paper from the *Archiv for Mathematik og Naturvidenskab*, Band 10, "Om seter eller strandlinjer i store hoider over havet." As I here describe, as existing in a great part of Central Norway, a phenomenon quite analogous to the famous parallel roads of Lochaber, and also make an attempt towards the solution of the much-discussed question of the origin of these shelves, an abstract will perhaps be of some interest to your readers.

The Norwegian roads I have seen are all situated on the southern side of what geography-books call the Dovrefjeld. In a great many, if not all, of the valleys originating here, especially in Glomdalen, which the railroad from Christiania to Trondhjem follows, and in Foldalen and Rendalen, one to three horizontal shelves are to be seen on both sides, with all the peculiarities described by MacCulloch, &c., from Lochaber. Perhaps, however, the shelves do not slope so much against the valley, and the detritus in it is more worn than in the common till. But there is another more significant difference. Not only at a single point, as noted from Glen Spean, but for several kilometres—*e.g.* in Rendalen—the rock appears as a vertical wall on the inner side, giving the road an aspect exactly like the well-known *strandlinjer* from our coasts. Such rock-shelves alternate in the same road with the more common detrital shelves, just as in the raised beaches near the sea. In Norwegian they are called *sete*, pl. *seter*, viz. "what one sits upon."

Their horizontality requires, as in Lochaber, a water-level as an accompanying factor in their formation. But here in Norway this can certainly not have been the sea, as advocated by Darwin for the roads in Lochaber. Their height is from 657 to 1090 metres, and while the land stood only 180 metres lower than now, the central part of the country was yet covered by a *mer-de-glace* of very considerable bulk, up to 650 metres, which certainly must have destroyed such superficial formations as these detritus roads. Several other arguments may also be brought forward against their marine origin. In Lochaber the coincidence in height of the roads and the cols leading eastward has settled the question that it must have been in local dammed lakes that the shelves originated.

In Norway such a coincidence with cols is not as yet evidently demonstrated, but the elevations already known make it quite probable. The main rivers in the examined tract are the Glommen (the greatest river in Norway) and its affluent, the Folla. The cols at their sources are 664 metres and 950 metres high, and with these heights agree very nearly eight *seter* and three great terraces at different places in Glomdalen, and two *seter* and one terrace in Foldal. This result and some others in accordance with it were mainly obtained by measurements with the aneroid during a single week last summer, and I cannot therefore but take it for granted that a closer examination will find corresponding cols to all *seter*.

The great question here, as in Lochaber, is, What has dammed up these great lakes, which attain a length of 280 kilometres and a depth of more than 300 metres? The difficulties which beset any theory supposing detrital obstacles are still more insurmountable here than in Scotland. About 1000 feet to be removed without traces for every great valley! At the highest *sete* (1090 metres) in the Rondane Mountains it is necessary to build up detritus dams almost all round, as the present environs will not contribute much. Against Agassiz's glacier theory in the form adopted by Jamieson there is advanced the very vigorous objection that a glacier from any neighbouring valley would certainly not be forced up against the opposite side of the valley to the required height when its way up and down the glen was free; besides which the ends of glaciers are generally very much creviced, and there must have been glaciers in all the valleys if in any. To this powerful argument from Milne Home and others there may be added for the Norwegian *seter* that any purely local obstruction in several parallel valleys at about 61° 40′ N.—the southern boundary of the *sete* region—is not very probable.

Where, then, is the required dam to be found? Both in Lochaber and in the *sete* region of Central Norway we meet with the same remarkable glacial phenomenon: the striæ go *upwards* against the drainage. The boulder transport makes this an indisputable fact for a great part of Glomdalen. From this it is a certain deduction that the glacier-shed has not followed the watershed. In Scotland the glacier-marks go higher in the western part than to the east of Lochaber, and as the precipitation is also greater here the originally higher part of the *mer-de-glace* to the west must certainly have persisted for the longest time. By the great ablation the outer margin of the nap shrank from the east coast, gradually retreating up the Great Glen and Strath Spey, &c., towards the corner between the highest mountains in Scotland, where the last rest must have lingered rather long. *This last rest of the inland ice was*, I presume, *that which formed the block*, gradually damming up lakes as it sank below or shrank behind the cols. That it was solid enough as it lay there as a mighty bulk without crevices, which are only caused by movement, can hardly be doubted. The dying rest perhaps sent also relatively slowly-moving glaciers almost to the last straight up the glens in the same direction as the striæ till.

In Norway the last rest of the great inland ice may be supposed to have persisted where the greatest thickness had been, viz. below the glacier-shed. This can be found by the assistance of the southern limit of the north-going striæ, which, as might be expected, coincides very well with the known southern limit of the *seter*, with the exception of a few observations of striæ which a later examination may prove erroneous as to the direction. This line is in Gudbrandsdalen, Österdalen, &c., 200 to 300 km. south of the watershed, and is at a still greater distance in Jemtland, in Sweden. This somewhat surprising result agrees perfectly on closer examination with the orographical and climatological probability, and may also be directly deduced from the glacial physics, but this I cannot here demonstrate to its full extent.

Between this last ice-rest and the watershed now lies this peculiar row of grand glacier lakes, which may be traced up to Swedish Lapland, though as yet no *seter* are known farther north than Jemtland. Everywhere this tract is distinguished from other highland valleys by its astonishing *terraces*. In these, now and then, is found a finely-laminated clay, which elsewhere is confined to the niveau below 500 feet, the old sea-level. This is the case not only in Österdalen and Jemtland, but in Swedish Lapland up to 1400 feet, to the great perplexity of the older geologists of Sweden (such as Erdmann), who, convinced that this clay could only be formed in the sea, were forced to suppose a former, else improbable, sinking of the land to this extent. Its deposition in our great glacial lakes is quite natural.

The conclusions these *seter*—beaches of great height—lead to as to the origin of the *strandlinjer* near the sea, I shall not follow out here. I shall only remark, with respect to the parallel roads of Lochaber, that Prestwich's hypothesis of landslips is untenable as soon as the alternation of rock-shelves and detritus-shelves is recognised. A different origin for the Scottish roads and for our *seter* can hardly be supposed. ANDR. M. HANSEN

University Library, Christiania, December 17, 1885

The New Star near χ' Orionis

THIS star, since December 20, 1885, has been very slowly decreasing in brightness. No trace of nebulosity was observed around it. Its colour on December 19 was red-orange, now it is yellow-orange. Its spectrum is of the 3rd order of Secchi. On December 19 it was very brilliant from the red to the blue, with six to eight brilliant bands decreasing in light to the violet, or the more refrangible side. Now the red of the spectrum is very dark, the yellow less luminous, and the blue more faint than before. The maximum of light is always in the green.

The apparent position of the new star, which I determined on December 20, 1885, 10h. 0m. 17s., Palermo M.T., was

$$\alpha = 5\text{h. } 49\text{m. } 4{\cdot}54\text{s.}, \ \delta = 20^\circ\ 9'\ 4''{\cdot}3.$$

Palermo Observatory, January 5 A. RICCÒ

Anchor Frosts

MR. J. HANDS, in NATURE of January 14 (p. 246), gives an interesting account of an anchor frost, "the most marked effects of which are," he says, "seen in *comparatively* still water." He adds, "it is said, that water coming upon it (anchor frost) from above will rise in level and flow over it, as over a solid obstruction. This I have not seen myself."

I have seen (and *felt*) this occur on at least one occasion, rather to my discomfort.

When in the Arctic, early one morning in late autumn, I went out to shoot deer for our winter stock of food, and forded a stream at a shallow rapid, dry-shod, in Eskimo boots coming up to the knee. The day, for the season, became very cold, and on my return homewards in the evening I found that the water in the rapid had risen so much that it came fully a foot above the tops of my boots, filling them with water. This increase of depth was wholly caused by the obstruction of a collection of ice-crystals in the form of wet snow, or pulp (through which my feet readily sank), adhering to the stony bottom of the stream. I had to hurry over the mile or two to my fireless tent, rip off my frozen boots and trousers, then jump into my blankets.

The position of this anchor-ice was the very opposite to that described by Mr. Hands, being in a swift but shallow rapid flowing out of a comparatively still deep pool frozen over with a thin coat of ice, but, where open, close above the rapid, having many small ice-crystals floating on and near the surface. The cause of these crystals coming into contact with, and adhering to, the stones at the bottom of the rapid I have given elsewhere, possibly in a previous number of NATURE.

The tenacity of cohesion of this soft mass of wet snow is more clearly indicated by its resisting the great force of a strong rapid, than where it occurs in comparatively still water.

JOHN RAE

4, Addison Gardens, Kensington, W., January 16

The Dover Boring

AS the deep boring at Dover is alluded to in the last number of NATURE (p. 255), it may be well to state that a short notice thereof was appended to my paper on the Chatham borings, which was read in abstract at the meeting of the British Association last year, and that a fuller account was included in my paper "On Deep Borings in Kent," read to the Geological Society a few weeks ago (December 2, 1885), and noticed in NATURE of Dec. 24, p. 190. Since then I have got some further information, and specimens of the deeper beds found are now under examination by Mr. J. Sharman, Palæontologist to the Geological Survey. My paper being now in type, though not yet published, there is no need to enter into details, either of this or of a still deeper boring now going on in the same county. Any additional evidence as to the deep-seated rocks of Kent I hope to give in a supplementary paper, if needful, and I hope also shortly to visit the sites of the two borings referred to.

WILLIAM WHITAKER

33, East Park Terrace, Southampton

The Viper and its Young

I WAS very much interested in an account of a viper swallowing its young, given in NATURE a short time ago, and would like to corroborate the statement of Mr. Middleton's correspondent, anent this extraordinary performance, by relating as briefly as possible a little incident of which I was a witness. About the end of August 1885, I was watching a coolie underbushing in the bush on the Demerara River, Demerara, when suddenly a large labaria snake raised his head with open mouth just in front of the coolie. The man struck at it with his cutlass (a knife about twenty inches long), and afterwards assured me that he hit the snake, but I saw the reptile glide off towards the river. I pursued, but without success, the snake having doubtless taken advantage of the river as a means of escape. The coolie, who was a thorough bushman, having been born and brought up in the bush, told me that in all probability there would be another labaria not far off, as they always went in pairs. Next afternoon I heard that William, the coolie, had encountered another labaria, which he had killed. On my going to the place where he was at work, he told me he had buried the snake after cutting off the head. I may here state that a bushman almost invariably buries a snake after killing it, interring the head in a separate grave from the body. This the bushman does because, he says, if any one puts his foot on a snake's skeleton and a bone pierces the skin, the result will be nearly akin to the bite of the snake. This common belief among the sons of the forest has no doubt a good deal of truth in it, especially if a bone be broken in the wound. The interment of the head in a separate grave is merely done as a graphic assurance that the snake can never come to life again. Being curious to know if this labaria was the one I had seen on the previous day, I made William dig the reptile up, and was pleased to find it altogether a much thicker and shorter snake. On recounting his narrow escape from a bite, William vented his spleen by giving the snake's body a hack with his cutlass, when, to my astonishment, out through the wound came seven young ones, varying from five to ten inches in length, as nearly as I could guess. They were all quite lively, although covered with a sort of thin film or saliva. The largest of the brood seemed quite determined on business straight off, so I rapped him over the neck with the back of my knife. We killed the whole lot of them, and William carefully buried them, remarking that the bite of the young was quite as bad as the bite of the old snake. Now these snakes had been buried at a depth of eight or ten inches for from sixteen to eighteen hours, and on liberation did not seem a whit the worse for their entombment. William told me that when he saw the snake first it was lying coiled up fast asleep, and that he had nearly put his foot right on top of it; he, however, cut a stick and killed it before it awoke. We both agreed that from the appearance of the snake she had shed her skin only a few days before. This in all probability was the case, as I found a shed skin about three yards from where she had been killed. The little snakes seemed to me to be inside the stomach, and not in the gullet as Mr. Middleton suggests. The mother also was in a place where there was scarcely any likelihood of her ever having been disturbed to cause her to swallow her brood, and it will be evident that the young did not quickly perish even after the mother was dead. From what has just been stated, would it not be reasonable to advance the theory that the mother snake swallows the young ones after they are hatched, and retains them in her stomach until they attain a development that fits them to take care of themselves, when she either vomits them up, or they wriggle out of her mouth of their own free will?

Not being a naturalist, I am sorry that I cannot give any but the Indian name of this snake, but I will endeavour to find it out if you wish. The labaria must be well enough known to naturalists. A CREOLE

White Blackbirds

A WHITE blackbird lived in our garden a year or so ago for about twelve months. Our gardener had seen it there, or at least one like it, before. I often saw it within a few yards' distance, and it was certainly three parts white, though presenting a mottled appearance. Some neighbours who heard us speak of it said it must be *their* white blackbird, meaning that they had seen it in their gardens. It was shy, but not more so than other blackbirds, and once, during sharp winter weather, came close to the house and into the yard where the poultry feed. I have not seen it for some months, nor heard of it in any other garden. A. S. MATHEWS

Edgbaston

Curious Phenomenon in Cephalonia

MR. LEDGER (p. 246) need not have had any doubt about the correctness of the information sent him by his friend about currents running from the sea *into* Cephalonia. It is a well-known fact, and the following account of it is from Dr. John Davy's "Ionian Islands," published in 1842, vol. i. 164:—

"The next phenomenon I have to mention is very extraordinary, and apparently contrary to the order of nature: it is the flowing of the water of the sea into the land in currents or rivulets which descend and are lost in the bowels of the earth. This occurs in Cephalonia, about a mile and a half from the town of Argostoli, near the entrance of the harbour, where the shore is composed of freestone, and is low and cavernous, from the action of the waves.

"The descending streams of salt water are four in number; they flow with such rapidity that an enterprising Englishman has erected a grist-mill on one of them with great success. I have been informed that it produces him 300*l*. a year. The flow is constant unless the mouths through which the water enters are obstructed by sea-weed. No noise is produced by the descent of the sea-water, and rarely is any air disengaged; the streams have been watched during earthquakes, and have not been found affected by them. It is stated that fresh-water is perpetually flowing through fissures in the rock from the land in the trench which has been dug for the reception of the mill-wheel, and that, when the sea-water is prevented rushing in, then the water in the trench rises higher by several inches than usual, and the water is brackish to the taste. The phenomenon has been long known to the natives. The little information I have obtained respecting these extraordinary currents I owe to my friend Dr. White, surgeon of the Second Battalion of the Rifle Brigade, collected by him when stationed in the Ionian Islands about 1840."

If Mr. Ledger's friend could give us more information it would be most desirable. I am sorry I had not an opportunity of examining the mill when I was amongst the islands in 1857.

Gateshead, January 17 R. S. NEWALL

After-Images

CAN any reader account for the following interesting phenomenon:—If I close my eyes in the presence of a strong light, so close that not a ray of light can penetrate the lids—in fact, I may generally place my hands firmly over my eyes—I can see pictures of great splendour, more beautiful than any decoration I have ever beheld, sometimes in the form of some splendid architectural design, most elaborately worked out; at others, beautiful landscapes; again, fine geometrical and other designs, as well as every conceivable form of conventional treatment, such as might be applied to carpets, or other floor decorations, iron-work, &c. I would add that all this is seen without any apparent preconceived action of the will, as sometimes, if I close my eyes with the deliberate intention of seeing any particular object, I am disappointed, though not so frequently now as when I first noticed the phenomenon a few years ago. I have sometimes seen designs positively ugly, but as a rule they are most beautiful in form and colour.

I have visited but few grand and noble buildings, and seen but little of beautiful landscapes, as I am only a humble mechanic, but I take great delight in reading descriptions of such buildings and scenes, and am a true lover of sound, substantial, and elaborate workmanship. J. C. S.

PROFESSOR TAIT ON THE PARTITION OF ENERGY BETWEEN TWO SYSTEMS OF COLLIDING SPHERES[1]

SINCE Clerk-Maxwell published, in 1860, his first grand investigation on the subject, it seems to have been taken for granted, rather than proved, that in a mixture of great numbers of colliding spherical particles of two kinds, the ultimate state would be one in which the average energy of translation is the same for a sphere of either kind. Also that his Corollary, which extends the proposition to a mixture of many systems, is true. Further extensions have been made, the results of which have been considered as irreconcilable with the kinetic theory of gases, at least in its present form.

So far as I am aware, no really *convincing* proof of this theorem has yet been given. Maxwell's first proof is so sketchy, and involves so many inadmissible assumptions, that it cannot be looked on as more than an illustration of a truth which his deep insight had enabled him intuitively to perceive. More recent proofs depend so much on a species of analytical verbiage (under cover of which any amount of assumptions may be tacitly introduced), that, besides being totally unintelligible to any but specialists, they do not bring full conviction even to specialists themselves. What is required is plain, clear statement, and justification of every step about to be taken, such as will commend it to the careful reader, and leave no doubt on his mind as to *what* is about to be done, and *why;* though the mere details of the subsequent necessary calculation may be beyond him. Nothing does greater harm to the average reader, in the way of shaking his belief in the results of an investigation, than the use of analysis instead of, or so as to mask, thought. One may make a mistake in evaluating a definite integral, just as one may make a mistake in adding a column of figures. But when the process of forming the expression to be integrated, or of obtaining the items of the column of figures to be added, is not made fully intelligible, incredulity is very justly aroused, however we may be inclined to trust the special skill of the mere analyst or of the arithmetician in his proper sphere.

