THURSDAY, SEPTEMBER 13, 1877

STAR OR NEBULA?

FOLLOWING close upon the publication of Dr. Vogel's paper on the new star in Cygnus, Lord Lindsay has communicated an interesting letter to the *Times* announcing the fact that the new star has now put on the appearance presented ordinarily by the so-called planetary nebulæ.

Of all the lines chronicled by Cornu and Vogel only one remains, that namely which the latter observer showed to be constantly increasing in brightness while all the rest were waning, and which, moreover, as Vogel also distinctly showed, is coincident in position in the spectrum with that observed in the majority of the nebulæ.

The observations of such rare phenomena as the so-called new stars, are of such vast importance, and will no doubt ultimately provide us with a clue to so many others of a different order, that we may well congratulate ourselves that the recent *Nova* was so well watched, and that there is such perfect completeness and unity in the chain of recorded facts.

It should have been perfectly clear to those who thought about such matters that the word star in such a case is a misnomer from a scientific point of view, although no word would be better to describe it in its popular aspect. The word is a misnomer for this reason. If any star, properly so called, were to become "a world on fire," were to "burst into flames," or in less poetical language, were to be driven either into a condition of incandescence absolutely or to have its incandescence increased, there can be little doubt that thousands or millions of years would be necessary for the reduction of its light to the original intensity.

Mr. Croll has recently shown that if the incandescence observed came for instance from the collision of two stars, each of them half the mass of the sun, moving directly towards each other with a velocity of 476 miles per second, light and heat would be produced which would cover the present rate of the sun's radiation for a period of 50,000,000 years.

A very different state of affairs this from that which must have taken place in any of the Novas from the time of Tycho to our own, and the more extreme the difference the less can we be having to deal with anything like a star properly so called.

The very rapid reduction of light in the case of the new star in Cygnus was so striking that I at once wrote to Mr. Hind to ask if any change of place was observable, because it seemed obvious that if the body which thus put on so suddenly the chromospheric spectrum were single, *it might only weigh a few tons or even hundredweights*, and being so small might be very near us. Mr. Hind's telescope was dismounted, and I have not yet got any information as to change of position; and as I am now writing in the Highlands, away from all books, I have no opportunity of comparing the position now given by Lord Lindsay in R.A. 21h. 36m. 52s., Dec. + 42° 16′ 53″, with those given on its first appearance by Winnecke and others.

We seem driven, then, from the idea that these phenomena are produced by the incandescence of large masses of matter, because if they were so produced, the running down of brilliancy would be exceeding slow.

Let us consider the case, then, on the supposition of small masses of matter. Where are we to find them? The answer is easy;—in those small meteoric masses which an ever-increasing mass of evidence tends to show, occupy all the realms of space.

In connection with this, perhaps I may be permitted to quote the following from one of my "Manchester Lectures":—

"There is one point to which I think I may be permitted to draw your attention, although at present it rests merely upon an unendorsed observation of my own. I thought it would be worth while to try what would happen if I inclosed specimens of meteorites, taken at random, in a tube from which I subsequently exhausted the air by a pump. After the pumping had gone on for some considerable time, of course we got an approach to a vacuum; and arrangements were made by means of which an electric spark could pass along this apparent vacuum, and give us the spectra of the gases evolved from the meteorites. Taking those precautions which are generally supposed to give us a spark of low temperature, and passing the current, we got a luminous effect which, on being analysed by the spectroscope, gave us that same spectrum of hydro-carbon which Mr. Huggins, Donati, and others have made us perfectly familiar with as the spectrum of the head of a comet. There, then, we get the atmosphere of meteorites, not necessarily carbonaceous meteorites, but meteorites taken at random; and this atmosphere is exactly what we get in the head of a comet.