In seeking such a convincing proof, I have become from time to time suddenly aware of specially dangerous traps which (some almost obvious, others extremely difficult to detect) abound in this particular region of inquiry. Some of these will appear in what follows. Hence I determined not to be content with anything short of absolutely pointing out the nature of, and the reason for, every step; so that even those who cannot follow the step itself may fully understand *why* it has been taken, and be in a position to judge of its legitimateness.

Limits of space forbid my giving all this in an abstract, so that I must confine myself to a very condensed statement.

For reasons given, we assume the truth of the "error-law" distribution of speeds in any one system of spheres. This will be called the "special" state.

When two systems are mixed, we assume the mixture to be complete; and, on account of the small fraction of the whole number of particles (one from each, or one from either, system), which are at any time in collision, *and of the perfect freedom of collision between any two assigned particles* (this is a point of special importance), we assume that each system, by its internal collisions, maintains its own "special" state. Hence in our investigations the collisions of two particles of the same system need not be attended to. Their sole function has been assigned, and we assume that they accomplish it.

But it is most distinctly to be understood that the above assumptions are absolutely necessary to the prosecution of the inquiry in the manner adopted; and, therefore, to whatever result it may legitimately lead, that result is not to be held as accurate if any of them be departed from. Thus the extensions of Maxwell's Theorem, given by Boltzmann and others, must not be considered as legitimate extensions of that Theorem and its corollaries unless, in the collisions between complex particles, the mechanism of each degree of freedom of any one such particle has perfectly free access for collision with that of the corresponding as well as with that of the non-cor-

[1] Abstract of Paper read to the Royal Society of Edinburgh, January 18. Communicated by permission of the Council.

responding degrees of freedom of the same or of other particles. For instance, Maxwell's Theorem itself is not proved if the spheres of one system have not as perfect freedom for mutual collisions as for collisions with those of the other system. We are not entitled to *assume* that they can then acquire, much less that they can maintain, the "special" state on which the further argument is based. This is one of the traps into which Clerk-Maxwell fell; for he assumed that the result could be deduced from the consequences of a sort of typical impact between two particles, one from each system, moving in directions at right angles to one another, and each having the mean-square speed of its own system.

Let the masses of two impinging spheres, whose coefficient of restitution is unity, be P and Q; and let u and v, measured towards the same parts, be the components of their velocities along the line of centres at impact. Let these become, after impact, u' and v'. Then we have, as in the text-books,

$$P(u'-u) = -\frac{2PQ}{P+Q}(u-v) = -Q(v'-v);$$

which gives, at once,

$$P(u'^2-u^2) = -\frac{4PQ}{(P+Q)^2}(Pu^2-Qv^2-(P-Q)uv)$$
$$= -Q(v'^2-v^2).$$

Each of these equal quantities is double the amount of energy transferred from one sphere to the other.

Now, when kinetic equilibrium has been (at least approximately) arrived at, such transference must (on the average) cease:—so that the equilibrium condition will be

$$P\overline{u^2} - Q\overline{v^2} - (P-Q)\overline{uv} = 0,$$

where the bars indicate average values.

Everything turns on the proper estimation of these averages. For, if the average of uv be taken as zero, we have Clerk-Maxwell's result; provided that $P\overline{u^2}$ and $Q\overline{v^2}$ be proportional to the average energy of a P and a Q respectively. This is a comparatively obvious trap.

But if we consider that collisions are more likely to occur between two particles, having *given* speeds, if they be moving towards opposite parts than if towards the same parts, we see that, on the average, u and v are more likely to have unlike, than like, signs; and therefore that the value of $\overline{uv}$ is negative. It is not so easy to see, beforehand, what sort of changes this consideration may produce in the values of $\overline{u^2}$ and $\overline{v^2}$.

This leads to an inquiry as to the relation between the relative speed of two particles and the probability of their collision, and the formulæ become complicated.

I found, by an *approximate* investigation in which the above consideration was given effect to, that, if the average energies of a P and a Q be called, as usual, $3P\alpha^2/2$ and $3Q\beta^2/2$, we have, nearly,

$$\overline{u^2} = \alpha^2/2, \quad \overline{v^2} = \beta^2/2; \quad \overline{uv} = -e\alpha\beta;$$

where e depends only on the relative magnitudes of α and β. If this were true, it would follow at once that the average energy per sphere would be less for those of greater mass.[1]

But I soon found that at least part of this must be erroneous, because though many of its consequences would require a mere modification of the *mode of stating* certain well-known theorems, others were incompatible with physical principles.

Yet it seemed (and this is a specially good instance of the pitfalls I have alluded to) hardly possible that, as $\overline{uv}$ is certainly negative, we could get $P\alpha^2 - Q\beta^2 = 0$ for the form of the above expression, except when $P = Q$.

When I revised my calculations, dispensing with methods of approximation, I found that, strange as it appears, the average value of $u(u-v)$, the P part of the above expression, depends on α only, and *does not involve* β! Its value is $2\alpha^2/3$, of which

$$\overline{u^2} = \frac{4\alpha^2+3\beta^2}{6(\alpha^2+\beta^2)}\alpha^2 \text{ and } -\overline{uv} = \frac{\alpha^2\beta^2}{6(\alpha^2_1+\beta^2)}.$$

If the above result, which has been obtained by the evaluation of a number of troublesome definite integrals, be correct, there must be some very direct and simple proof that $\overline{u(u-v)}$ depends on α only.

[1] This conclusion, after I had seen it to be erroneous, and had taken timely precautions, sufficient (as I thought) to prevent its appearing in NATURE, was unfortunately published as a definitely-ascertained fact; without any allusion to the *approximation* on which I had stated it to be based.

REPORT TO THE TRINITY HOUSE ON THE INQUIRY INTO THE RELATIVE MERITS OF ELECTRICITY, GAS, AND OIL AS LIGHTHOUSE ILLUMINANTS

THE Committee appointed by the Trinity House to report on the merits of electricity, gas, and mineral oil as lighthouse illuminants have recently issued a valuable report giving an account of the investigations carried out under their directions, and the conclusions they have arrived at. The Committee consisted of Elder Brethren of the Trinity House. They were assisted by Mr. A. Vernon Harcourt, who was appointed by the Board of Trade to co-operate with the Committee, and by Prof. W. Grylls Adams and Mr. Harold Dixon, in the more purely scientific part of their investigation.

Three temporary lighthouses were erected on the South Foreland, and fitted up for electricity, gas, and mineral oil; the optical arrangements were "multiform" in all three—that is, consisted of several similar sources of light, each with its own condensing lenses, superposed; in the case of the electrical tower there were three superposed lamps, as was also the case with the oil tower: but in the gas tower there were four lamps; the two former were therefore "triform," whereas the latter was a "quadriform" light." Any one lamp in either tower could be lighted independently of the others, so as, for instance, to permit biform electricity to be compared with triform oil and quadriform gas.

The lamps for the electric light, and the magneto-electric machines for working them, were supplied by M. de Meritens; the gas apparatus was that of Mr. Wigham, each burner consisting of 108 jets in concentric rings, of which a part only might be employed; the oil lamps in the third tower during the greater part of the trials were six-wicked Douglass pattern, but burners of this description with seven and eight concentric wicks were also tried at various times during the progress of the experiments.

In addition to the temporary lighthouses, three observing huts and a photometric gallery 380 feet long were erected.

The actual observations that were made may be divided into two classes—eye-estimations, and photometric measurements. The former were made by the Elder Brethren, by officers on board the light-vessels in the neighbourhood, by merchant officers in passing ships, and by the coastguard officers at those stations from which the lights were visible. These eye-observations were of two kinds:—(1) Estimations of the comparative brilliancy of the lights; (2) definite statements as to the various distances at which the lights were visible in hazy or foggy weather.

With reference to observations of the first kind, they were conducted in accordance with regulations issued by the Trinity House Committee: the observers were instructed in filling in the books of forms which were issued to them, to put down in one column the light from the electrical tower as 100 and in the other column the estimated brilliancy of the lights exhibited by the other two towers as compared with it. It seems probable that the recorded numerical values of the relative brilliancy of the lights can only be a very rough approximation, and that the figures can hardly be taken as indicating with any degree of precision how much brighter one or other of the lights was on any particular occasion. This would probably be admitted by all who have any acquaintance with actual photometric measurements, and who therefore know how difficult it is to form any reliable judgment of the relative illumination of two surfaces, even when these surfaces are actually in contact, excepting the relation of equality. In the case of the experimental lights the comparison must have been rendered still more difficult by the fact that what was to be compared was not the comparative illumination of two moderately bright surfaces in close proximity, but the comparative brilliancy of two lights at some distance from each other, their very brightness adding to the difficulty.

Still these estimations are manifestly valuable as setting forth in a clear and unmistakable form that, to the average observer, a particular light appeared the most brilliant; and such seems to have been the way in which they were regarded by the Committee, for on page 21 they state "it will be evident that by mere eye-measurement proportions can only be approximately determined, although the order of superiority may be accepted as proved."

The results of these determinations are set forth in four tables, from which it appears that in clear weather, and in weather that, although not absolutely clear, was not very foggy, there was no question as to the absolute superiority of the electric light over both its competitors, the electric light in the single form having a superiority of more than 30 per cent. assigned to it, as over gas, or oil, in their highest powers (*i.e.* quadriform for gas, and triform for oil); the large-sized gas-burner, with 108 jets, appears to have been slightly superior to the six-wick oil-burner, and consequently the quadriform gas to the triform oil.

The eye-observations of the second kind, those in which the distances at which the lights were visible in foggy weather were recorded, gave much the same result: that the electric light penetrated through the fog to the greatest distance, and that the oil and the gas were about equal in their penetrating power.

These observations also showed that in the case of the electricity the best result was obtained when the currents produced by two or even three machines were sent through a single lamp, and not when each of the lamps was worked by its own special current.

The photometric measurements were carried out by Mr. Dixon, Mr. Harcourt's pentane flame being used as the standard. As is well known, Mr. Harcourt's standard is an air-gas flame which, unlike the so-called standard candles still commonly used for photometric purposes, is not subject to irregular variations in its light-producing powers. Part II. of the Report contains a full account of the standard flame, and the two arrangements for producing it, both of which were in use at the South Foreland. In Mr. Harcourt's original arrangement the air-gas was made and stored in a gas-holder by causing a volume of pentane to diffuse into a known volume of air, and then burning the mixture under certain definite conditions which could be accurately produced at all times. The conditions were such that the flame emitted the same amount of light as an average sperm candle burning under the conditions laid down in the Acts of Parliament which control the quality of the metropolitan gas supply, an amount of light which may differ considerably from that emitted by any single candle.

Mr. Harcourt's pentane lamp was also used; in this arrangement the air-gas is produced as it is required. The lamp is very simple in construction, and the flame is just as constant as in the older form, and as easily regulated, whilst, unlike the older form, the lamp is extremely portable, the whole apparatus not occupying much more space than a packet of candles.

Two kinds of photometer were used: a bar-photometer with a Leeson star disk, and Mr. Harcourt's table-photometer. The latter is a variety of shadow-photometer, and possesses two special advantages:—(1) In common with all shadow-photometers the two sources of light are on the same side of the illuminated surface, and therefore there is less risk of the results being rendered untrustworthy by diffused or accidentally reflected light than when, as in the more commonly employed arrangements, the sources of light are on opposite sides. (2) The comparison being made by altering the size of the flames, and not their distance, the two portions of the illuminated surface do not alter their relative position, and are always in that which is most favourable for comparison, accurate juxtaposition. The difference in colour between the arc light and the pentane rendered it impossible to employ the shadow-photometer for the estimation of the electric light. For these measurements a Leeson star disk was employed, and it was found that reliable measurements could be obtained by placing the disk between the two lights and moving it to and fro until the pattern of the star was equally distinct on either side, although on the two sides the colours of the pattern and the background were reversed.

There was so little difference between the colour of the gas and oil flames and that of the pentane flame, that in the case of these two illuminants measurements could be made both with the star disk and with the shadow-photometer.

Comparisons were made in the photometric shed of the light emitted by the De Meritens electric lamp; the Wigham gas-burners with different numbers of jets up to the maximum of 108; the Douglass Argand gas-burner; the Sugg gas-burner; and the Siemens regenerative gas-burner; and also the six- and seven-wick Douglass oil-burners.

The amount of light emitted by each of the experimental lighthouses was also determined, the observations being made in the huts which had been erected for this purpose at different distances from the towers. At the hut nearest to the towers the light from all the burners could be compared directly with the pentane lamp giving the light of one candle, but at the second hut only the electric light and the higher powers of the gas and oil lights could be directly compared with the pentane lamp; the single gas and oil lights had to be condensed by a lens before accurate measurements of them could be taken; an achromatic lens, lent by the Astronomer-Royal, was used for this purpose. The fraction of the light lost by the absorption and reflection of the lens was experimentally determined and allowed for in the observation.

The general result of a very large number of observations appears to have been that there is but little to choose between oil and gas as far as their illuminating powers are concerned, and that electricity is greatly superior to both.

The experiments brought out one fact of great practical as well as scientific interest—that remarkable changes in the transparency of the air occur without any visible haze or mist. To quote Mr. Dixon's words:—"Invisible clouds seemed to float by, obscuring the lights for a time as they passed across our line of vision. Sometimes the French lights at Calais and Cape Grisnez showed brilliantly, when the photometer at Hut 2 proved that the lights from the experimental towers, only a mile and a quarter away, had lost one-fourth to one-third their power."

With a view of further investigating the fog-penetrating powers of these different lights, the photometer shed was filled with an artificial steam-fog, by means of a pipe brought from the boiler of the engine-house, and the 108-jet Wigham gas-burner, and an electric arc fed by one machine, were pitted against each other, and the distances from which the lights could be seen determined. In all cases the electric arc became visible before the gas flame, as the observers walked up the shed towards the lights, confirming the other eye-observations which have been already mentioned.

The experiments showed also that the electric light suffered a greater proportional loss than either of the two other illuminants when passing through fog or haze, but that, owing to its far greater initial intensity, it nevertheless exceeded the other lights in its penetrating power.

The Committee add to their Report some account of the cost of the three illuminants, from which it appears that there is but little difference in the first cost of the electric and gas systems, the latter being slightly the more costly; but, on the other hand, the annual cost of the gas is estimated at rather less than that of the electricity. The cost of the mineral-oil apparatus is estimated, both for its installation and for its annual maintenance, at about two-thirds that of either gas or electricity.

The general conclusions arrived at by the Committee—conclusions which seem fully borne out by the evidence set forth in the Report—are, that the "electric light, as exhibited in the experimental tower at South Foreland, has proved to be the most powerful light under all conditions of weather, and to have the greatest penetrative power in fog;" that for all practical purposes the gas and oil were equal; and "that for the ordinary necessities of lighthouse illumination, mineral oil is the most suitable and economical illuminant, and that for salient headlands, important landfalls, and places where a very powerful light is required, electricity offers the greatest advantages."

GEOGRAPHICAL EDUCATION

THE Council of the Royal Geographical Society have been making a determined effort during the past eighteen months to improve the position of geography in the education of this country, with special reference to the higher schools and universities. They have collected information as to the position of the subject and the methods used in teaching it in the schools and universities of the leading Continental countries as well as in England, and published the results in the form of a Report, which has attracted considerable attention, and is likely to lead to useful results. In connection with this inquiry the Society has arranged an Exhibition of Appliances in use in Geographical Education at the rooms, 53, Great Marlborough Street, which, since it was opened in the beginning of December, has attracted many visitors of the class for whose special benefit it was intended. Already there are signs that this Exhibition will do real good in at least leading to the multiplication and improvement of the meagre appliances in use in English schools. Nothing could show more strikingly the marked difference in the variety and quality of these appliances in use in English and in Continental schools.

The catalogue of the Exhibition covers 80 large octavo pages. It is arranged in eight divisions—wall-maps, globes, telluria, planetaria, &c., models and relief-maps, geographical and ethnological pictures, atlases, text-books, miscellaneous. Upwards of 200 wall-maps are shown, while about 100 more have not been hung for want of space. All the leading types of this kind of work are represented on the walls. They are arranged geographically—maps of the world, of Europe, and parts of Europe, and so on. The object aimed at in hanging the maps has been to bring side by side those of the same region by different publishers and in use in different countries, so that visitors may compare the results for themselves. Some of the English work thus shown is certainly good—accurate, carefully executed, and fairly well adapted for its purpose, especially the maps of Stanford and Keith Johnston. The Exhibition, it should be remembered, is purely educational, and therefore the finest cartographical work of our best publishers and our Ordnance Survey must not be looked for; some of this work will compare favourably with the best work of other countries. As a whole, it must be admitted, that English school-maps are far behind those of the leading Continental countries, notably Germany, Austria, Switzerland, and even Italy. We do not seem to be guided by any definite principles in the construction of such maps; our teachers, as a rule, have never seen good school-maps, and the best English cartographers seem to think such work beneath them. We in England seem to cherish the pernicious idea that a school-map should be something quite different in kind from an ordinary map of the best class. In the Continental countries mentioned above, on the other hand, it is recognised that in the case of young people, even more than with men and women, only the very best work should be used, for first impressions are everything. In elementary wall-maps, of course, the minute details of the finest hill-shading and other features would be out of place, but the style and method of the work should be the same, only more generalised. For example, in Austrian schools, maps produced by photography from reliefs are absolutely forbidden on account of the exaggerated impression which they convey. The reliefs are almost necessarily exaggerated in such cases, and the light thrown on them from a particular direction to give picturesque effect; the result as a rule being a misrepresentation of the real configuration of the ground. Maps which attempt to indicate physical features by the use of variety of colour are but little used on the Continent. They do not appeal at all to the eye or help the imagination of the child, and are of no use in helping him to read maps executed in the usual way, which are the maps he must deal with when he grows up to be a man. The use of colour for special features is certainly useful, but then only in advanced classes. For the younger classes in Continental schools one does find it, but almost invariably conjoined with graphic mountain-shading. In the best maps, moreover, when the method is used, often only one, generally not more than two, colours are introduced: green for the lowest levels, tints of brown for the higher levels. In Kiepert's maps, brown alone, in deepening tints according to altitude, is used, just as blue is used after a similar fashion to indicate the varying depths of the sea. And this reminds us of the common practice in the best Continental schools, of always having two maps of the same region for teaching-purposes—one physical and the other political. On the former, always without names and political indications, the physical features are everything, and are boldly brought out; in the latter the physical features are still clear and prominent, but are accompanied by what are known as "political" features. In England one map has usually to serve not only for all grades of classes, but for both physical and political teaching: and as in our best school-maps the physical features are faint and obscured by the glaring colours used for political divisions, they are almost hidden when covered with names and other details.

In the matter of outward appearance, even, our school-maps leave room for great improvement. They, as a whole, cannot be compared as to taste and style with the best Continental maps. The finest of these are either not coloured at all, or the colours are put on faintly and delicately to show political divisions; often only boundary lines are coloured, so that the physical features, which have so much to do with political development, are well shown. The taste of our teachers and map-makers in this matter requires radical reformation; the more glaring and vivid the colouring of wall-maps, the more popular they seem to be. They are enough to ruin the taste of pupils. As examples of what school-maps should be, those of the district of Graz, of the Canton of Zürich, of Switzerland, by Ziegler; of the Alpine countries, by von Haardt, and the same region by Randegger, may be taken as examples in various grades, from the elementary stage upwards. Only the best work should be placed before the pupil from the beginning. There is certainly one good English specimen,—a map of the district around Bradford, by a Bradford teacher, for local geography. The scale is two inches to a mile; there is no overcrowding, and the physical features are bold, careful, accurate, and tasteful, after the best manner of hill-shading. These ought to be the characteristics of all school-maps, which ought to be a picture that the eye of the pupil can at once understand. The elementary principles of hill-shading are easily learned—a few hours' teaching would do; without it, how can the pupil be expected to read his map? It is almost better to have no names on elementary maps; the children should be taught to look for things, not words; the teacher ought to be able to give all the names needed.

Of course, school-maps, especially for the elementary stages, should not be crowded with names and symbols, while at the same time they should be of a character that will lead up to the understanding of the best staff-maps. It is evident from the detailed and beautiful maps from Germany, Austria, and Switzerland, that geography is carried to a much higher stage in these countries than in England. Our maps seem mainly intended to answer the common English conception of geography, that of mere memory-work; the maps without names are "test-maps" to test the memory of the pupils, not physical maps, on which no names should be. Now that local geography is made the starting-point in elementary schools, we want a thoroughly good series of large county maps, with few names, but with the physical features, not in too great detail, but executed with as much care and precision as on a staff map. Local maps ought to be done by teachers themselves, as in the case of the Bradford map referred to. There are several exhibits by London Board-school teachers, creditable to their zeal and industry, but indicative of their want of enlightenment more than of anything else.

One of the best means to teach the pupil to understand a map is to train him to draw maps for himself, either from a model, or, better still, from nature. This is done, we are glad to say, in several schools in this country, notably in Gordon's College, Aberdeen; several specimens of the work thus done in the latter school are shown in the Exhibition. The map must always be the mainstay both of the geographer, of the teacher, and of the pupil, and therefore every means should be taken to train the eye and the understanding to read it as if it were a book. If this Exhibition enlightens our teachers as to the value and characteristics of really good maps, it will have accomplished much.

One of the most striking features of the Exhibition is the number of reliefs of various kinds, from the large model down to the relief-atlas. The finest relief is without doubt that of the Monte Rosa group from Zürich. Here the vertical and horizontal scales are the same; the region embraced is comparatively small, and the scale large—1 : 150,000. The relief itself is by Prof. Imfeld, an eminent Swiss engineer, while the colouring, according to nature, is, we believe, by Prof. Heim, the geologist. For teaching-purposes, for physical geography, its value is great; unfortunately its price is a bar to its general use. The reliefs of a glacier and of a volcanic island are, however, cheap enough, and should be in every school. The model, by Mr. Jordan, showing the contours of the ocean bed around our shores, is also most instructive, though the exaggeration is great—28 times. It has been constructed for the Science and Art Department. Of relief-maps the finest are no doubt the three sections of the Central and Eastern Alps, by Col. Cherubini, in which the vertical scale is only exaggerated twice that of the horizontal. Mdlle. Kleinhans's relief-maps of Europe and France are also fine specimens of such work. There are also German, Italian, and English relief-maps of small size, in which the vertical scale is enormously exaggerated, and which therefore, if used at all, must be used with great caution. Good reliefs are in themselves of great service in giving the pupils a vivid notion of the appearance of a region; but one of their chief uses, in our estimation, is in enabling the pupil to understand the meaning of a map. Therefore besides every relief there ought to be a map of the same region, the one being used to interpret the other. There are several so-called ideal reliefs in the collection, some of them by English Board-school teachers, in which every salient feature on the earth's surface is brought together within an area of a few inches. Such productions ought to be discouraged. Much better to make reliefs of real landscapes, say of the Isle of Wight, or of a limited area around a school; such, for example, as that of the region around Rochester or Kent, by a master in one of the schools there.

One of the most novel features in the Exhibition is the collection of geographical pictures. There are several series of them, the finest, no doubt, being that published by Hölzel, of Vienna, which, in about thirty wall-pictures, shows some of the most characteristic and typical landscapes in various parts of the world. Such pictures add greatly to the living interest, as well as to the instruction, of a lesson in geography. They must above all things be accurate, and therefore large photographs are to be preferred as models to pictures from a purely artistic standpoint. Indeed, photographs themselves, on a large scale, make excellent pictures for geographical purposes, such as those of the Yosemité Valley in the Exhibition, or the well-known photographs of the Alps by Mr. Donkin. Equally serviceable is the series of twelve typical life-size heads of races, edited by Prof. Kirchhoff, of Halle, and sold at a very cheap rate. There are also several pictures of groups of peoples in their native surroundings, some of which are very good.

The Exhibition also contains a considerable collection of globes, including slate globes of various sizes, which we think can be made of great service in the hands of a good teacher. The telluria are mostly of the well-known kind—complicated, and easily put out of order. The simpler such apparatus are, the better; children are apt to contract misleading and erroneous ideas from such things—ideas difficult to eradicate. One of the simplest is exhibited by Stanford: a glass globe with a candle for the sun, with only the earth and moon at the end of the arm. Some means should always be taken to counteract the misleading impressions as to scale conveyed by such instruments; and for this purpose an idea has been borrowed from the arrangement in the Jermyn Street Museum, showing the relative sizes and distances of the sun and planets. A yellow disk, about 6 inches in diameter, is fixed on the wall of one of the rooms, to represent the sun; and 56 feet away are two pellets of wax, $1\frac{1}{2}$ inch apart—one, 1/20 of an inch in diameter, to represent the earth; and the other, 1/60 of an inch, to represent the moon. The whole arrangement is intended to show what would be the relative sizes of sun, earth, and moon, if these were reduced to a scale commensurate with a distance of 56 feet.

Another interesting exhibit is a section of the contrivance devised by Prof. G. H. Darwin, on which he read a paper to the Royal Society some years ago, intended to give a truer representation of the globe than an ordinary projection. It consists of a figure formed of twenty hexagons and twelve pentagons, the projection on which is but very slightly distorted. Of much historical and antiquarian interest are the two large Mollineux globes from the library of the Inner Temple, made in the time of Queen Elizabeth.

There are about 200 atlases shown, like the wall-maps, from various countries—England, Germany, France, Austria, Belgium, Holland, Italy, Switzerland, Denmark, Sweden. Even more than in the wall-maps does the superiority of Continental work to English work come out in these publications. Many of these cheap foreign school-atlases contain some of the finest cartographical work: such as Wettstein's atlas, published in Zürich for about half-a-crown, with about thirty maps of perfect finish. In this, as in some other foreign atlases, are one or two sheets intended to give the pupil an elementary idea of the principal symbols used in cartography—notably of hill-shading. With such a knowledge the pupil will see far more in a really good map than otherwise he could possibly see. Accuracy, beauty, and adaptability to their special purposes are far more frequent characteristics of Continental school-atlases and wall-maps than of English.

Of text-books there are some two or three hundred from all the countries already named, including a few from America. The vice of English text-books is the prominence given to mere memory-work, and the absence of any attempt to show the relations between physical and political geography. Of physical geographies and physiographies we have a few that are not surpassed by those of any country. It is the general text-book that is put together with so little skill and knowledge. In this department foreign countries show far more unsatisfactory work than in the case of maps. Some of the best Continental text-books, especially German, are small, such as that of Kirchhoff, used in all classes of German schools, and in which mere memory-work is reduced to a minimum. In Germany, and indeed in most of the Continental countries represented, the teacher is of far more importance than the text-book, and is to a large extent independent of it; in England everything must be put into the text-book, for few of our teachers know anything of the subject. It is a mistake altogether to write text-books for the youngest classes, those in which elementary notions and local geography are taught; these should depend entirely on the living voice of the teacher, with black-board, compass, simple reliefs, and pictures.

Such are a few of the exhibits brought together in this very useful Exhibition; there can be no doubt that the many teachers who have visited it will have learned a few useful lessons; we hope, for one thing, they will be more exacting as to the character of the maps and other appliances supplied by publishers.

A series of lectures has been arranged in connection with the Exhibition, which so far have been well attended, and been followed by useful discussions. In December two lectures were given, one on the aims and methods of geographical education, the other on appliances. Last Tuesday Mr. Bryce lectured on the historical bearings of geographical education, and next Tuesday Prof. Moseley lectures on its scientific bearings, with Sir Joseph Hooker in the chair. On Saturday next a Conference will be held, in which the whole subject of the position of geographical education will be discussed, with special reference to its place in examinations; Sir Beauchamp Walker, ex-Director of Military Education, will preside at the Conference.

HUNTER'S HOUSE

THE three subjoined drawings are very faithful delineations of some of the portions of John Hunter's house and grounds, at Earl's Court, to which I drew attention in NATURE for Jan. 7. The first drawing supplies the view of the house looking into the meadow, in which view the house is, I believe, nearly the same as it was when Hunter lived in it. The second sketch is that of the Lions' House, or den, situated at the end of the

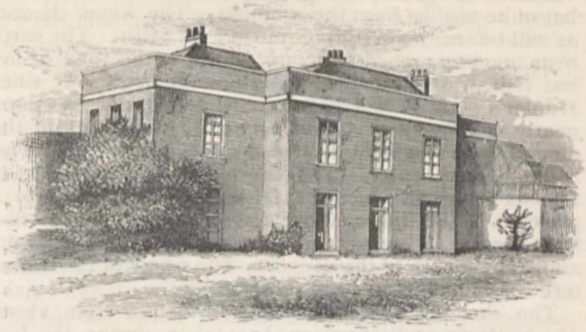

FIG. 1.—Hunter's House. From the meadow.

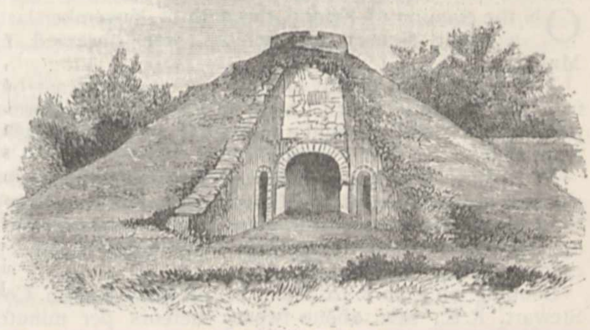

FIG. 2.—The Lions' House.

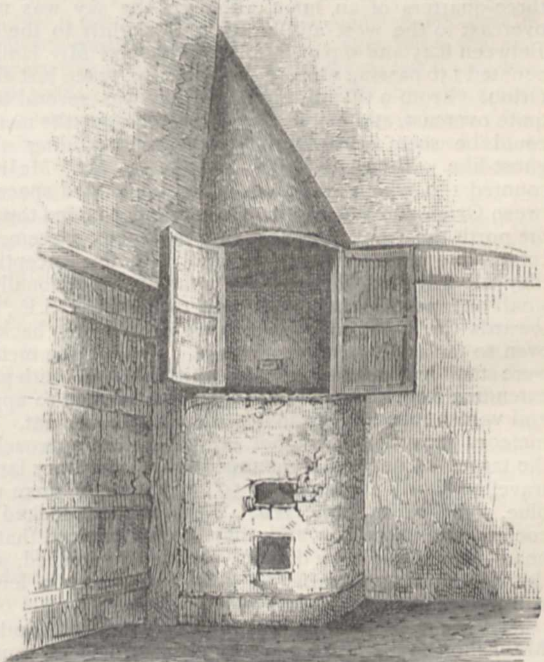

FIG. 3.—The Copper.

meadow at the back and to the right of the house, but quite visible from the windows. The Lions' House, as will be seen, is a raised mound of earth. The earth rests upon an arched structure, which, at the time of my last visit, was in excellent condition, although ever since Hunter's time it has been a cow-house, and has done nearly a century of useful service. At the top of the mound there is a little wall, of a circular shape, inclosing a small open space. The third sketch illustrates the famous copper in which the Irish giant was boiled to a skeleton. The space above the copper up to the flue from the roof is covered in, but two doors open in front above the mouth of the copper. The whole of this structure has remained in good preservation.

The sketches are selected for NATURE from views which Bertram Richardson has taken during the last autumn, as part of a series of homes and birthplaces of illustrious men. B. W. RICHARDSON

THE METEOR SHOWER AT THE MAURITIUS

ON the evening of Friday, the 27th of November last, a great shower of meteors was observed at Mauritius.

The weather was cloudy and the sky often overcast, but from the accounts which I have received from different parts of the island it would appear that the shower lasted from at least 7 p.m. till midnight.

At Reduit, about 900 feet above the sea-level, where the sky was clearer than at the Observatory, His Excellency Sir J. Pope Hennessey, saw many bright meteors, which at first appeared to travel from N.W. to S.W., and a crackling noise was heard.

Looking on from 8 to 8.30 p.m. at Beau Bassin, Col. Stewart, R.E., saw about twenty meteors per minute, apparently travelling from N.W. to S.W.

About 7 p.m. several members of the Rev. Mr. McIrvine's family, happening to turn their faces towards the north, immediately observed a number of bright meteors, and in a short time they counted 200. Later on, Mr. McIrvine and two other observers counted 700 in three-quarters of an hour, although the sky was much overcast to the west and north and slightly to the east. Between 8.45 and 9 p.m. Mr. McIrvine and Mr. Hollway counted 150 passing along a narrow clear space just above Orion. From 9 till midnight the sky was several times quite overcast, and as the clouds cleared away the meteors could be seen faintly through the mist, gliding along ghost-like. Between 11.34 and 11.50 Mr. McIrvine counted 160, which appeared in an unclouded space between Orion and the zenith. The sky was clouded towards the north the whole evening, and the meteors seemed to come from under that cloud, and, with few exceptions, they all travelled towards the south. Occasionally, a small one, needle-like, darted now towards the S.E., now towards the S.W., but none were seen going back, or even so far aside as east or west. Most of the meteors were small and needle-like, of a whitish colour, with paths extending from 5° to 40°, although some seemed to appear and vanish instantly without perceptible movement. The meteors moved quickly, not unlike arrows approaching the target in an archery competition. The very largest travelled slowly across 30° to 50°, and some of them were blue, some white, some red. Many of them looked like comets, and every now and then it was noticed that the head—which was very distinct—suddenly vanished, while the double-winged train (20° to 40°, or more, in length) still moved on.

At Vacoas, at an altitude of nearly 1300 feet, the Hon. Mr. Elliott first saw the meteors at 7.15, and he counted 791 from 8.35 to 9.15. The principal direction seemed to be from N.N.E. to S.S.W. The most brilliant passed near Venus.

In the same part of the island, Mr. Freeland observed a great many meteors between 10.15 and 11.30. The shower was not constant, but at short intervals, and the meteors travelled from north to south.

At the Observatory, in the northern part of the island, the weather was cloudy, and the sky generally entirely overcast. At 8.20 p.m. several meteors were seen coming from the northward. Between 9.1 and 9.9 Mr. Bell and myself, with two other observers, counted not less than 204, though the greater part of the sky was overcast, and not less than 173 between 9.9 and 9.16. Between 9.26 and 10.40, the sky was completely overcast. From 10.40 to 10.50 glimpses of Aries, Taurus, and Orion were got, and in that interval six large meteors with long trains passed towards the south-eastward between α Arietis and the Pleiades, and three more between 0.30 and 0.40 a.m. The sky then began to clear up towards the N.W. and north, and I kept up watch till 1.15 a.m., but no more meteors were seen.