"Now let me go one step further; and to take that step with advantage, allow me to refer to another point . . . . that whereas Schiaparelli has connected meteorites and falling stars with comets, Professors Tait and Thomson, on the other hand, have connected comets with nebulæ, both of them being, according to those physicists, clouds of stones. Now how was one to carry these spectroscopic observations into the region of the nebulæ? A Leyden jar was included in the circuit, and we had what is generally supposed to be an electric current giving us a very much higher temperature than we had before. What, then, was the spectrum; the spectrum, so far as the known lines were concerned, was the spectrum which we get from the nebulæ; for the hydro-carbon spectrum, which we get from the atmospheric meteorites at a low temperature, was replaced by the spectrum of hydrogen; the spectrum of hydrogen coming, of course, from the decomposition of the hydro-carbon, with the curious, but at present unexplained, fact that we got the spectrum indications of hydrogen without indications of carbon. In my laboratory work I have come across other curious cases in which compound vapours, when dissociated, only gave us one spectrum at a time—by which I mean that in a vapour consisting of two well-known substances, under one condition we only get the spectrum of one substance, and under another condition we get the spectrum of the other substance alone, so in others again of both combined. The evidence seems, therefore—though I do not profess to speak with certainty—entirely in favour of the ideas of Sir William Thomson and Prof. Tait on the one hand, and of Schiaparelli on the other. I note this because I shall have again to refer to the conclusion to be drawn from it, namely, that there is probably an intimate connection between nebulæ, comets, meteorites, and falling stars."

I have given the above extract to show that a mass of meteorites at a temperature higher than that found to

exist in a comet's head could give us the hydrogen spectrum which was discovered with such richness in the *Nova*, and which is represented in the spectra of most nebulæ.

The *Nova* now exists as a nebula so far as its spectrum goes, and the fact not only goes far to support the view I have suggested as against that of Zöllner, but it affords collateral evidence of the truth of Thomson and Tait's hypothesis of the true nature of nebulæ.

The nebular hypothesis in its grandeur and simplicity remains untouched by these observations; the facts so far from being in direct opposition to it help us, I think, all the better to know exactly what a nebula is.

There is another point of extreme interest to the spectroscopist if we accept the bright line observed in the star by Dr. Copeland and others to be veritably the chief nebula line.

It is clear from Dr. Vogel's diagram (given in last week's NATURE) that this line brightened relatively with each decrease in the brilliancy of the hydrogen lines. On December 8, 1876, it was much fainter than F, while by March 2, 1877, F was a mere ghost by the side of it. On any probable supposition the temperature must have been higher at the former date.

Now it is well known that within certain limits the lines in the spectrum of a compound body get brighter with *decrease* of temperature, because at the higher one the compound almost entirely ceases to exist as such, and we get the lines of its constituents. It is a fair theory then to suggest that the famous nebula line may belong to a compound. Nay the fact as it stands alone further points to the possibility that the compound in question contains hydrogen as one of its constituents.

J. NORMAN LOCKYER

Craig Dhu, Kingussie, September 10

THE GLACIAL GEOLOGY OF ORKNEY AND SHETLAND

NO one can claim to speak with more authority on matters Orcadian than Mr. Laing, and few men are better fitted to judge of evidence and probabilities. His interesting letter (see p. 418 of this number of NATURE) calls attention to certain points which he regards as affording a crucial test of the value of some contending hypotheses in geology.

He asserts (1) That there is no evidence that the Orkney and Shetland Islands have ever participated in the general glaciation of Britain. (2) That these islands contain no raised beaches or marine terraces to prove any alteration of the relative levels of sea and land.

I. It would indeed be extraordinary on any hypothesis that no traces of glaciation should exist in Orkney. Could it reasonably be supposed that at a time when "the adjacent islands of Great Britain and Ireland" lay under a deep mantle of snow and land-ice which protruded even from the opposite shores of Caithness, these northern islets enjoyed a happy immunity from the cold which sealed up the more frigid south? I am afraid that on the contrary we must believe Orkney to have been in as evil case as its neighbours, no matter even if it should have succeeded in subsequently divesting itself of all traces of its wintry garb. It will not be necessary to discuss the bearing of Mr. Laing's facts upon any rival geological doctrines if it can be shown that the facts themselves do not exist. He courteously invites examination and disproof, and I think with all deference to him that I can point to evidence which when he next revisits his county will satisfy him that Orkney is no exception to the general glaciated condition of Scotland.

I have twice visited Orkney, and each time was too intent upon the curious history of the Old Red Sandstone of that region to have time to note all the features bearing upon the glaciation of the islands. But these features were too striking to escape notice, and I find in my note-books and on my map records of the observations jotted down at the time. So far from there being, as Mr. Laing asserts, no trace of ice-work among these islands, I found them to be well glaciated and to contain in particular, excellent illustrations of (1) *roches moutonnées*, (2) boulder-clay, and (3) valley-moraines.