I did not see the similar shower that was observed here in 1872; but from what I saw between 9.1 and 9.16 p.m on the 27th of November last, during which time Andromeda, Aries, Taurus, Orion, &c., were visible, it is certain that the radiant-point was near γ Andromedæ, or that there was a radiant-space around that star.

The meteors shot to the southward, south-eastward, and south-westward, some of the largest with trains of 20° to 40° in length, disappearing to the southward behind the Port Louis and Pieterboth mountains, and others bursting with great brilliancy near Venus, Fomalhaut, α Gruis, &c.

On referring to the account given of the shower of November 27, 1872, by Mr. C. Bruce and Mr. Ed. Newton, it would appear that the radiant-point was the same on both occasions, or very nearly so, but that the maximum intensity of the shower was earlier this year than in 1872. C. MELDRUM

Mauritius, December 22, 1885

NOTES

THE meeting of the British Association to be held at Birmingham, beginning on Wednesday, September 1, will derive more than usual interest and importance from the exhibition of local manufactures which is to be held in connection with it. The Exhibition will be on a very much larger scale and of a much more popular and attractive character than has ever been attempted before. It is to be an Exhibition illustrative of products and processes connected with the manufacturing districts of Birmingham and the surrounding district within a radius of fifteen miles, which will include the whole of the Black Country, the nail district, and other towns where manufactures are carried on. The Exhibition will be on a very complete scale, and will embrace as nearly as possible all the industries of the district, which will include the following:—Engineering, hardware, heating and lighting, arms and ammunition, jewelry, glass and pottery, stationery, leather, furniture and decoration, and a miscellaneous class, including scientific and musical instruments. The special feature of the undertaking will be that in every trade represented processes will be either completely shown or fully indicated. Workmen will be seen engaged in carrying out most interesting or difficult operations connected with various industries. The Exhibition will be opened on August 26, and close on October 1, three weeks after the termination of the visit of the Association.

A PROJECT has been started in Berlin to establish there an Anthropological Exhibition, which will do with regard to the races of men what zoological gardens do with regard to animals. In the Exhibition or garden it is intended that representatives of various races shall permanently reside, while of such races as cannot stand the cold of the climate representatives will be brought to Germany to reside there during the summer. An

Ethnological Museum is to be established in connection with the Exhibition, which is said to have the support of several capitalists. Possibly the recent success in Berlin and London of Japanese and Indian villages has led to this project, which, however, is a far more difficult undertaking, but which, if carried out, would prove of great public interest. A good many years ago, at the Crystal Palace, an attempt to represent various peoples and their habits by means of models was commenced, but it was never carried very far. Some of these models are still to be seen at the south-west corner of the main building.

THE annual meeting of the Association for the Improvement of Geometrical Teaching was held at University College, Gower Street, on Friday, January 15, when certain additions to the rules were carried and twenty new members (including three honorary members) were elected. At the afternoon sitting, the President (R. B. Hayward, F.R.S., Harrow) read a paper on the "Correlation of the Different Branches of Elementary Mathematics." A discussion on the paper was commenced by the Rev. G. Richardson (Winchester), in which the Chairman (R. Levett, Birmingham), Profs. Carey Foster, Hudson, and Minchin, Messrs. A. J. Ellis, Heppel, Walters (Dover College), and the Rev. J. B. Lock (late of Eton) took part. We hope to notice the paper when the Report of the Association has been printed.

ON December 31 last, Mr. G. J. Symons completed the twenty-fifth year of his work in connection with "British Rainfall," and it has been thought a good opportunity for presenting him with a pecuniary testimonial, to which all observers of rainfall are invited to subscribe. The Committee have already published a first list of subscribers, and as they are anxious to present Mr. Symons with the testimonial as early in the year as possible, all observers who intend to subscribe are requested to communicate with the treasurer, Rev. Clifford Malden, St. Lawrence Rectory, near Ventnor, Isle of Wight.

As examples of tropical rainfall, it may interest our readers to learn that during the present rainy season in Jamaica, which has succeeded a period of serious drought, there was recorded at the Government Cinchona Plantations on December 21 last a fall of 11·80 inches in twenty-four hours, while the gauge, the readings of which are taken at 7 a.m. daily, was full and overflowing. On the crest of the Blue Mountain range, on the same plantations, the record was 31·50 inches for one week, of which period three days were fine.

THE following alteration has been made in the arrangements for the Friday evening meetings at the Royal Institution before Easter:—Prof. W. H. Flower, F.R.S., will give a discourse on Friday, February 19, on "The Wings of Birds," instead of Prof. W. K. Parker, F.R.S., on "Birds, their Structure, Classification, and Origin."

THE thirty-ninth annual general meeting of the Institution of Mechanical Engineers will be held on Thursday, February 4, and Friday, February 5, at 25, Great George Street, Westminster. The chair will be taken by the President, Mr. Jeremiah Head, at 7.30 p.m. on each evening. The following papers will be read and discussed, as far as time permits:—Description of an autographic test-recording apparatus, by Mr. J. Hartley Wicksteed, of Leeds; description of tensile tests of iron and steel bars, by the late Mr. Peter D. Bennett, of Tipton; description of a hydraulic buffer-stop for railways, by Mr. Alfred A. Langley, of Derby; on the distribution of the wheel load in cycles, by Mr. J. Alfred Griffiths, of Coventry.

THE Council of the Society of Telegraph Engineers and Electricians are at present engaged in considering a proposal brought before them by Prof. J. A. Fleming, and having for its object the establishment of a National Electric Standardising Laboratory.

THE third Electrical Exhibition at St. Petersburg was opened on January 1 by Prince Michael Nikolaievitch. It is held in the buildings of the Pedagogical Museum, and is said to be the largest ever held. The telephonic department forms a special attraction.

A GERMAN edition of Prof. R. S. Ball's researches on "Theoretical Dynamics" is in the press. The volume will contain the "Theory of Screws," published in 1876, and the papers subsequently read to the Royal Irish Academy. The whole has been edited and translated by Dr. Harry Gravelius, of Berlin, who has occasionally added developments necessary for continuity and completeness.

A PROPOSITION has been made in Ceylon for the systematic observation of the singular migration of butterflies in that island. Despite occasional references in the local press, nothing has yet been done towards compiling and editing a scientific and comprehensive record of annual observations. It is proposed therefore that volunteers should watch for the migration, and send a postcard bulletin to the editor of the records, noticing date, direction of flight, direction of wind, the weather, and the species. For the last purpose amateur observers are to send one specimen of each species noticed, in order to insure scientific accuracy. A competent naturalist is stated to have offered to revise, assort, and edit all such notices once or twice a year, and publish a periodical report of progress. The annual summary will appear in the *Taprobanian Magazine*, the first number of which we recently noticed.

WITH the great spread of education throughout England during the past sixteen years it is extraordinary how little here compared with the United States the work of the schools has been supplemented by those "universities of the people," free libraries. No doubt the costliness of working one in a community where the produce of the penny rate does not amount to 500*l.* a year is a great difficulty, as such a sum is absorbed in the ordinary working expenses of rent, attendance, gas, and newspapers. We would call attention to the success of a method of supplementing an insufficient income clearly shown by a catalogue we have received from the Coventry Free Library. For many years its rate brought in little more than paid the above expenses. A club was then established consisting at first of a few assiduous readers who selected their books, kept them for their own use for six months, and then sold them to the Free Library at one quarter of published price. To the club the advantages were that the Free Library, open at all hours, being their depot, they had scarcely any working expenses, the books all remained permanently within their reach, and yet, instead of having to purchase at the end of the year books which they did not want, one-third of the amount of their subscription was returned to them for further purchases of books. The advantage to the Library is shown by the present catalogue, from which we learn that the still-increasing list of members has now reached 172, and, accordingly, that it is passing more than 1200 works yearly into the Library at an expense of over 200*l.* per annum. There is an increase of over 11,000 works in the Library since the last catalogue was printed; and a larger proportion of them than usual in a Free Library are high-class and costly books derived from this source, which must make the Library the resort of the most studious and best educated readers of the city.

IN the last number of *Naturen*, Herr Karl Hesselberg closes his series of interesting papers on the climate of Norway. The small number of systematically organised meteorological stations in the country has necessarily interfered with the acquisition of all the data required to formulate a comprehensive and scientific theory of the Norwegian climate. As a contribution, however, to our meteorological knowledge, the author's numerous tables of the frequency and periodicity of certain weather phenomena in various parts of the country are of considerable value, while special and novel interest attaches to his observations of various anomalous meteorological conditions, such, for instance, as the occurrence of a maximum rainfall at points far inland and unconnected with the sea, which he refers to the influence of cyclonic agencies.

M. PAUL BERT, who has been gazetted Resident-General in Tonquin and Annam, has been interviewed by several correspondents, and has written articles indicating that he will endeavour to promote the interests of science. He is desirous of establishing a "Tonquin Institute," some organisation similar to the Institut d'Égypte, which was created by Bonaparte in 1798. Although nothing definite has been stated, these declarations have created some sensation in the French scientific world.

MORE than usual seismic activity is reported from Central and South America. On the 18th ult. the town of Amatitlan, in Guatemala, was nearly destroyed by an earthquake, there being altogether 131 shocks. In other parts of Central America shocks of earthquake have occurred. It is reported from Guayaquil that symptoms of earthquake have been observed at Chimbo, in Ecuador, coincident with a renewed eruption of the volcano of Cotopaxi. The previous eruption of this mountain was lately referred to here. The Ecuador volcano, Tunqurqua, is in a state of violent eruption, being evidently, it is stated, in sympathy with Cotopaxi.

AN influential Committee has been formed for the purpose of raising a permanent record of Dr. Redwood's services to chemistry in its relation to medicine and pharmacy. It is proposed to found a "Redwood Scholarship" in connection with the Pharmaceutical Society, which has for more than half a century been the principal scene of Dr. Redwood's labours. Subscriptions should be sent to the Honorary Secretary, Prof. Dunstan, 17, Bloomsbury Square, London, W.C.

MR. LANGTON COLE, of Loughrigg, Sutton, Surrey, writes to the *Times* that a remarkable meteor was seen there on the 16th at 5.9 p.m. in bright twilight. Its apparent course, which was marked by a continuous and brilliant train, was from the zenith to a point due east, about 15° above the horizon. It was brighter than Venus, and the diameter of its head seemed about one-sixth of that of the moon. A Wimbledon correspondent also writes that he witnessed the fall of a meteorite, apparently a few miles east-north-east of Rickmansworth Church, at about 5.5 p.m. on the same day. The "nucleus" was comparatively small, and showed vividly the colours of the rainbow. The tail was not the long fleecy fiery thing one sometimes sees in such cases, but a well-defined oval, about the apparent size of the moon in her present phase, and as bright and creamy as molten silver.

THE fourth of Prof. Terrien de Lacouperie's course of lectures on Indo-Chinese philology will be delivered on Wednesday, the 27th inst., at University College. The subject will be "The Languages of Thibet and Burmah."

THE last number of the *Folk-Lore Journal* (vol. iii., part 4) contains some Chilian popular tales collected *vivâ voce* in the country, and translated by Mr. Moore. Rev. Walter Gregor, in a paper on "Some Folk-Lore of the Sea," describes the superstitions and sayings of the fishing population on the north-east coast of Scotland. Some of the former are very curious survivals; while other customs appear to have for their object the drinking of whisky at some one else's expense. Mr. Christopher Gardner, of the Consular Service in China, gives a number of Mongolian folk-tales, translated apparently from M. Potanin's work on North-Western Mongolia; and Dr. Morris continues his folk-tales of India, the present instalment being the most important contribution to the number.

WE regret to learn of the death of Mr. J. B. Jeaffreson, M.R.C.S., on the 12th inst. Till lately President of the Highbury Microscopical Society, he was well known in the North of London as a diligent worker with the microscope in biological research.

THE Berlin Academy of Sciences has granted 3000 marks (150*l.*) to Lieut. Quedenfeldt for an exploring tour to the Atlas Mountains. Lieut. Quedenfeldt will principally study the natural history of the district.

AT the forthcoming Indian and Colonial Exhibition it is intended not only to display turtles in tanks, but to hatch them from the ova. It is exceedingly interesting to watch the manœuvres of the infant turtles on being liberated from the ova, and this is sure to prove one of the sights of the Exhibition. A spacious conservatory is being specially erected for the purpose, in which the turtles will be surrounded by every detail of their natural existence.

A STRIKING evidence of the fertility of the sea-trout (*S. trutta*) has been revealed at the South Kensington Aquarium, where several have been artificially spawned with great success. We believe this is the first time on record that this species has been made to yield ova under similar circumstances. The fish in question had been kept in captivity with other species of Salmonidæ for three years, and therefore had never visited the sea, as is their wont, but notwithstanding the check thus placed upon their natural instincts, their condition has not been in the least impaired, neither have their productive functions become disorganised. The operations of the inhabitants of the Salmonidæ tank at the Aquarium are very interesting to watch at this season of the year, especially the manner in which the fish pair with opposite species—for instance, the fontinalis with the common trout, the sea-trout with the *Gilleroo* trout, &c. In captivity, fish yield their ova much later than they do when in a wild state; but of every thirty subjected to artificial existence there is, upon an average, only one barren fish amongst them.

AT the Lochbuy Fishery, Isle of Mull, the property of the Maclaine of Lochbuy, large quantities of ova of salmon and sea-trout are being incubated, consignments having been imported from abroad. The extensive waters on the Lochbuy estate, which were formerly destitute of fish, now teem with life, the result of systematic pisciculture. The proprietor has been most successful in spawning from the fish captured in the rivers of the property.

THE papers in the last number (No. 3) of the *Proceedings* of the Chester Society of Natural Science are of a more than usually high order, which is not surprising when the names of some of the authors appear. Prof. McKenny Hughes has a paper, with elaborate illustrations, on the geology of the Vale of Clwyd; Mr. Aubrey Strahan writes on the denudations of North Wales; while Prof. Judd suggests as a problem for Cheshire geologists the investigation of a patch of secondary strata between Audlem and Wem, not far from Chester,—the points suggested are the exact extent and limits of this outlier, the relations of the Lias to the surrounding strata, and the nature, thickness, and fossil contents of the strata of which it is composed. A committee of of the Society has been appointed to examine into the subject. Mr. Mackintosh describes certain traces of an interglacial land-surface near Crewe. Mr. Walker has three papers—one on the climatic causes affecting the distribution of Lepidoptera in Great Britain, the second on the Macrolepidoptera of the Chester district, which is a long and careful list; and his third paper is on the climate of the Chester district considered in its relation to fruit-growing. Dr. Stolberforth describes the special forms of microscopic life found by surface dredging in the estuary of the Dee. Mr. Ruddy gives a list of the Caradoc or Bala fossils found in the neighbourhood of Bala, and Mr. Siddall writes on the American waterweed (*Anacharis Alsinastrum*, Bab.), its structure and habit, and adds some notes on its introduction into this country, the causes affecting its rapid spread at first, and present apparent diminution. Mr. Shrubsole has three short papers—one a list of the land and freshwater shells of the Chester district, a second on the *Glauconome disticha* from the Bala beds at Glyn Ceiriog, and the third on the occurrence of *Calcisphæra* (Williamson) in the Eglwyseg rocks near Llangollen. It will be noticed that these fifteen papers, with two exceptions, refer solely to the district in which the Society works, and that they refer to its geology (including palæontology), meteorology, and several departments of its natural history. The Society is to be congratulated on the thoroughness and comprehensiveness of its work for the past year.

ACCORDING to the *Colonies and India* the Winnipeg Historical Society has suggested to the Canadian Government that a scientific investigation be made into the remarkable ancient mounds recently found in the Canadian North-West, and the suggestion has been warmly commended in the Canadian press. It is pointed out that these mounds are rapidly disappearing under the ploughshares of the farmer, and with them will go the best means of settling the problem whether the mound-builders crossed from Asia and passed down the river valley to the central portions of the continent, or whether their migrations were from south to north.

THE recent attempts to cultivate the tea-plant in the neighbourhood of Messina have been very successful. Similar experiments had been made some years ago without giving any satisfactory results.

AN International Exhibition, similar to that held at Antwerp last year, is planned by the city of Geneva for 1887.

THE Provincial Diet at Salzburg has issued a law interdicting the sale of Edelweiss-plants with roots. The Tyrol Diet has also asked for Government regulation of the trade in these plants.

MR. JAMES GRIEG, of the Museum of Bergen, informs *Naturen* that in the course of last summer a male specimen of *Palinurus vulgaris* was taken in a lobster pot at Manger. This, as far as is known, is the first time that this crustacean has appeared as far north as the Norwegian coasts.

THE following new books and new editions have been received by us since January 1:—"A Tangled Tale," by L. Carroll (Macmillan and Co.); "East Anglian Earthquake of 1884," by R. Meldola and W. White (Macmillan and Co.); "Osteology of the Mammalia," 3rd edition, by W. H. Flower (Macmillan and Co.); "A Brief Text-Book of Political Economy," by F. A. Walker (Macmillan and Co.); "A Treatise on Colours and Pigments," 2nd edition, by J. S. Taylor (Winsor and Newton); "Catalogue of the Coventry Free Library"; "Practical Bacteriology," by E. M. Crookshank (Lewis); "Key to Todhunter's Mensuration for Beginners," by the Rev. Fr. L. McCarthy (Macmillan and Co.); "Catalogue of Fossil Mammalia," British Museum, part 2, by R. Lydekker; "Geology," vol. i., by Prof. Prestwich (Clarendon Press); "Annuaire de l'Académie Royale de Belgique" (Hayez, Bruxelles); "The Rotifera; or, Wheel Animalcules," by Hudson and Gosse (Longmans); "Light," 4th edition, by Prof. Tyndall (Longmans); "Year-Book of Pharmacy, 1885" (Churchill).

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus* ♂) from India, presented by Messrs. Phillips Bros.; a Vervet Monkey (*Cercopithecus lalandii* ♂) from South Africa, presented by Mrs. Sinclair; a Ring-tailed Coati (*Nasua rufa* ♂) from South America, presented by Mr. C. E. Dashwood; a Northern Mocking Bird (*Mimus polyglottus*) from North America, presented by Mr. F. Green; a Jackal Buzzard (*Buteo jacal*) from South Africa, presented by the Rev. C. W. H. Reynolds; a Jay (*Garrulus glandarius*), British, presented by Mr. E. R. Collins; three Hoary Snakes (*Coronella cana*) from Constantia, South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; a White-throated Capuchin (*Cebus hypoleucus* ♀) from Central America, deposited; four Cirl Buntings (*Emberiza cirlus*), two Pied Wagtails (*Motacilla lugubris*), British, purchased; a Vulpine Phalanger (*Phalangista vulpina*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

COMET BROOKS.—Dr. H. Oppenheim has computed the following elements and ephemeris for Comet Brooks:—

$$T = 1885 \text{ Nov. } 24\cdot7806 \text{ Berlin M.T.}$$

$$\left.\begin{aligned} \pi &= 296^\circ\ 38'\ 45'' \\ \Omega &= 262\ \ 1\ 48 \\ i &= 42\ 25\ 11 \end{aligned}\right\} \text{Mean Eq. } 1886\cdot0.$$

$$\log q = 0\cdot03012$$

Error of the middle place (O – C).

$$d\lambda = -4'' \qquad d\beta = -2''$$

Ephemeris for Berlin Midnight

1886	App. R.A. h. m. s.	App. Decl. ° ′	Brightness
Jan. 22	21 35 11	+15 21·0	0·3115 ... 0·59
24	21 42 32	+16 7·0	
26	21 49 50	+16 51·9	0·3203 ... 0·54
28	21 57 4	+17 35·7	
30	22 4 14	+18 18·5	0·3295 ... 0·49

The brightness on December 28 is taken as unity.

This comet was independently discovered by Mr. E. E. Barnard, of Vanderbilt University, Nashville, Tennessee, on December 27, the night after its discovery by Mr. Brooks.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 JANUARY 24-30

(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 January 24

Sun rises, 7h. 52m.; souths, 12h. 12m. 22·5s.; sets, 16h. 33m.; decl. on meridian, 19° 9′ S.: Sidereal Time at Sunset, 0h. 49m.

Moon (at Last Quarter on Jan. 27) rises, 21h. 13m.*; souths, 3h. 39m.; sets, 9h. 53m.; decl. on meridian, 1° 53′ N.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	6 55	10 50	14 45	23 10 S.
Venus	8 39	14 17	19 55	5 5 S.
Mars	21 6*	3 35	10 4	5 9 N.
Jupiter	22 12*	4 11	10 10	1 4 S.
Saturn	13 45	21 55	6 5*	22 38 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Occultation of Star by the Moon

Jan.	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
24	B.A.C. 4043	6½	3 40	4 40	100 222

Jan.	h.	
24	18	Jupiter in conjunction with and 0° 17′ south of the Moon.
26	16	Venus stationary.
26	21	Mars stationary.
30	6	Mercury at greatest distance from the Sun.

Variable-Stars

Star	R.A.	Decl.		
	h. m.	° ′		h. m.
U Cephei	0 52·2	81 16 N.	Jan. 27,	23 21 *m*
λ Tauri	3 54·4	12 10 N.	,, 26,	4 21 *m*
			,, 29,	3 14 *m*
δ Libræ	14 54·9	8 4 S.	,, 29,	0 46 *m*
U Coronæ	15 13·6	32 4 N.	,, 26,	20 49 *m*
U Ophiuchi	17 10·8	1 20 N.	,, 24,	11 42 *m*
			and at intervals of	20 8
δ Cephei	22 24·9	57 50 N.	Jan. 28,	5 0 *m*
			,, 29,	19 0 *M*

M signifies maximum; *m* minimum.

Meteor Showers

One of the minor periodical showers with radiant at R.A. 135°, Decl. 40° N., shows a maximum during the present week. Occasionally large meteors are observed from this radiant. Meteors from a radiant about R.A. 180°, Decl. 35° N., should also be looked for.

GEOGRAPHICAL NOTES

M. DE WOGAN, who has been searching in a small canoe for the true source of the Danube, communicates the result in a recent *Bulletin* of the Paris Geographical Society (Nos. 19 and 20). The story that it takes its rise in the gardens of the Prince of Fürstenburg at Donaueschingen, where a monument recording the fact is erected, is, he says, a fable. The Danube, he has found, is formed by the union of two small streams, the Brig, or Brigach, which takes its rise at Saint-Georges, to the north of the Mountain Tryberg, at about a mile from the source of the Neckar, and the Breg, or Bregach, which rises at St. Martin, to the west of Tryberg, and twenty miles from Donaueschingen, where both streams unite. M. Wogan, who has explored these streams and their tributaries, criticises and corrects the statements of MM. Réclus and Saint-Martin in their geographical works on this subject. M. Charles Rabot, in the same *Bulletin* describes a journey made during the last autumn in the peninsula of Kola, in Russian Lapland, a region which is largely a blank on our maps. In August M. Rabot traversed the peninsula twice, from north to south, from the Arctic Ocean to the White Sea. He describes it as excessively monotonous, covered by forests, with many large lakes, or rather marshes. On the eastern shore of Lake Imandra there is a range of mountains, called Umbdek, which reaches an altitude of a thousand metres, and which is the highest elevation in European Russia, except the Caucasus. These are a picture of savage desolation. He has come to the conclusion that the western part of Russian Lapland is far from being flat, as generally represented on the maps. Between the White Sea and the ocean there are three ranges of mountains separated by large depressions covered with forests, marshes, and lakes. M. Rabot concludes with some observations on the inhabitants—Russian Lapps and Samoyedes.

MR. CYRIL HAVILAND, of Sydney, in a letter in the *Times*, points out how little is really known in a scientific sense, of the islands of the Southern Pacific and of parts of the Australian coasts. Eleven of Her Majesty's vessels are at present in Sydney; they cruise frequently in these seas, but, says Mr. Haviland, no one is any the wiser. He thinks that these ships, and others of the Royal Navy suited for the purpose, should, as far as possible, be utilised by placing on board one or more specialists in the various fields of science, with the appliances necessary to enable them to prosecute their researches. He says that had only one professed naturalist been borne on the books of the *Nelson* or the *Diomed* during their stay on the Australian station, much light might have been thrown on many problems, for the seas and islands abound with undiscovered species. The suggestion is certainly a good one, for there must be many occasions when good scientific work could be done in the vessels of our Navy without in the smallest degree interfering with the object of the cruise or the discipline of the ship. How much may be done in that way by an officer of scientific attainments even in the midst of his professional work, is shown by the instance of Dr. Guppy, whose numerous communications in our own columns and elsewhere have made his name well known in the world of science.

AMONGST the articles in the current number of the *Proceedings* of the Royal Geographical Society is one by Mr. Ravenstein on bathy-hypsographical maps, with special reference to a combination of the Ordnance and Admiralty Maps. The leading features of maps such as Mr. Ravenstein suggests are that all heights and depths would be referred to one and the same datum-level; the features of the ground would be shown by means of horizontal contours, which would enable the compiler to limit himself to the introduction of a comparatively small number of carefully-selected figures; the intervals between the contours would be tinted to bring out the relief of the ground; the line along which land and water meet at ordinary spring tides would be marked; the foreshore and all sand-banks which uncover would be clearly indicated as on ordinary Admiralty Charts; roads, railways, and other features calculated to obscure the physical features of the ground would be omitted. A physical outline map of this character could be utilised for illustrating the hydrographical, geological, and other features of the country. Another important paper is Mr. Delmar Morgan's translation of the notes of M. Kossiakof, the military topographer who accompanied Dr. Regel on his journey in 1882 in Karateghin and Darwaz, on the borders of Chinese Turkestan and Afghanistan.

A LONG letter has just been received from Mr. H. O. Forbes, who, it will be remembered, left England in the beginning of last year, for the exploration of the interior of New Guinea. Mr. Forbes arrived at Port Moresby on August 28 last, and on September 2 started for Sogeré, in the interior, to prospect. He had a pleasant trip, saw the lie of the land, and the people—taking to them and they to him—and returned to Port Moresby to pick up his men and his baggage to start for the Owen Stanley Range in true earnest. On October 1 Sogeré was reached again. Within a week houses were erected for Mr. Forbes, his white companions, his men, and his stores; and soon after everything had been brought from Port Moresby and housed. Returning to the Astrolabe Range with Mr. Hennessy, Mr. Forbes completed his survey. On his return to Sogeré he found everything in shape, and began work at once with the help of his companions, collecting in the fine forest near the village, taking observations, and laying plans for the future. Mr. Forbes had made up his mind that it would be impossible to accomplish the ascent of the Owen Stanley Range this season, one of the results of the delay caused by the loss of his baggage. In the end of April, when the wet season is passing over, the attempt will be made. He had sent his Malay servant, Lopez, to camp out in search of a rare bird of paradise; and it speaks well, he says, for the quiet of the country that he can go off alone to a distant village where his language is unknown. On his way to the coast for supplies Mr. Forbes met Sir Peter Scratchley, who went on to Sogeré with Mr. Forbes, and expressed himself charmed with the house and the work already done, as well as with the good relations established with the natives. Mr. Forbes went back with Sir Peter Scratchley in order to accompany the latter to the north coast and Huon Gulf. Without additional funds it is very doubtful if he will be able to accomplish all he has planned.

THE current number of Dr. Umlauft's *Rundschau* contains an article on the geographical knowledge of the Alps in early times, the present instalment dealing with the Roman period. Other articles describe the Samoans and their customs; a cruise in the Straits of Magellan; while Herr Gavazzi discusses the orography of "the Croatian Mesopotamia," as he calls the district lying between the Drave and the Save. There are also some interesting statistics relating to the populations of German towns, schools in Finland, &c., but the most generally interesting of these are the statistics relative to the journeys of the various travellers who have crossed Africa from time to time. Dr. Livingstone crossed from St. Paul de Loanda to Quilimane, a distance of about 4000 kilometres, in twenty months; Commander Cameron from Bagamoyo to Catombela, 6000 kilometres, in thirty-two months; Mr. Stanley from Bagamoyo to Boma, 11,500 kilometres, in thirty-three months; Major Serpa Pinto from Benguela to Durban, 3700 kilometres, in sixteen months; Lieut. Weissmann from St. Paul de Loanda to Sadani, 4000 kilometres, in twenty-two months; Mr. Arnot from Durban to Benguela, 3500 kilometres, in thirty-nine months; Messrs. Capello and Ivens from Mossamedes to Quilimane, 4500 kilometres, in fourteen months. If these figures be accurate, it would appear that Mr. Stanley travelled more rapidly than any of the others, although he is closely pushed by MM. Capello and Ivens, for while his monthly average was about 349 kilometres, theirs was 321; but then his journey was about two and a half times longer than theirs in distance.

An official memorandum communicated to the German Reichstag lately gives some details about the Marshall Archipelago, of which Germany has just assumed the protectorate. It includes thirty lagoon islands or atolls, none of which rise more than ten feet above the sea. The vegetation is limited to the coca palm, the bandanas, and the bread-fruit tree. The native fauna are a small lizard, land- and water-crabs, and a few wild pigeons. There are absolutely no springs or running water, the inhabitants being dependent on rain-water caught in hollows and clefts in the rock, which rapidly becomes brackish on account of the porous medium. The group naturally divides itself into two chains, the eastern or Ratack, and the western or Ralick. It is in this latter that the largest island of the whole group, Jaluit, is situated. It has an area of about thirty-five square miles, contains about 1000 inhabitants, and possesses a good harbour. On it are the factories of the European and American Companies trading to the group. American missionaries have also stations there, the work of which is carried on by Sandwich Islanders.

A Russian scientific expedition to proceed to China is being organised under the direction of Dr. Piassetsky. The expenses will be provided partly by the Imperial Exchequer, and partly by the Moscow Commercial Committee.

The French Minister of Public Instruction has informed the Geographical Society of Paris that he has added to the Committee on historical and scientific work a section on historical and descriptive geography.

In the last number of the *Mittheilungen* of the Vienna Geographical Society (Bd. xxviii. No. 12) Herr Becker describes the "Blue Grotto of Busi," one of the Dalmatian Islands, which has only recently been discovered, and which owes its name to a peculiar light effect. It greatly resembles the celebrated "Grotta azzura" at Capri, but seems to be inferior to the latter in several respects. Herr Wienkowski has a curious paper on the "Pomeranian Kassubs," a remnant of the Wendic peoples which once inhabited the districts between the Saale and Elbe on one side and the Vistula on the other. The sub-title of the paper is, "A Contribution to the Ethnography of Germany." The Kassubs, although, according to a popular song of their own, as numerous as the sand on the sea-shore, now are very few in number, and their special characteristics are disappearing with the spread of a common school education. The writer gives an historical sketch of the Kassubs, describes their occupations, dwellings, clothing, food, marriage and harvest customs, the speech, and concludes with a few words on their proverbs and tales. Prof. Palacky gives a brief account of attempts at acclimatisation of plants in the Congo region, and a letter from Dr. Lenz from the Congo is also published.

THE BENEFITS WHICH SOCIETY DERIVES FROM UNIVERSITIES[1]

To be concerned in the establishment and development of a university is one of the noblest and most important tasks ever imposed on a community or on a set of men. It is an undertaking which calls for the exercise of the utmost care, for combination, co-operation, liberality, inquiry, patience, reticence, exertion, and never-ceasing watchfulness. It involves perplexities, delays, risks. Mistakes cannot possibly be avoided; heavy responsibility is never absent. But history and experience light up the problem; hope and faith give animation to the builders when they are weary and depressed. Deeply moved by these considerations, I desire to bring before you, my colleagues in this work, without whose labours all would be a failure, you who are Trustees, and you who are teachers, before the citizens of Baltimore, and before this company of students pressing forward to take the places of authority in the work of education and administration—before you all, my friends, I wish to bring some aspects of university life, which, if not new, may perhaps be stated in terms which are fresh, with illustrations drawn from our own experience.

I ask you to reflect at this time on the Relation of Universities to the Progress of Civilisation, and I begin by assuming that we are agreed substantially on the meaning of both these terms. The word university, as applied to a learned corporation, is several hundred years old, and in all times and lands has embodied the idea of the highest known agency for the promotion of knowledge and the education of youth. Civilisation is a new word, hardly introduced a century ago, though the idea which it embodies is as old as organic society. Guizot, to whose eloquence we owe the popularity of this term, avoids its formal definition, declaring in general terms that civilisation is the grand emporium of a people, in which all its wealth, all the elements of its life, all the powers of its existence, are stored up. "Wherever," as he goes on to say, "the exterior condition of man becomes enlarged, quickened, or improved, wherever the intellectual nature of man distinguishes itself by its energy, brilliancy, and its grandeur; wherever these two signs concur, and they often do so, notwithstanding the gravest imperfections in the social system, there man proclaims and applauds civilisation." Assuming, then, that by university the highest school is understood, and by civilisation the highest welfare of mankind, let us inquire into the influence which the advancement of knowledge by means of superior educational establishments has exerted or may exert upon the progress of society.

A little reflection will remind us of five great agencies by which modern Christian civilisation is helped forward: first, The Family, unit of our social organisation, recognised by Aristotle as the basis of society, and styled by modern philosophers "the focus of patriotism" (Lieber), and the very "starting-point of social morality" (Maurice); next, Trade or Commerce, the exchange of one man's products for another's, the traffic between communities and nations; third, Law and Custom, written and unwritten, the enforcement of duties and defence of rights, the equitable adjustment of conflicting claims; fourth, Religion, the acknowledgment of personal responsibility to an infinite and all-controlling Power. The last to be named is Knowledge, the recorded observations and experience of our race in ancient and in modern times, or, in other words, Scientia, science in its broadest significance.

These five influences working in dwelling houses, market places, state houses, churches, libraries, and schools, control our modern life; and that state of society is the best, in which domestic virtue, mercantile honour, and the freedom of exchange, obedience to law, pure and undefiled religion, and the general diffusion of knowledge, are the dominant characteristics. We are only concerned at present with the last of these five factors.

The means by which our race has acquired knowledge and preserved its experience are manifold. The inhabited world is a great laboratory, in which human society is busy experimenting. Observation, exploration, and reflection have been allied in interpreting the physical characteristics of the globe, ever since the primæval law, "Subdue the earth," was heard by primitive man; experiments in social organisation have also been made on a colossal scale, and in little microcosms; war has taught its pitiful lessons; superstition, irreligion, vice, and crime, as well as literature, art, law, religion, and philosophy, have all been teachers; customs, traditions, epics, creeds, codes, treaties, inscriptions, parchments, books, pyramids, temples, statues, museums, schools, pulpits, platforms, have all been employed to perpetuate and diffuse the knowledge which has been acquired; but ever since Europe emerged from the darkness of the Middle Ages, Universities have been among the most potent of all agencies for the advancement and promulgation of Learning. Their domain, the republic of letters, has been wider than the boundaries of any state; their citizens have not been restricted to any one vocabulary; their acquisitions have been hid in no crypt. They have gathered from all fields and distributed to all men. Themes the most recondite, facts the most hidden, relations the most complex, have been sought out and studied, that if possible the laws which govern the world might be discovered, and man made better.