1. Mr. Laing mentions the granitic axis which runs north from Stromness. When he has occasion to cross it again, gun in hand, let him stop here and there on the exposed hummocks and he will find them admirably ice-worn and striated. Well-preserved surfaces of this kind overlook the wild cliffs of Yesnaby, and others, of equal clearness, occur on the slopes behind Stromness. But further examination will show him that these markings are not confined to the hard granite and gneiss. Thus on the roadside at the south-east end of the Lake of Stennis, beautifully striated flagstones may be seen, the striæ in all these cases running north-west and south-east, as if produced by a movement from the latter quarter. Nay, even among the soft yellow sandstones of Hoy, well smoothed and striated surfaces may be noticed on the summit of the cliffs near the Old Man, at a height of 600 or 700 feet above the waves of the Atlantic.

2. Unmistakable boulder-clay occurs in Orkney. It is not generally or thickly spread over the surface, as in the lowlands of Scotland, but rather, as in Caithness, lies here and there in hollows, the rest of the surface of the islands being covered with a thin argillaceous soil, derived, as Mr. Laing points out, from the decay of the underlying flagstones. A thick mass of this boulder-clay lies on the north-west side of Shapinsha, another in the sheltered hollow of Kirkwall Bay, and a third forms a notable feature on the north coast of Flota. Mr. Laing cannot but be familiar with these and other localities, and he probably refers the deposits there to disintegration of the rock underneath. Of course the boulder-clay consists here, as elsewhere, mainly of the *débris* of the rocks below, and as these rocks are flagstones, breaking up into sharp-edged fragments, the stones in the clay are very commonly more or less angular. If, however, he finds, as he will assuredly do, that many of the stones are well polished and striated along their major axis, he may be satisfied that the deposit is a glacial one.

3. So far, the evidence which I have adduced shows that the Orkney Islands participated in the general widespread glaciation of the adjacent mainland. But we may believe that in so northern a locality, if the form and height of the ground in any manner permitted, the lingering snows would still form glaciers on the hills, though they had retreated from the lower grounds. Now there is only one mass of high ground in Orkney—the island

of Hoy, and there, if anywhere, traces of the last glaciers should be found. Two years ago, when engaged with my friend and colleague, Mr. B. N. Peach, in making a careful examination of the north end of that interesting island, I found what we had been in search of—a beautiful and complete proof of the unconformability between the Upper Old Red Sandstone and the Caithness flags. So engrossed were we with the magnificence of the natural sections where this structure is displayed, that we had climbed into the mouth of the green corrie below the Coulax Hill before we were aware that we stood upon a glacier-moraine. But from the top of the ridge, and, still better, from the steep grassy slope on the west side, three or four successive horse-shoe-shaped mounds could be seen extending across the valley, and becoming progressively lower and shorter when traced upwards, till the last of them died out at the base of the acclivity behind. Not only were they in external form and arrangement as perfect examples of moraines as could be desired; their internal composition bore ample testimony to the same origin. My companion and I found further proof that the other valleys of Hoy had also once nourished their separate glaciers, the most striking evidence being supplied by a moraine-mound nearly half a mile long and fifty or sixty feet high, which runs across the mouth of the glen to the east of Hoy Hill on the north-east side of the island. The angular rubbish of this moraine rests upon a stiff, red, sandy boulder-clay full of striated fragments of red sandstone. The hills from which these glaciers descended rise from 1,400 to 1,550 feet above the sea. That so small and so low an island as Hoy should have had its glaciers, creeping probably even down to the sea-level, need not surprise us, when we remember that small ocean-girt groups of mountains, like those of Skye and Mull, had their glaciers, and that even in Arran, more than three degrees of latitude further south, and from hills little more than 100 feet higher than those of Hoy, glaciers existed on such a scale as to leave behind them the huge moraines of Glen Cloy.

Mr. Laing refers also to Shetland, and though he states that his acquaintance with that region is not so intimate as his knowledge of Orkney, he believes that as little evidence of glaciation can be found there as among his native islands. In this case, too, I am afraid his statements are too absolute. It is now many years since Mr. C. W. Peach chronicled the occurrence of abundant striated rock-surfaces and boulder-clays with striated stones in the Shetland Islands (see "Report" of British Association for 1864, Sections, p. 60). From my own observation also I can speak confidently as to the correctness of these determinations. Even on the low and remote westerly islet of Papa Stour Mr. B. N. Peach and myself found boulder clay and many transported blocks of gneiss, schist, and other rocks foreign to the immediate locality, while the prevailing pink porphyry showed glacial striæ running N. 5° W. On the Mainland also, between the head of Bixetter Voe and Walls, we observed some curious mounds which if not true moraines are at least parts of the glacial series. Since our visit my colleague, Mr. John Horne, has spent some time in Shetland and has obtained ample evidence of the presence of a sheet of ice over that region (see NATURE, vol. xv. p. 139). There can indeed be no doubt that both Shetland and Orkney have been severely ice-ground and that the movement of the ice has been on the whole along a north-west and south-east line. So far therefore from these islands offering any exception or difficulty in regard to this geological question they bear their independent and concurrent testimony to the now generally received doctrine.