In one of our halls there hangs a diagram which I never pass without pausing to think of its significance, listening as I would before the sphinx to discover if it has any message for me. It contains a list of European universities founded since the dawn of modern states—a period of more than seven centuries, a list of over two hundred names. Every state in Europe, every great city, has its high school. Popes, emperors, kings, and princes have been their founders; ecclesiastics, reformers, republics, municipalities, private citizens, munificent women, have contributed to their maintenance. Wherever European civilisation has gone, the idea of the university has been carried with it. to North and South America, to Australia, even to India, China, and Japan; it came with the Virginians to Williamsburg, with the New Englanders to Cambridge and New Haven; it was planted in California before there was an organised state on the Pacific slope.

[1] An Address by D. C. Gilman, President of the Johns Hopkins University.

The idea is often vague, sometimes perverted, commonly half-developed, at times inflated,—nevertheless it contains this principle of life, that in every civilised community there must be a high school, capping, crowning, binding, all other institutions for the advancement of learning.

Allow me to turn your attention to some historical illustrations.

Notwithstanding the great renown of Charlemagne, greatest of monarchs between Cæsar and Napoleon, the fact that his empire was founded upon the principle of superior education is not so familiar; but a recent writer (Mr. Mullinger) has given us an instructive essay on the schools of Charles the Great, and a still more recent writer (Mr. R. L. Poole) has made a study of their influence. "If his reign marks the dividing line between ancient and modern history," says the latter, "it is not only by virtue of its political facts but also because he begins the education of the Northern races—fitting them in time to rule the world as the Romans had done before them."

A monk of St. Gall has preserved for us what purports to be an authentic account of the mode in which learning was introduced into the Frankish empire, and although the extract is long I am sure it will not weary you, as I read from the translation of Mr. Poole.

"When," says the monk, "the illustrious Charles had begun to reign alone in the western parts of the world, and the study of letters was everywhere well-nigh forgotten, in such sort that the worship of the true God declined, it chanced that two Scots from Ireland lighted with the British merchants on the coast of Gaul, men learned without compare, as well in secular as in sacred writings; who, since they showed nothing for sale, kept crying to the crowd that gathered to buy, 'If any man is desirous of wisdom, let him come to us and receive it; for we have it to sell.' This therefore they declared they had for sale, since they saw the people to traffic not in gifts but in salable things, so that they thus might either urge them to purchase wisdom like other goods, or, as the events following show, turn them by such declaration to wonder and astonishment. At length their cry being long continued was brought by certain that wondered at them or deemed them mad, to the ears of Charles, the king, always a lover and most desirous of wisdom: who, when he had called them with all haste into his presence, inquired if, as he understood by report, they had wisdom verily with them. 'Yea,' said they, 'we have it and are ready to impart to any that rightly seek it in the name of the Lord.' When therefore he had inquired what they would have in return for it, they answered, 'Only proper places and noble souls, and such things as we cannot travel without, food and wherewith to clothe ourselves.' Hearing this he was filled with great joy."

Several instances in modern history may be cited, in each of which the close of a great civil commotion has been marked by the foundation of a university. One of them is quite familiar. A little more than three hundred years ago, Leyden, so lately freed from the horrors of a siege, "so lately the victim of famine and pestilence, had crowned itself with flowers." The university was to be inaugurated. In the grand procession rode a female figure, the Holy Gospel, attended by Four Evangelists; then came other allegorical figures, emblematic of Law, Medicine, and the Liberal Arts, and then the magistrates and dignitaries. Down the Rhine floated the semblance of Apollo and the Muses, and each Professor, as he advanced, "was kissed by Apollo and all the nine Muses in turn," whose salutation found further expression in "an elegant Latin poem." I have taken these statements, as you doubtless surmise, from the pages of Motley, to show you the enthusiasm of the Low Countries in respect to their university; but a truer impression of the work then inaugurated would be given by recounting the roll of the great men who have taught in that university and of the great scholars whom they have trained. Grotius, Descartes, Scaliger, Boerhaave, Wyttenbach, Arminius, and Gomar, were among the early scholars who resided in Leyden, and the list might be extended until it reached our own contemporaries and our own countrymen.

A few years earlier, when the Reformation in England was nearly completed, Henry the Eighth reorganised the University of Cambridge, and laid the foundations of that splendid college, which might be called a university in itself, if ever a college could claim the more comprehensive name, Trinity College, which before the century had passed, trained for the world that great triumvirate whose statues glorify the approach to the chapel, Isaac Barrow, Lord Bacon, and Sir Isaac Newton, *qui genus humanum ingenio superavit.*

The foundation of the University of Berlin is a noteworthy modern instance of the erection of a great high school, in a time of national sorrow. The story has often been given, and was recently made the opening passage in an inaugural address by Helmholtz. Prussia had been overrun by France, the resources of the state were almost exhausted, but Frederick William the Third, led on by William von Humboldt, Stein, and other great intellects, determined to infuse new spirit into a despondent people, by conferring on them the greatest benefit which it was in his power to bestow, a university, founded on such a liberal plan, that it rose at once to the very front rank.

So within our recollection, that monarch's greater son, the Emperor William, when Strasburg had been reclaimed by Germany, determined that it should be the seat of a university, and already that new foundation stands among the strongest and best of German high schools.

These examples of universities founded each of them at the close of a sharp social crisis, often occurs to my mind when I remember that our foundation was projected at the close of a civil war, and was established in the firm belief that it would bind together in the love of Literature and Science all classes and all creeds. A physician who has lately died in communion with the Roman Catholic Church, has often said to me, "I tell everybody that there is one thing on which we can all agree, and that is the university," and another, of the same religious creed, has just written me, "I sincerely hope to see your prediction as to all Christian forces come true. Life is too short, and there is too much good to be done, to have any force or energy wasted in barren controversy."

I have made these historical allusions, most of which I am well aware are familiar, in order to raise the questions: Why is it that universities are so highly esteemed? What are the advantages which follow their foundation? Remembering that a university is the best organisation for the liberal education of individuals, and the best organisation for the advancement of science, apply the double test,—what is done for personal instruction, and what is done for the promotion of knowledge, and you will be able to judge any institution which assumes this name.

Ask, first, is it a place of sound education? Are the youth who are trained within its walls honest lovers of the truth,—are they learned, are they ready, are they trustworthy? When they leave the academic classes, do they soon find a demand for their services? Do they rise in professional life? Are they sought for as teachers? Do they show aptitude for mercantile, administrative, or editorial life? Do they acquit themselves with credit in the public service? Do the books they write find publishers? Do they win repute among those who have added to the sum of human knowledge? Have they the power of enjoying literature, music, art? Can they apply the lessons of history to the problems of our day? Are they always eager to enlarge their knowledge? Do they become conservative members of society, seeking for progress by steady improvements rather than by the powers of destruction and death? Are they useful, courteous, co-operative citizens, in all the relations of life? Do the charities, the churches, the schools, the public affairs of the community, receive their constant consideration? Are there frequent manifestations among them of unusual ability in science, in literature, in oratory, in administration? As the roll of the alumni increases and the graduates are counted by hundreds and not by scores, does it appear that a large proportion are men of honourable, faithful, learned, and public-spirited character? These are the questions by which, as the years go on, a university is to be tested, or to sum all questions in one, is it proved to be a place for the development of manliness?

I beg leave to dwell a little longer upon this text, because I think there is danger of its importance being overlooked. The material resources of a university, the aggregate numbers who attend its courses, its numerous buildings, its great collections, appeal to everybody,—only those who look at results are competent to give a conclusive opinion, and their opinion cannot be formed in one decade. A generation is the briefest period for a fair review. When the year of our Lord 1900 comes, this foundation will be a quarter of a century old. To that remote tribunal we appeal for judgment on our work of to-day. But we may anticipate this final verdict, and ascertain by our own inspection and inquiry what is done in any institution for the education of youth, what opportunities are afforded, how those advantages are regarded by the most intelligent young men, and what kind of scholarship is developed at the termination of the academic course.

Here let me protest against the common method of estimating intellectual work by numerical standards alone. I have heard it said that some men are possessed by a statistical devil. They can only think in figures: they will ask, in respect to a new acquaintance, how much is he worth; of a library, how many volumes; of an orchestra, how many pieces; of a college, how many students. I have known the expenses of an institution made a dividend, and the number of scholars the divisor, the quotient representing the cost of each pupil. All this is wrong, absolutely and wholly wrong. If such a standard were allowable, the largest number of scholars taught by the cheapest teacher would be the greatest success. It is not the number but the quality of students which determines the character of a high school. It is important to count; it is better to weigh.

Having spoken of what the university does for individuals, I add that it has a second function. It benefits associated as well as individual man. It renders services to the community which no demon of statistics can ever estimate, no mathematical process ever develop. These functions may be stated as the acquisition, conservation, refinement, and distribution of knowledge.

These carefully chosen words I proceed to explain.

1. It is the business of a university to advance knowledge; every professor must be a student. No history is so remote that it may be neglected; no law of mathematics is so hidden that it may not be sought out; no problem in respect to physics is so difficult that it must be shunned. No love of ease, no dread of labour, no fear of consequences, no desire for wealth, will divert a band of well chosen professors from uniting their forces in the prosecution of study. Rather let me say that there are heroes and martyrs, prophets and apostles of learning as there are of religion. To the claims of duty, to the responsibilities of station, to the voices of enlightened conscience, such men respond, and they throw their hearts into their work with as much devotion, and as little selfishness, as it is possible for human nature to exhibit. By their labours knowledge has been accumulated, intellectual capital has been acquired. In these processes of investigation the leading universities of the world have always been engaged.

This is what laboratories, museums, and libraries signify. Nothing is foreign to their purpose, and those who work in them are animated by the firm belief that the advancement of knowledge in any direction contributes to the welfare of man. Nor is research restricted to material things; the scholars of a university are equally interested in all that pertains to the nature of man, the growth of society, the study of language, and the establishment of the principles of intellectual and moral conduct.

2. Universities are conservative. They encourage the study of the history, the philosophy, the poetry, the drama, the politics, the religion, in fine, the experience of antecedent ages. Successors of the ancient monasteries, they keep alive in our day the knowledge of ancient languages and art, enrich the literature of our mother tongue, hold up to us the highest standards of excellence in writing, and enable us to share in the thoughts of the noblest of our race. Let me especially remind you that to the universities men turn instinctively for light on the interpretation of the Scriptures. When new manuscripts are discovered, or new versions are proposed, or new monuments are unearthed, it is to the universities, where the knowledge of ancient and remote tongues has been cherished, that the religious world looks for enlightenment and guidance. Their dominant influence is highly spiritualising; I would even go farther and say that it is truly religious. I am not unmindful that within the academic circles men are found whose spiritual insight is but dim—so it is in all other circles—but I assert, without fear of contradiction, that the influence of study is, on the whole, favourable to the growth of spiritual life, to the development of uprightness, unselfishness, and faith, or, in other words, it is opposed to epicureanism and materialism. In belief, there are tides as there are in the ocean, ebb and flow, ebb and flow; but the great ocean is there, with its deep mysteries, unchanging amid all superficial changes. Faith, with all its fluctuations, is as permanently operative in human thought as Knowledge.

3. Universities are refining. They are constantly, by laborious processes, by intricate systems of co-operation, and by ingenious methods, engaged in eliminating human errors and in submitting all inherited possessions to those processes which remove the dross and perpetuate the gold. No truth which has once been discovered is allowed to perish,—but the incrustations which cover it are removed. It is the universities which edit, interpret, translate, and reiterate the acquisitions of former generations both of literature and science. Their revelation of error is sometimes welcomed, but it is generally opposed; nevertheless the process goes on, indifferent alike to plaudits or reproaches. If their lessons are hard to the beginners, they lead the persevering to high enjoyment.

4. Universities distribute knowledge. The scholar does but half his duty who simply acquires knowledge. He must share his possessions with others. This is done in the first place by the instruction of pupils. Experience has certainly demonstrated that, with rare exceptions, those men are most learned who produce most. The process of acquiring seems to be promoted by that of imparting. The investigator who is surrounded by a bright circle of friendly inquisitors and critics finds his best powers developed by this influence. Next to its visible circle of pupils, the university should impart its acquisitions to the world of scholars. Learned publications are therefore to be encouraged. But beyond these formal and well recognised means of communicating knowledge, universities have innumerable less obvious, but not less useful, opportunities of conveying their benefits to the outside world.

These general principles I propose to illustrate by asking you to go with me around the circle of the sciences, that we may observe the part which universities have taken, or should take, in respect to the various departments of knowledge.

Let me begin by saying that a university should discover and teach all that can be known of the Human Body. If you ask me why this is so important, I reply, in order that every one may be able to lead a healthier, stronger, and more rational life than is now possible for the want of more knowledge. Hospitals are essential to alleviate sufferings which have been encountered; physical training is of great value; but still more important to humanity is the laboratory in which are studied the laws of life. A celebrated physiologist declares that "a hundred years of life is what Providence intended for man," and others tell us that most of our minor ailments may easily be avoided, and the number of efficient days may be largely increased. Science has proved that many diseases which used to scourge the civilised world may be prevented, and it has recently brought us within sight of new discoveries which will still further interrupt the progress of pestilence. The discoveries of anæsthetics have marvellously alleviated the sufferings of humanity. The causes and remedies of cerebral excitement and degeneration have never been understood as now, and the possibilities have never been so great for the restoration to their normal activity of the powers which have been alienated. In view of these great results and of these anticipations, it is clearly the duty of a university to study all the forms and functions of life which are manifested in organisms lower than man, all the laws which govern animal and vegetable growth, all that can possibly throw light on human physiology.

Those who are devoted to research of this kind, revealing with their microscopes the structure and the life-histories of the minutest organisms, are constantly, and in most unexpected ways, coming upon new illustrations of the plan of creation, which have an important bearing upon the welfare of man. They are the interpreters of nature and the benefactors of humanity; and I do not hesitate to add that if there is any branch of learning which at the present time deserves the most generous support, it is surely Biology, because of its obvious relations to the health and happiness of every human being. I cannot but think that those who oppose its study will be ranked in future years among the obscurantists of the nineteenth century.

(*To be continued.*)

PRJEVALSKY'S EXPLORATIONS IN CENTRAL ASIA

THE last number of the *Izvestia* of the Russian Geographical Society (xxi. 3) contains a letter from M. Prjevalsky, dated Lob-nor, January 29, 1885. After having spent a month at Tsaidam, the expedition undertook, in August, its journey towards the west. A special disease, called *khasa* by the Mongols, and consisting in a strong fluxion of all four feet, attacked fifty-three camels of the caravan, as well as all the cattle of the Mongols, and compelled the expedition to stop for a fortnight. Only seven camels succumbed to the disease, and on September 18 the expedition resumed its further advance, following the foot-hills of the Kuen-lun—that is, of the border-range of the plateau of Thibet. Southern Tsaidam is an immense flat land, formerly the bottom of a lake, covered with brushwood at the foot of the mountains, and with salt clay elsewhere. A narrow salt lake, Dobasun-nor, extending west to east, receives the rivers Bayan-gol, Naidmin-gol, and Umu-muren. Pheasants are numerous in the brush and the small marshes covered with rush. Other birds, even migratory, are very few, as also the mammals, which must avoid a ground impregnated with salt. Only bears coming from Thibet are numerous when the fruits of the *khormyk*-brush are ripe. During Chingiz Khan's time the legend says, the region was inhabited by agriculturists, "Mongasy," who left their traces in irrigation canals; but now all Tsaidam is peopled only with Mongols, thinning in the south, living on cattle-breeding. The Umu-muren is the western boundary of the plains impregnated with salt of the southern Tsaidam. Further north and north-west, as far as the Altyn-tagh Mountains, extends an immense dry desert, the soil of which consists of clay, sand, and gravel. Several of its parts man never visits, and only savage camels wander on its barren surface. M. Prjevalsky met with only two places having plenty of fresh water and grazing grounds: at Hansy and at Has, where a lake of the same name has a circumference of nearly thirty miles. Two Cossacks were sent from Has to discover a route towards Lob-nor, and after a fortnight's searching they succeeded in finding a place reached by M. Prjevalsky in 1877.

Leaving at Has some provisions under the guard of seven Cossacks, the remainder of the party went west to explore the valley nearly 150 miles long between the Altyn-tagh, in the north, and the Kuen-lun, in the south; the valley slowly rises from 9000 feet at Has to 14,000 feet at the junction of both chains of mountains. An easy passage across the Altyn-tagh leads them to Cherchen, and must have been utilised formerly on the route from Khotan to China, while another route led, *viâ* Lob-nor, to the Sa-cheu oasis.

The excursions of the party around Has took fifty-four days, during which a region absolutely unknown before was explored. It has a very poor flora and fauna; of mammals only a hundred antelopes were shot, and a new species of *Ovis* has been discovered. M. Prjevalsky gave it the name of *Ovis dalai-lamæ*.