II. There is, however, one very remarkable feature of Orkney and Shetland to which Mr. Laing has referred, and with regard to which my own observations, so far as they go, thoroughly bear out his statement. I allude to the absence of raised beaches. During the surveys which I have made in conjunction with Mr. B. N. Peach we have continually asked each other what has become of the familiar raised beaches which skirt the Scottish coast-line even as far as the shores of Sutherland. Mr. Horne was equally struck by their absence. It is indeed inconceivable that if our raised beaches be due to a rise of the ocean level from the accumulation of a polar ice-cap (a doctrine which I for one have never accepted) there could fail to be found some remnants of them among the innumerable sheltered creeks and bays of these northern islands, in positions where on the near mainland they would assuredly be found. Well-marked raised beaches skirt the north coast of Sutherland within sight of the hills of Orkney. And yet I never observed any trace of a terrace which by possibility could be made to do duty for a raised beach, either in Orkney or in Shetland, and Mr. Laing's much wider acquaintance with these islands confirms my belief that such terraces probably do not exist in Shetland, if not also in Orkney. But the difficulty of accounting for their absence is not inconsiderable, even if we hold that our raised beaches point to successive elevations of the land. Why should they cease with the northern bays of the mainland of Scotland? Can we suppose that the upheaval so marked in Sutherland did not affect Orkney?

During a recent visit to Sutherland and Caithness I tried to find some satisfactory solution to these questions. It is important to observe that on the mainland the raised beaches disappear when we pass from the crystalline rocks into the Old Red Sandstone. Travelling, for example, along the coast-line from Inverness, by the Beauly, Cromarty, and Dornoch Firths, we find ourselves, almost without intermission, upon one or other of the level sandy terraces which form so conspicuous a feature of these shores. Even upon the strip of Jurassic rocks the same platform runs on to Helmsdale. But northwards the coast rises in one long line of precipice, from which slice after slice is cut as the lines of joint split open under the influence of air and sea. I have seen no satisfactory raised beach in Caithness. The only places where, from the shape of the coast-line, the existence of such deposits was possible are in Thurso Bay, on the coast between Dunnet and Duncansbay Heads, and in the bays between Freswick and Wick. But even on these more sheltered and less precipitous shores the rock usually stands up in low cliffs and runs out in reefs, or steep banks of boulder-clay rise from the edge of the beach, or ridges of blown sand stretch for some distance inland. Now the rocks of Orkney are identical with those of Caithness; they split up into the same long lines of sea-cliff, they are swept by the same stormy seas, and

washed by the same heavy tempestuous rains. Along by far the larger part of the immensely-extended coast-line of these islands no raised beach could have been formed, or, if formed, could have remained until now. So rapid is the retreat even of the solid cliffs, that both there and in Caithness a Pict's house may now and then be found, from which the outer walls on the seaward side have disappeared, together with the solid ground on which they stood, while the surge is ever breaking at the base of the cliff below. Even into the sheltered inlets the same vertical sea-cliffs often run, so that the possible localities for the formation and preservation of raised beaches are comparatively few in number. A more diligent search among these few resting-places may yet reveal the existence of some fragments of marine terraces in Orkney. In the meantime the want of raised beaches in Caithness, where, to judge from the proximity of those in Sutherland, they probably at one time existed, should put us on our guard against a too hasty and sweeping inference from their absence in Orkney.

With regard to Shetland, however, the case is far stronger. Rocks of many varied kinds form the islands of that group running out into ridges and chains of islets, and inclosing innumerable *voes* and land-locked inlets. Nowhere could there be a more admirable surface for the formation and conservation of raised-beaches. The absence of these deposits cannot therefore be accounted for except, as I am constrained to believe, on the supposition that they never existed there at all. That interrupted elevation of the land, to the pauses in which the raised-beaches point, seems to have lessened towards the north. It is still traceable by means of these terraces on the northern shores of the mainland. Evidence of it has not been detected in Orkney, though as I have said, this may not show that it did not affect these neighbouring islands. But when we recede to the far Shetlands, all trace of the former lower level of the land ceases—at least it is not preserved in lines of raised beach.

ARCH. GEIKIE

PENNINGTON'S "BARROWS OF DERBYSHIRE"

Notes on the Barrows and Bone-Caves of Derbyshire. With an Account of a Descent into Elden Hole. By Rooke Pennington, B.A., LL.B., F.G.S. (London: Macmillan and Co., 1877.)

MR. PENNINGTON has done good service to science by publishing his "Notes." The objects he describes belong to the palæolithic, the neolithic, and the bronze ages of Britain and Western Europe generally; but, following Prof. Boyd Dawkins, the author includes the entire period between the close of the palæolithic age and the earlier part of the iron age under the comprehensive name of the prehistoric ages. Moreover, to bring the eras of the archæologist into correlation with those of the biologist, he reminds the reader that during the prehistoric ages, "the animals living in Europe were generally speaking the same as those which live there now," whilst palæolithic man was accompanied by the mammoth, and many other extinct forms.

The author's prehistoric researches were conducted partly in caverns, but mainly in barrows. The latter, usually heaps of stone and turf, were either of an oblong form, or, much more frequently, "round heaps, like a basin or saucer turned upside down."

The circular barrows appear to have been in some cases nearly fifty feet in diameter, and fully five feet high at the centre. That on Abney Moor was surrounded with a rampart of earth fifty feet in exterior diameter, and having on it ten upright equidistant stones about three feet high, whilst the inclosed mound measured but twenty feet across. Almost all the barrows appear to have yielded human bones, and in some instances more or less complete skeletons, some of which occupied stone cists, whilst others did not. The body of a young man, about seventeen years of age, had the skull protected with four stones, one being a cap stone, whilst large pieces of limestone were piled irregularly round the rest of the skeleton. All the bodies found entire were in a contracted position, and there seems to have been a tendency to place them on the left side, facing north or north-westerly. Two or more skeletons were found in some cases in the same barrow, and two were met with in the same cist in a barrow on Gautriss Hill. In Siggett barrow the skeleton of a child was found very near the feet of that of an adult. Some of the barrows contained evidence of cremation; thus, in the centre of that on Abney Moor was a large flat piece of sandstone, on which human bones, accompanied by flint flakes, a chert flake, beads of jet and of amber, and a good arrow head, had been carefully deposited. There was satisfactory evidence that the funeral fire had been lighted on the spot.

Relics of water-rat, horse, red deer, roe deer, *Bos longifrons*, goat, hog, and dog were also found in the barrows, and, with the exception of the first only, commingled with the human remains. In a cist in Oxlow barrow part of a boar's tusk had been placed with the human skeleton. The horse, roe deer, goat, and dog appear to have been the least prevalent forms. On the other hand, when speaking of water-rats, the author says, "I never explored either a burial mound or a cave without finding plenty of them;" and in one instance he says "Rats came out by spadefuls."

Of articles made or selected by man the barrows yielded a cut antler, quartzite and other "foreign" pebbles, chipped flints, pottery, chert flakes, beads of jet and of amber, holed stone hammers, bone pins, arrow heads, and bronze rings and celts.

The prehistoric caves and "rock shelters" situate in Cave Dale, Hartle Dale, and Creswell Crags, contained, with the exception of roe-deer only, remains of all the barrow animals, and of wolf, fox, shrew, badger, cat, hare, rabbit, duck, and fowl, in addition. They also yielded flint flakes, a holed sandstone hammer, charcoal, pottery, some of which was Roman, a cut stag's horn, a bone comb, pieces of jet, a celt and some ornaments in bronze, a few iron articles, and a coin of Hadrian.

When speculating on his discoveries the author remarks of the skeleton of the youth supposed to be about seventeen, that the people who buried him must have been "actuated by some other feelings of respect than those springing simply from personal valour or wisdom. This boy must have been of some rank; possibly the eldest son of the chief. The rudiments of government and of

hereditary station seem to have existed, for it was not every person who was honoured by so large a cairn."

The contents of the long-shaped barrows differed from those of circular outline. The former contained neither metals nor burnt bodies; all the human skulls were long or "boat-shaped;" and the barrows seemed of higher antiquity than the others.

The neolithic and the bronze people had similar customs; each disposed of their dead by cremation, as well as by burying some of them entire and in a contracted position; each used polished stone celts, and jet and amber ornaments; each made coarse pottery, and ornamented it with the same rude designs; and during each period the skulls of some of the people were long and narrow, whilst those of others were round.