Most valuable geographical discoveries were made with regard to the central part of the Kuen-lun. In the longitude of Hansy this immense border-range of the Thibetan plateau is snow-clad, and reaches, under the name of Jin-ri, the height of 20,000 feet. To the east of this mountain-mass runs a chain named Marco Polo, which is accompanied on the north by a series of ridges parallel to it, and described under the names of Garynga, Dzukha, Toroi, and several others, until the Burkhan-buddha range. To the north-west of the Jin-ri, another snow-clad range, named "Columbus" by M. Prjevalsky, followed by a third range, also snow-clad and formerly unknown, continues further, to join the Altyn-tagh. A range, which has been seen only at a distance, and called "Problematic," runs due west of Jin-ri, and probably reaches also the Altyn-tagh; a high range, 12,500 to13 ,000 feet above the sea-level, including an elongated salt lake, which does not freeze in winter, occupies the space between the "Problematic" ridge and those situated towards the north.

The climate of the region is very severe. In December the temperature was seen to fall during the night below 40° Cels. Day and night strong westerly winds were blowing, often taking the force of a gale which filled the atmosphere with sand and dust. Snow was very scarce; so also must be the rains in the summer, as far as one may judge by the barrenness of the region; this part of the Thibetan mountains must escape the influence of the south-westerly monsoons of India, which bring so much moistness to North-Eastern Thibet. Water, however, is not scarce; the snow-summits supply many small rivers which flow from the mountains. Remains of summer-stations are seen on these rivers and streamlets, people coming there in search of gold, which seems to be as usual in North-West as in North-Eastern Thibet.

Returning in January to the station of Has, M. Prjevalsky resumed his journey to Lob-nor, 170 miles distant, where he was well received by his former acquaintances. There he proposed to stay throughout February to study the migrations of birds.

As known from his telegrams dated June 20 and July 13 (received on August 31), the expedition reached Keria, but was prevented from penetrating thence into Thibet, and the indefatigable traveller proposed to march on Khotan, and thence to Aksu.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The Class List of the Mathematical Tripos Part III., just issued, for which only wranglers can enter, contains in the first class the names of Messrs. Barnard (Emmanuel), 4th Wrangler; Berry (King's), Senior; R. Holmes (St. John's), 5th; Love (St. John's), 2nd; Richmond (King's), 3rd; and Roseveare (St. John's), bracketed 6th. Thus it includes the first five Wranglers, and one of the two bracketed sixth. The names are in alphabetical order.

The Sidgwick Prize has been awarded to Mr. T. Roberts, B.A., St. John's College.

The long list of lectures for this term, issued by the Special Board for Physics and Chemistry, includes, in addition to the ordinary courses of Prof. Liveing, Prof. Dewar, and Mr. Main, Mr. Pattison Muir's, on Principles of Chemistry; Dr. Kuhemann's, on Methods of Analysis and Principles of Organic Chemistry; and Mr. Heycock's, on Chemical Philosophy.

Demonstrations and practical courses suited to the various classes of students, will be given in the University, St. John's, Caius, and Sidney College Laboratories, and Prof. Liveing gives a course of Spectroscopic Chemistry; and Mr. Robinson, one on Chemistry as Applied to Agriculture.

The courses of Physics include Prof. Thomson, on Magnetism; and lectures on various branches by Messrs. Atkinson, Glazebrook, Shaw, and Hart; and practical courses at the Cavendish Laboratory. Elementary and Advanced Demonstrations in Mineralogy will be given.

Prof. Stuart is lecturing on Theory of Structures.

In Geology Prof. Hughes begins a course of lectures on a district to be visited at Easter on January 26, and also lectures on the Principles of Geology. Other work is divided among Messrs. Teall, T. Roberts, Marr, and Harker.

In Physiology the usual lectures are being given by Prof. Foster, Drs. Lea, Gaskell, and Hill, and Mr. Langley. Prof. Macalister lectures on the Organs of Digestion and Reproduction; Prof. Newton on the Geographical Distribution of Vertebrates. Mr. Hans Gadow's course is on the Morphology of the Sauropsida (recent and extinct); other courses are conducted by Messrs. Sedgwick, Harmer, and Weldon.

Dr. Vines's general elementary course of Botany is continued, supplemented by Mr. F. Darwin on the Biology of Plants (advanced); Mr. Gardiner on the Anatomy of Plants (advanced); Mr. Potter's demonstrations on Advanced Systematic Botany.

Advanced work in Mathematics is represented by Prof. Stokes on Physical Optics, Prof. Adams on Lunar Theory, and Prof. Thomson on Electro-magnetism. Mr. Glazebrook is lecturing on the Theory of Light, Mr. Hobson on Higher Dynamics, Mr. Macaulay on Thermodynamics, and Mr. Forsyth on Higher Algebra. Dr. Besant lectures on Analysis, Mr. H. M. Taylor on Higher Plane Curves, Mr. Stearn on Electrostatics, Mr. Larmor on Theory of Conduction and Analytical Optics.

THE number of students inscribed in the several Universities of the Italian kingdom amounts to 15,151; excepting 200 who follow the free Universities, all of them follow the Government teachers, viz. law students, 5133; medical, 6132; science, 1627; literature and philosophy, 441. The largest number of students in proportion to the population is recorded in Central Italy, the largest number of law students in the Neapolitan States, the largest number of science students in Northern Italy, the largest proportional number of philosophical and literary students n Central Italy.

SCIENTIFIC SERIALS

The Quarterly Journal of Microscopical Science, No. ci., November 1885, contains:—On the relations of the yolk to the gastrula in Teleosteans and in other Vertebrate types, by J. T. Cunningham (plates 1-4).—On the structure and function of the sphæridia of the Echinoidea, by Howard Ayers (plate 5). Suggests that these organs have for their function the perception of chemical changes in the surrounding water (*i.e.* taste and smell), and the reporting of the same to the nervous centres of the animal, from whence the intelligence is sent out to the spines and pedicellariæ, which latter are at once alert to secure the food-substance.—The nerve-terminations in the cutaneous epithelium of the tadpole, by A. B. Macallum (plate 6). The results are summarised as follows:—(1) Certain fibres of the nerve network, situated below the corium, and known as the fundamental plexus, give origin to fibres which enter the epithelium, and terminate in comparatively large bead-like bodies between the cells. (2) From a network of fine anastomising nerve-fibrils situated immediately below the epithelium, and forming meshes, each narrower than the surface covered by an epithelial cell, arise other excessively fine fibrils, which end either within or between the cells or after branching, in both fashions. (3) One, commonly two, often three or more, nerve-fibrils terminate in the interior of each epithelial cell near its nucleus. (4) The figures of Eberth are sheaths for intracellular nerve terminations.—On green oysters, by Prof. E. Ray Lankester (plate 7). The occurrence of a species of Navicula in the intestine of the green oysters of Marennes, is confirmed. The bluish pigment in the Navicula is described as "Marennin." The description and illustration of the secretion-cells of the epithelium of the branchiæ and labial tentacles of the oyster in which the Marennin absorbed in the intestine of green oysters is deposited follows, and it is proved that it is to this substance that the green parts owe their colour. The green oyster is very beautifully figured, of natural size, from a sketch by Miss A. Stone. The bluish pigment is, in the early spring, of a decidedly green hue.—The system of branchial sense-organs and their associated ganglia in Ichthyopsida: a contribution to the ancestral history of Vertebrates, by Dr. John Beard (plates 8-10).

American Journal of Science, December 1885.—On the effect on the earth's velocity produced by small bodies passing near the earth, by H. A. Newton. It is shown that the effect upon the earth's motion caused by the meteors that penetrate the earth's atmosphere, exceeds at least one-hundredfold that caused by the meteors that pass by without impact.—Sources of trend and crustal surplusage in mountain structures, by Alexander Winchell. The general meridional trend of the older mountain systems is discussed, and the cause of this orographic disposition is referred to the early period of incrustation. It is also argued that meridional trends would be further promoted by the secular subsidence of the earth's equatorial protuberance, as well as by lunar tidal action.—The genealogy and the age of the species in the Southern Old Tertiary, part iii., reply to criticisms, by Otto Meyer. In reply to Prof. Hilgard, the author maintains with further argument the original contention that only a competent and careful examination of the fossils could indicate the relations of the Old Tertiary strata of Mississippi. He also endeavours to show that Prof. Hilgard's views on the stratigraphical succession below Claiborne, Jackson, and Vicksburg are incorrect.—The condensing hygrometer and psychrometer, by Henry A. Hazen. Objections are raised against the condensing hygrometers now in use, such as those of Mr. Dines and Crova. An efficient psychrometer is described, with instructions for its use, and a table of relative humidity applicable to the sling psychrometer.—A new form of absorption cell, by Arthur E. Bostwick. The cell here described has been devised and used by the author for the purpose of obtaining the absorption-spectra of liquids, which have little selective absorption, and which would therefore have to be used ordinarily in large quantities.—Preliminary notice of fossils in the Hudson River slates of the southern part of Orange County, New York, and elsewhere, by Nelson H. Darton. Here the author deals with the fossils discovered in many new localities, which have thrown much light on the complicated stratigraphic structure of these districts.—Report of the American Committee-Delegates to the Berlin International Geological Congress, held September 28 to October 3, 1885, by Persifor Frazer, Secretary.—Bright lines in stellar spectra, by O. T. Sherman. Bright lines hitherto admitted to form part of but six stars, β Lyræ, γ Cassiopeiæ, and four small stars in Cygnus, are now detected by the 8-inch equatorial of Yale College Observatory in numerous other stars, a full description of which awaits the completed apparatus. The number of approximate coincidences renders it very probable that the lines observed are those of the solar atmosphere, and from these observations it would seem that there are many stars in the same condition as the sun, but with the corona more pronounced.—Note on the optical properties of rock-salt, by S. P. Langley. The most perfect rock-salt prisms procurable in Europe fail to show distinctly a single Frauenhofer line. But, after long searching, blocks have at last been obtained in America, from which prisms have been cut which show these lines with all the sharpness of flint glass. The prism here described, which has been made by Brashear of Pittsburgh, shows the nickel line between the D's.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 17, 1885.—"Second Report on the Evidence of Fossil Plants regarding the Age of the Tertiary Basalts of the North-East Atlantic." By J. Starkie Gardner. Communicated by Sir J. D. Hooker, K.C.S.I., F.R.S.

The position and physiography of this headland in the Isle of Mull has been fully described by the Duke of Argyll. It is the point of land separating Loch Laigh and Loch Scridain, and is about two miles in circumference and a mile across.

It is composed mainly of two sheets of basalt with remains of a third sheet, on some eminences and along the shore of Loch Laigh. These are almost horizontal, with a slight dip east, up Loch Scridain, and a considerable dip in the same direction up Loch Laigh. The upper sheet is not less than 40 to 50 feet thick, crystallised into rude massive columns, now much fissured and weathered, whilst the lowest presents a thickness of 60 feet, visible above low water, the upper two-thirds being amorphous, and the rest fashioned into slender and most perfect columns, bent in every direction, like those of the Clam-shell cave at Staffa. The beds are so exceedingly horizontal towards the seaward direction, that no one can doubt the columnar basalts of Staffa and the Treshnish Isles, Geometra and the mainland of Mull, being on the same horizon, if not parts of the same sheet. Between the two great lava-beds at Ardtun is intercalated a bed of sedimentary deposit, reaching a maximum of 60 feet thick, and consisting of pale very fine-grained clay and limestone at the base, then sand and gravel, black laminated shales, whinstone, gravel, and laminated sands. The gravels are made up of flint pebbles and subangular rolled fragments of older lava-beds in a matrix of broken-down volcanic material. They present all the ordinary lines of current bedding, beautifully weathered out, and the pebbles are drifted precisely as in ordinary river gravels.

There can be no question whatever, indeed, but that the gravels are the deposits of the waterway of a river of some magnitude, and the shales its overflows and backwaters. Its deposits traverse the whole seaward face of the headland, and their extension inland is marked by two beds of coal. An intrusive sheet of fine compact basalt rises on one side of the head, cutting a devious way through each bed in turn, and dipping beneath the sea at the other extremity. On the coast, near the centre of the head, occurs a small chine, apparently due to the weathering out of a vertical dyke, which has cut through the gravels and shales; it was here that I resolved to excavate them.

With the assistance of a barrel of powder and the removal of a mass of the intensely indurated shingle bed, to the extent of perhaps hundreds of tons, many square yards of the whinstone and the underlying black shales were exposed. The large specimens of *Platanites aceroides* and *Onoclea hebridica*, now exhibited, were the results. The ravine, however, proved an unfortunate selection, for the whinstone became poorer in fossils as we got farther in, and the underlying black shales, though crowded with leaves, were so squeezed and full of slickensides or faulted surfaces, and, consequently, so brittle, as to be practically valueless. From the condition of the shales and calcined appearance of the gravels—here of a steely-gray colour, intensely hard, with pure white and occasionally cherry-coloured flints, it is evident that the ravine must be the site of an old dyke, and if proof were wanting of a violent upthrust at this spot it is to be found in the upturned edges of the bottom bed on the west face. The succession of beds in the section we had been so laboriously working at in the ravine in no way prepared me for the discovery that within 100 yards there existed, many feet below the lowest sedimentary bed present in the ravine, a deposit of limestone, rivalling in fineness and texture the celebrated lithographic stone of Solenhofen, and containing exquisitely-preserved leaves, completely different in character to any previously seen in the basalts.

The new flora differs considerably from that of the shales above, and very large leaves of many kinds occur in the clay at the base. The leaves in the limestone are smaller and very sparsely scattered through it; there are, moreover, no cleavage planes, and hence much patience is required to obtain and develop them. I have obtained about twenty species of dicotyledon from it, the most prevalent being *Grewia crenata*, Hr., and *Corylus MacQuarrii*, Forbes, and *Acer arcticum*, Hr., all of which are also found in beds of the same age in Greenland. There are no ferns and only three conifers, a large variety of *Ginkgo adiantoides*, Unger., a new *Podocarpus*, the most northerly species found, and *Taxus Campbelli*. The fragments from the clays show about eight additional species, and altogether I should judge that both floras were very rich. The most characteristic plants of the shales are those described by the Duke of Argyll and Edward Forbes, *Platanites aceroides* and *Rhamnites multinervis*. *Taxites Campbelli* is not, as affirmed by Heer, identical with *Sequoia Langsdorfii*, but is a true *Taxus*. Other leaves are certainly referable to *Protophyllum*, and we have representatives of leaves determined as *Alnus, Cornus, Berchemia, Populus*, and *Corylus*—but among them there are none, so far as I can ascertain, that have ever been found in European beds of Miocene age. The flora seems to bear a *primâ facie* resemblance to Cretaceous floras of America rather than to any yet known from Europe. The resemblance of the Coniferæ to those indigenous to China at the present day is too remarkable to be overlooked.

It has become evident that the fluviatile rocks of the British basalts are of far greater extent and importance than had hitherto been imagined. Their base is exposed at Burg Head on the opposite side of Loch Scridain, resting upon Jurassic rocks and fragmentary masses of chalk, and is formed of two immense sheets of ash, the lowest of which is full of scoriæ. About 100 feet above these, resting upon columnar basalt, are sands and clays from 9 to 12 feet thick, in every respect similar to those of Ardtun Head. Overlying these is a bed of rudely columnar basalt, and there cannot be much doubt about the fluviatile series on both sides of the loch being upon the same horizon. The beds are, in fact, seen to be horizontal to the west as far as the eye can reach. The horizon of the Ardtun gravels would, therefore, seem to be about 150 feet from the base of the series. Taking into account the superior thickness of the basalts in Mull, and above all the presence of ash-beds at their base, it seems probable that they were nearer the vents than Antrim, and that their lowest beds are at least not newer, so that the Mull leaf-beds at 150 feet from the base should be much older than the Glenarm and Ballypalady leaf-beds at 600 feet from the base.

The horizontal extent of the fluviatile beds of Mull is more difficult to estimate. Gravels and fluviatile beds exist in many localities, and black shales, with identical leaves, have been found in Canna, and leaflets of *Taxus* or a similar foliaged conifer at Uig.

A very interesting relic of the Eocene vegetation occurs at Burg, for a large tree, with a trunk 5 feet in diameter, has been enveloped as it stood to a height of 40 feet, by one of the underlying lava-beds. Its solidity and girth enabled it to resist the fire, but it subsequently decayed, leaving a hollow cylinder filled in with debris, and lined apparently with the charred wood. There is also the limb of a larger tree in a fissure not far off. The wood proves to be coniferous, belonging possibly to the *Podocarpus*, whose leaves are so conspicuous in the beds above.

Mathematical Society, January 14.—Mr. J. W. L. Glaisher, F.R.S., President, in the chair.—Mr. J. B. Colgrove, Loughborough Grammar School, was elected a Member, and Mr. S. O. Roberts was admitted into the Society.—Mrs. Bryant, D.Sc., read a paper on logarithms in general logic. An animated discussion followed between the author and Mr. Kempe, F.R.S., in which Prof. Sylvester, the President, and Mr. S. Roberts, F.R.S., also took part.—Mr. J. Hammond (Prof. Sylvester in the chair) read a paper on a class of integrable reciprocants (see report of Prof. Sylvester's Oxford lecture in NATURE, January 7, p. 222).—Capt. Macmahon made a short communication also bearing on reciprocants.