The evidence of infanticide, slaughter of slaves, and cannibalism during the prehistoric ages is thought to be too conclusive to admit of doubt.

We must content ourselves with a brief mention of the Palæolithic "finds" described by the author. He first found bones in 1870 in Windy Knoll quarry, near the northern part of the mountain limestone of Derbyshire. Aided by Mr. Tym he began systematic work there in 1874, and Prof. Boyd Dawkins joined them in 1876. A cavity in the rock—not a cavern—proved to be crammed with remains of grizzly bear, wolf, fox, water-vole, shrew, bat, bison, reindeer, roe deer, hare, and rabbit. Omitting vast numbers of mere fragments, there were more than 3,500 bones and teeth of bison, of which a large number were calves; 1,200 specimens of reindeer, also including calves, but in a lower ratio; and sixty canine teeth of grizzly bear—the only ursine species met with. The remains varied much in their state of preservation, but a very large number were perfect, and many were in their proper relative positions.

The history of the "find" was probably this:—"A swampy place was resorted to by the migrating herds of bison and reindeer. The overflow would escape into the 'water-swallow' hard by, a precipitous place into which animals might and did fall." There was no trace of mammoth, rhinoceros, hyæna, or man.

A fissure in a mountain limestone quarry at the Staffordshire village of Water-houses yielded, in 1864, remains of mammoth, hippopotamus, and rhinoceros, about twenty feet below the surface of a deposit of loam and angular fragments of limestone, and containing a number of quartz pebbles. In 1873 relics of bison, horse, and wolf, were met with in a prolongation of the same fissure, but at not quite so low a level. The bones were probably all of them those of animals which had fallen in.

Mr. Pennington has increased the value of his book by giving an account of the Rev. Mr. Mello's discoveries in the caverns of the Permian formation at Creswell Crags, on the confines of Derby and Nottingham shires. Mr. Mello began his researches in 1875, and in 1876 an exploring committee was formed, who have thoroughly examined the Pin Hole, Church Hole, and Robin Hood Caves. In the last the deposits were, 1st, or uppermost, soil containing Romano-British relics; 2nd, breccia; 3rd, light-coloured "cave-earth;" 4th, a mottled bed; and 5th, or lowest, red sand. Remains of extinct animals occurred in the lowest three, and included *Machairodus latidens*, cave lion, leopard, wild cat, cave hyæna, wolf, fox, Arctic fox, glutton, grizzly bear, brown bear, pole-cat, water-vole, mammoth, woolly rhinoceros, horse, bison, reindeer, great Irish deer, wild boar, and hare. We observe, however, that Prof. Boyd Dawkins does not mention the Arctic fox, or the glutton, or the wild boar as amongst the "finds" (see *Quart. Journ. Geol. Soc.*, No. 131, pp. 590, 602). The remains of hyæna were very numerous, and the condition of the older osseous relics betokened that at least most of them had been introduced by him. The author is of opinion that the fauna was Arctic or north temperate.

The lower deposits contained large numbers of broken and chipped fragments of quartzite, which must have been derived from a distance. Flint flakes occurred in hundreds, and of all sizes and forms, in the upper layers, where quartzite fragments were but few. Scrapers and lance-points were the commonest of the flint tools. Bone implements were also met with, and included a needle and a pin or lance-head, &c. There was also a sketch of a horse on a piece of flat bone—the first, and, up to the present time, the only example of palæolithic fine art found in Britain. The explorers also met with a piece of amber and bits of charcoal, and found reason to believe that the hare was largely used as food. The amber does not appear to be mentioned by Prof. Dawkins.

Our limited space forbids us to follow the author through his interesting speculations on palæolithic anthropology; but we cannot help doubting whether the exploring committees of the caverns near Settle and Torquay will endorse his opinion that "no caverns in this country have furnished such a variety of evidence as to ancient man and the animals which furnished him with food and clothing" as those of Creswell Crags. Those of us who at the close of the Plymouth meeting of the British Association, visited the caverns at Brixham and Torquay, and noted that they almost overhang the sea, cannot but regard the author's proposition that "the palæolithic cave dweller of England was an inlander" as being much too sweeping.

Finally, whilst perusing the volume which we now close reluctantly, we have again and again caught ourselves wishing that anthropologists would supply us with good definitions of "savage" and "barbarian," and tell us whether the words are to be used as synonyms.

OUR BOOK SHELF

Mathematical Questions, with their Solutions, from the "Educational Times." Edited by W. J. C. Miller, B.A. Vol. xxvii. from January to June, 1877. (London: C. F. Hodgson and Son.)

JUST fifteen years ago we became aware, by the chance sight of a copy of the *Educational Times*, of the existence of a paper which gave up three or four pages monthly to the proposal and solution of mathematical questions. We at once sent to England, and a more careful examination of the copy we received showed us that it was a publication of very high merit, at least as regarded this one department. Hitherto we had in the main confined our mathematical reading to the usual rut passed over by mathematical masters who have only to do with the teaching of ordinary boys; now we were induced to join the, at that date, small band of contributors who rallied round the mathematical editor and derived much pleasure and profit from the study of the many

elegant solutions which were constantly being given. We have the number for October, 1862, before us, in which are Questions 1312 to 1320 proposed under six different names; we turn to the number for the current month, and the questions range from 5387 to 5419 from as many individual proposers, whose names are given. Here is evidence that a want has been met, and that there is considerable vitality in this direction; indeed, we may remark that this is the sole English periodical (since the demise of the *Lady's and Gentleman's Diary*) to which mathematicians can send high-class problems. University and college examinations swallow up a great deal of what is produced by residents at the universities, but these pages are open to all comers.

It soon occurred to us that here was a great mass of useful work being done and yet not producing the full benefit it might do if it were reproduced and published in a separate volume. The editor at once fell in with our views; indeed we found that the like idea had occurred to himself. There were, however, supposed pecuniary and other difficulties to encounter, but at last these were got over and the work, after one volume had been published, took its present form, which is now a conspicuous one on many a student's shelf. The fact that now their solutions would be treasured up in this more desirable shape seems soon to have led our foremost mathematicians to give in their adhesion, and as we run over the long list of contributors prefixed to the volume before us, there is hardly a name familiar to us which is not to be found there. France, Italy, and America also, are fairly represented. Ladies, too, there are, showing that

> "the gay determinant
> For (them) its rows exchanges,
> While Hamilton's weird delta turned (∇)
> O'er all the symbols ranges."

It says very much for the ability, in more directions than one, of the editor, that he has nursed the bantling which was handed over to his care more than sixteen years ago into the vigorous and lusty athlete of to-day. Nothing mathematical comes amiss to his net, but we may say that though the Dii majores roam about in their own special pastures, he has a marked predilection for the line taken up and well-worked out by Messrs. Woolhouse and Crofton, *i.e.*, of probability in its many applications.

It only remains to say that the "Reprint" is more than a reprint, for it contains about as much more original matter as appears in the monthly paper. Space is found for detached papers and notes, and for alternative solutions, often of equal, if not greater, interest, than the previously published matter.

There are occasional parenthetical notes—we think it should be more clearly indicated who is responsible for these, as they are often valuable ones.

The training the printers have gone through in getting out these solutions has placed them on a high level as printers of mathematics, and the volumes of this series reflect great credit upon them.

Cronicon Científico Popular. Por D. Emilio Huelin. Vol. I. (Madrid: 1877.)

WE perused this volume with interest and pleasant surprise; we were pleased at finding it to be an excellent and well-written review of all new occurrences in the scientific world, and we were surprised to see such a work emanate from a country which hitherto has contributed but too small a share towards the progress and welfare of science. If we place Turkey at the head of the list of the most unscientific countries in Europe, Spain and Portugal certainly come second on that list; it is gratifying, therefore, to see some sign of improvement. We congratulate Senor Huelin on his valuable publication, which is one of the best of the kind that has yet come under our notice. The arrangement of the contents of the volume is particularly good. The first few chapters are dedicated to generalities and the philosophy of sciences; some of them contain detailed lists of all scientific publications in the world. Then follow numerous chapters relating to the latest discoveries, inventions, theories, &c., on the domains of physics, chemistry, astronomy, meteorology, mineralogy, and geology; the chapters of the physical section alone numbering no less than eighteen, and those of the chemical section as many as twenty. Any occurrence at all worthy of record up to the end of last year is faithfully mentioned in the book. The second volume will contain the biological and mathematical sciences. We wish Senor Huelin and his publishers every success with their valuable addition to scientific literature.

Die Naturkräfte. Band 21. "Die Insekten" (1st part): "Der Organismus der Insekten." With 200 original Woodcuts. By Dr. Georg Mayr. (München: R. Oldenbourg, 1877.)