Chemical Society, December 17, 1885.—Dr. Hugo Müller, F.R.S., President, in the chair.—The following circular letter was read by the Secretary:—

Elizabeth Thompson Science Fund.—This Fund, which has been established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, "for the advancement and prosecution of scientific research in its broadest sense," now amounts to 25,000 dollars. As the income is already available, the trustees desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations, *not already otherwise provided for*, which have for their object the advancement of human knowledge, or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance.

Applications for assistance from this fund should be accompanied by a full statement of the nature of the investigation, of the conditions under which it is to be prosecuted, and of the manner in which the appropriation asked for is to be expended. The applications should be forwarded to the Secretary of the Board of Trustees, Dr. C. S. Minot, 25, Mt. Vernon Street, Boston, Mass., U.S.A.

The first grant will probably be made early in January, 1886.

(Signed) H. P. BOWDITCH, *President*.
WM. MINOT, Jun., *Treasurer*.
FRANCIS A. WALKER.
EDW. C. PICKERING.
CHARLES SEDGWICK MINOT, *Secretary*.

The following papers were read:—The action of steam on carbonic oxide, by H. B. Dixon. The action of steam in determining the union of carbonic oxide and oxygen has been explained by the author as leading to an alternate reduction and oxidation whereby the hydrogen conveys the oxygen to the carbonic oxide:—(1) $Co + H_2O = CO_2 + H_2$; (2) $2H_2 + O_2 = 2H_2O$. This explanation has been rejected by Moritz Traube (*Ber.*, 1885, p. 1890) on the ground that carbonic oxide does not decompose steam at a high temperature. Traube represents the influence of steam as consisting in the formation from it of peroxide of hydrogen, which oxidises carbonic oxide, steam being re-formed. The author has already shown that steam is decomposed by carbonic oxide at a high temperature, for when carbonic oxide is exploded in presence of steam with insufficient oxygen to completely burn it, the carbon dioxide formed is more than double the oxygen, and hydrogen is found in the residue. Horstmann arrived at the same conclusion. When sparks are passed through a mixture of steam and carbonic oxide, carbon dioxide and hydrogen are formed until a certain fraction (which varies with the nature of the spark) of the carbonic oxide is turned into carbon dioxide. When sparks are passed through a mixture of carbon dioxide and hydrogen, carbonic oxide and steam are formed until a certain fraction of the carbon dioxide is turned into carbonic oxide. In neither case is the reaction complete. An equilibrium is reached when about 10 per cent. of carbon dioxide is present to 90 per cent. of carbonic oxide. By the prolonged passage of the sparks a considerable quantity of formic acid is produced. When a coil of platinum wire is heated to redness in steam and carbonic oxide, carbon dioxide and hydrogen are formed until from 10 to 15 per cent. of the carbonic oxide has been oxidised. Similarly, when a coil of platinum wire is heated in carbon dioxide and hydrogen, carbonic oxide and steam are formed until the corresponding limit is reached. No formic acid is produced. When a coil of wire is maintained at a red heat in a mixture of carbonic oxide and steam, and the carbon dioxide formed is removed by means of a dilute solution of potash, the carbonic oxide is in time completely oxidised to carbon dioxide with the liberation of the corresponding volume of hydrogen. Similarly, when a coil of platinum wire is maintained at a red heat in a mixture of carbon monoxide and hydrogen, and the steam formed is removed by means of phosphoric oxide, the carbon dioxide is in time completely reduced to carbonic oxide. Since these experiments were made Naumann has shown that when carbonic oxide and steam are heated in a tube to 950°, 10·5 per cent. of carbonic oxide is turned into carbon dioxide.—On multiple sulphates, by Miss E. Aston and S. U. Pickering.—On the use of ferrous sulphate in agriculture, by A. B. Griffiths, Ph.D.—On phenyltribromomethane, $C_6H_5.CBr_3$, by Walter H. Ince.

Institution of Civil Engineers, January 12.—Sir Frederick J. Bramwell, F.R.S., President, in the chair.—The paper read was "On Gas Producers," by Mr. Frederick John Rowan.

EDINBURGH

Mathematical Society, January 8.—Dr. R. M. Ferguson, President, in the chair.—Mr. R. E. Allardice discussed a problem of symmetry in an algebraical function.—Mr. A. Y. Fraser gave an account of the methods for the quadrature of areas, especially by planimeters. He exhibited and described several of these instruments, including two of his own invention.

MANCHESTER

Literary and Philosophical Society, October 12, 1885.—Microscopical and Natural History Section.—Mr. Thomas Alcock, M.D., President of the Section, in the chair.—Prof. Boyd Dawkins, F.R.S., brought before the notice of the Section rock-specimens and microscopic slides illustrating the structure of the clay-slate of Snaefell in the Isle of Man.—Mr. Stirrup exhibited a small slab of the flexible sandstone of India.

SYDNEY

Royal Society of New South Wales, October 7, 1885.—Prof. Liversidge, F.R.S., President, in the chair.—Mr. Charles Moore, F.L.S., read a paper on the ringal of the North-West Himalayas, by Mr. Brandis (communicated by Baron von Müller, K.C.M.G.). Specimens of the bamboos now in this country were shown.—Prof. Liversidge exhibited a portion of a brick, the surface of which was green. The discolouration, he explained, was due to the presence of vanadium salts.

November 5.—Prof. Liversidge, F.R.S., President, in the chair.—The President referred to the loss the Society had sustained in the death of the senior Vice-President, the Hon. Prof. Smith, M.D., C.M.G., M.L.C.—Dr. Morris read some notes upon a very large number of experiments made with the view of discovering media having a higher refractive index than Canada balsam for the mounting of *Amphipleura pellucida*.—Mr. S. H. Cox, F.C.S., F.G.S., read some notes on the character of the Adelong Reefs.—The Rev. P. MacPherson described a collection of stone implements used by the Aborigines of Australia.—The Hon. J. M. Creed exhibited a pestle and mortar, used by the Aboriginals on the Murray River for grinding seeds.—Mr. H. C. Russell exhibited a new and simple form of tide-gauge.

PARIS

Academy of Sciences, January 11.—M. Jurien de la Gravière, President, in the chair.—Obituary notice of M. de Saint-Venant, Member of the Section for Mechanics, who died at Vendôme on January 6, by the President.—A new method for determining the elements of refraction, with a view to a more approximately correct knowledge of the true position of the heavenly bodies, by M. Lœwy. For this method it is claimed that it is extremely simple and direct, dispensing with the necessity of simultaneously ascertaining the value of any other quantity. It is also independent of any instrumental error, relying solely on differential measurements—that is, on operations by which alone a high degree of precision can be obtained.—Note on the constitution of the solar spots and on photography regarded as an instrument for discoveries in astronomy, by M. J. Janssen. These remarks are made in connection with a photographic image, presented by the author to the Academy, of the large spot visible on the solar disk on June 22, 1885, which was one of the largest hitherto observed. The image fixed on the photographic plate was formed with the violet rays of the region G, which affect the retina very feebly; hence, without the aid of photography, could scarcely ever be detected, even with the most powerful telescopes.—Note on the exceptional magnetic disturbance recorded by the magnetic registrar at the Observatory of the Parc Saint-Maur on January 9, by M. Mascart.—On the various states of the sulphur of antimony, which exists normally in two distinct states—that of a black crystallised sulphur, such as occurs in nature, and the orange hydrated sulphur obtained by precipitation, by M. Berthelot.—On the reciprocal actions and the equilibria established between the hydrochloric and hydrosulphuric acids and the salts of antimony, by M. Berthelot. It is shown: (1) That the inverse actions are produced in cases where the sign of the heat liberated by the reaction of two bodies, such as the sulphur of antimony and hydrochloric acid, is changed by the combination of one of them with a third body, such as water-forming hydrates, or even with one of the products of the reaction; (2) that the chemical action is not reversed abruptly, but according to a certain gradation of intermediate compounds, such as the hydrates, hydrosulphates, hydrochlorides, &c.; (3) that these secondary compounds exist for the most part only in a state of partial dissociation; (4) that they determine and regulate the chemical equilibria between the antagonistic bodies, according to the conditions of their own existence and dissociation; at this point intervene the physico-chemical laws of dissociation, which are at present being so actively investigated by chemists. — On alternating semi-anæsthesia regarded as a symptom of certain lesions of the rachidian bulb, by M. Vulpian.—Note on some meteorites which fell in the Hissar district, Punjab, on February 19, 1884, and at Chandpur, near Mainpuri, North-West Provinces, on April 6, 1885, by M. Daubrée. Both specimens, supplied to the author by Mr. Medlicott, of the Indian Geological Survey, appear to belong to the type of sporadic siderites, with respective densities 3·40 and 3·25.—Application of the transport of power by electricity in the cannon foundry of Bourges, by M. Favé. Since 1879 two movable cranes of 20 tons have been worked by electricity in this establishment without any accident.—Note on an arrangement of lenses with a great diameter and short focus presenting a very slight aberration, due to the late Col. Mangin, communicated by the Minister of War. The system consists of three lenses with a diameter of 0·60 metres, one bi-convex, the two others concavo-convex, having a resulting focal distance of about 1 metre. The curves are so calculated that there is nowhere a deviation of light of more than 2° 30′; and as the three lenses have no great thickness, the loss of light passing through them is scarcely one-twelfth, a loss more than compensated by the gain from the reduction of aberration.—Observations on Brooks's new comet made at the Paris Observatory (equatorial of the west tower), by M. G. Bigourdan.—Observations of the same comet made at the Observatory of Nice (Gautier's equatorial), by M. Charlois.—Summary of the solar observations made during the second half of the year 1885, by M. P. Tacchini. A progressive and rapid diminution of the solar spots was observed during the whole year, and especially during the last quarter. The faculæ were also less numerous, but the protuberances rather more frequent than in the previous six months.—On the propagation of sound in a cylindrical tube, in supplement to the labours of Regnault on this subject, by MM. Violle and Vautier. The main result of the experiments carried on in an underground conduit at Grenoble was that the velocity of propagation seemed to decrease with the intensity of the sound.—On the variations of the spectra of absorption and of the spectra of emission by the phosphorescence of the same body, by M. Henri Becquerel.—Note on the hydrates of hypophosphoric acid, by M. A. Joly. From the author's experiments this substance would appear to be as sharply determined by its crystallised hydrates as the phosphoric and phosphorous acids, and in the solid state it is fully as stable.—On the solubility of the sulphate of copper in presence of the sulphate of ammonia, by M. R. Engel.—On some combinations of acetimide with the metallic chlorides, by M. G. André.—Oh the preparation, properties, and reactions of iodaldehyde—

$$5C_2H_4O) + 4I + IO_3H = 5(C_2H_3IO) + 3H_2O,$$

by M. P. Chautard.—On the amylaceous granules of the cystosome of the gregarines, by M. E. Maupas.—On chlorophyll action (absorption of carbonic acid and emission of oxygen) in ultra-violet darkness, by MM. G. Bonnier and L. Mangin.—Verification of the existence of glacial formations in Equatorial Africa (Gold Coast between Cape Palmas and the Bight of Benin), by M. Chaper.—On the physiological action of the salts of lithium, rubidium, and potassium, by Mr. James Blake. It is shown that the relative toxic properties of the salts of lithium and rubidium increase with the atomic weight.—Researches on the coagulation of albumen, by M. Eug. Varenne.—Experiments showing that under certain conditions the charbon virus becomes attenuated in the ground, by M. V. Feltz.—On the transmission of glanders from mother to fœtus, by MM. Cadéac and Malet.—On the cultivation of wheat in the districts of Wardrecques (Pas-de-Calais) and Blaringhem (Nord), by MM. Porion and Dehérain.

BERLIN

Physical Society, Nov. 6, 1885.—Starting from the classical experiments of Bunsen and Roscoe respecting the action of light on a mixture of chlorine and hydrogen, Dr. Pringsheim had by recent experiments endeavoured to obtain a closer insight into the mode of the action of light. Light, as was known, was absorbed to a definite amount by chlorine, while hydrogen had a coefficient of absorption almost equal to zero. When now light passed through a mixture of chlorine and hydrogen, a part of the light was, in the first place, absorbed by the chlorine, just as though this gas were the only element through which it passed, and in all probability this absorbed amount was transformed into heat. In addition to this effect, on the other hand, the chemical affinity of the gases got excited, and in order to this operation light was likewise absorbed. Whether in this process we had a direct action of light-rays transformed into heat or only a kind of releasing influence on the part of the rays was a point that had yet to be determined. The difficulty of this determination was enhanced by the fact of the induction which Bunsen and Roscoe had already ascertained, in accordance with which the chemical combination of the chlorine with the hydrogen did not take place at once, but only a longer or shorter time after the beginning of the irradiation. By taking the gas-layer of great thickness Dr. Pringsheim was enabled to augment the time of the induction to twenty minutes, and the combination of the two gases was effected only in the twenty-first minute of the irradiation. For his experiments Dr. Pringsheim made use of a gas-developing apparatus in which concentrated hydrochloric acid underwent electrolysis by means of iridium electrodes, and from which the gases passed through a tube into a globular irradiation space whence a capillary, divided into millimetres, led to a vessel filled with water, from which, again, a thread of water penetrated into the capillary, and so served as index of the gas-pressure obtaining in the apparatus. Any heating influence expanded the gases and pushed the index outwards, while as often as hydrochloric acid was formed—the acid being at once absorbed by the water that was present in the insolation-globe—it caused an advance of the index, and the measure of this advance served as a criterion of the amount of acid formed. Experiments were next instituted in regard to the nature of the induction, and investigation was made as to whether it were identical with the chemical action of the light or were somewhat different from it. Sources of light of different intensity and different colour were examined in respect of their chemical and their inductive action, and it always turned out that the rays of most intense chemical action produced likewise the greatest induction. In the measurements of the chemical action of light, which were then taken in hand, a petroleum lamp was used as a source of light, the warm rays of the petroleum lamp being eliminated by means of an intercalated layer of water. Dr. Pringsheim first observed a sudden movement of the index outwards, which was at once followed by a speedy retirement to the initial position, and from this point the index was then observed proceeding slowly inwards, in proportion as muriatic acid was formed and absorbed. Seeing the first movement of the index might be interpreted as an effect of heat, control experiments were instituted with momentary illumination, at first by dropping a dark screen with small slit before the flame, and then by means of electric sparks. Each time now that the light ray struck the chlorine hydrogen gas mixture, the index was seen pushing suddenly outwards, and then as suddenly reverting to its former position, whence it then slowly retired inwards. There could, therefore, be no question in this case of any heating, but there must, on the contrary, be some other cause in operation, to the determination of which other experiments should be devoted.—Dr. König spoke on colour-blindness, and, in particular, on the important light it would throw on the theory of colours if, in addition to cases of red and green blindness, the existence of violet blindness could be demonstrated. Hitherto violet-blind persons had been described only by Herren Donders and Holmgren. These gentlemen had examined abnormal eyes, which, in the spectrum between red and green, saw a circumscribed gray band, exactly at the spot where, in the case of the violet-blind, the two remaining curves of colour-sensitiveness intersected each other. Last year, for the first time, Dr. König had an opportunity of examining an intelligent boy of from thirteen to fourteen years of age, who likewise testified to a quite distinct gray band in the spectrum between green and red, while he saw all other colours accurately. The belief that here was a case of a violet-blind person was, however, materially shattered when the spectral violet was presented quite pure and isolated before the boy. He then said he saw a colour which he had never before seen in his life. The boy was, therefore, not incapable of perceiving violet rays. Later, Dr. König had occasion to examine an eye affected with central turbidity of the retina, an eye which—so far as the experiments that were capable of being executed only with great care, allowed the determination of the matter—was, in point of fact, violet-blind. On investigating the neutral point, it was found with very great precision at the wave-length, 560·14. According to theory, the intersecting point of the red and green curve lay at 563·5 wave-length, very fairly, therefore, in agreement with the value thus found. The measurements of intensity between the wave-lengths 560 and 470 yielded values which likewise coincided exactly with those given theoretically for bichromatically violet-blind eyes. The now considerably more exact method for examining the colour-blind and the significance of these ascertained facts in relation to the theory would be set forth by Dr. König on a future occasion.—In the discussion which the first communication called forth, Prof. Landolt made the proposal of using a solution of lithium chloride in order to obtain, by way of electrolysis, a perfectly pure chlorine hydrogen gas mixture. In the case of electrolysis of hydrochloric acid there was a danger, he represented, of oxygen being united with the gas mixture. Prof. von Helmholtz said that the influence of the rays of light on the chlorine and hydrogen molecules might be conceived by supposing that they acted in a manner similar to that of elastic balls executing oscillations in a high-standing flat vessel, whereby they were continually passing up and down. Did one ball receive on some occasion or other a stronger impulse than usual, then it leaped over the edge and fell to the ground; so that in respect of the totality of movements in the vessel, a part of the energy was lost. In the same way, when an atom of chlorine and hydrogen approached so close to each other that they united chemically, a part of the energy of the oscillations of light became lost. In reference to the second communication (that of Dr. König), Prof. von Helmholtz set forth the difficulties of investigations of the kind in question, and laid special stress on a psychological difficulty. It was known that only the central part of the retina was trichromatic. With the part of the retina attaching itself periphericially, only two colours were seen, while the extreme region of the retina was monochromatic. Nevertheless, we always saw a white surface as white, whatever part of the retina were struck by these rays. It was plain that we had learned by experience to perceive objects that appeared white in the central field as white likewise when at the periphery they stimulated only two or but one kind of fibres. In all investigations into colour-blindness this psychological point was one which ought to be taken into quite material account.

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