THE importance of an examination of the internal as well as the external anatomy of insects has unhappily not hitherto engaged the attention which it deserves at the hands of British entomologists. It is a fact which cannot be disputed that by far the greater portion of that energy which our country has exhibited in the investigation of this branch of natural science has been devoted to the mere founding of types, and in consequence but little light has been thrown upon the ever-increasing array of problems which puzzle the biologist.

In studying the affinities of insects it is quite as important, and in all probability more so, that the internal structure and the embryology of insects should be known, as the external characters and the metamorphoses; it is therefore with unmixed pleasure that we welcome the appearance of Dr. Mayr's admirable and ably-illustrated treatise.

It would be impossible here to give even an outline of the vast series of facts which the learned author has brought together, nothing relative to the organism of insects being regarded as too insignificant for careful and unwearied research; as an instance of the thoroughness of his labours we would especially call attention to his interesting observations on the action of the legs of insects when walking, a point which he seems thoroughly to have studied and which he has amply illustrated, although many students would probably have regarded it as a matter of little moment. In fine, the entire volume is most valuable, and should be esteemed as a necessary hand-book, not only by every entomologist, but by all who have the interests of natural science at heart.

A. G. B.

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 ensure the appearance even of communications containing interesting and novel facts.]

Glacial Geology of Orkney and Shetland

A RECENT visit to Orkney has brought forcibly before me certain points of the highest interest in modern glacial geology, upon which, I believe, the state of the surface deposits in these islands is calculated to throw considerable light.

I may premise that although I am perfectly well acquainted with all the usual glacial phenomena of the North of Scotland, as described in Geikie's and other works, I am not a sufficient practical geologist to speak with positive certainty, though I think I know enough of the subject to establish a *primâ facie* case for what I have seen with my own eyes, and which I put forward in the hope that more competent observers may direct their

attention to the subject and either confirm or disprove facts which, if true, would seem to afford a crucial test of the truth or falsehood of some of the most important theories of modern geology.

The fact which I assert is, that there are no traces of glacial action, or of raised sea-beaches in Orkney.

I speak from an intimate personal acquaintance with these islands, which are my native county, and almost every yard of whose surface and shores I have explored with rod and gun, and in the course of canvassing at elections, and for many years back keeping a special eye on this very subject. Now I can assert positively that I never saw a boulder or perched block, or the trace of any till, boulder clay, kame, eskar, raised beach, or other form of glacial or marine action.

The whole of the islands consist—except a small patch of granitic axis—of Devonian strata, bare in places, but for the most part covered with a mantle of soil, which is the obvious result of the disintegration of the subjacent rock by existing sub-aërial causes, such as wind, frost, and rain.

In places, where soft strata come to the surface, this soil is deep and clayey, and the sections of it, afforded by the coast-line, might readily be mistaken at a distance, or by a superficial observer, for boulder-clay. But a close examination will show that the stones in this stony clay are always angular and always similar to the adjoining strata, and that the larger stones are generally deposited, allowing for subsidence and displacement, in the original lines of stratification conformable to those of the unworn rock below them. A good example of this may be seen within 200 yards of Kirkwall, on the east side of the bay under Cromwell's old fort.

Let any one compare this with the section of glacial boulder-clay shown on the other side of the Pentland Firth at Scrabster, and he does not require to be a geologist to understand the difference between a surface soil of glacial deposit and one of disintegrated rock.

In like manner I have observed innumerable sections of surface soil and of mounds and ridges, which at first sight might have passed for marine or glacial, and I have invariably found them to consist of angular fragments of the subjacent rock passing on the one hand into thoroughly decomposed rock or soil, and on the other into the solid strata on which they rest.

I believe I may state broadly that there is not a rolled or rounded stone or pebble, or trace of sand or gravel, in all Orkney above the level of the present sea-beach and blown sands, and away from the beds of the existing lakes and small streams.

There is not the vestige of a raised beach along the hundreds of miles of rocky coast of the various sounds and islands, or in the many sheltered inlets where, in the nearest counties of Scotland such as Sutherland, Ross, and Cromarty, raised beaches are invariably seen. All recent movements seem to have been movements of subsidence and not of elevation. The Loch of Stennis, with its surrounding plain, affords conclusive proof that at no recent geological period can the level of the sea have stood higher relatively to that of the land than it does at present. Had it done so the Loch of Stennis, which is now exactly level with the sea so that the tide flows into and out of it, must inevitably have been a sheltered inland fiord of salt water extending to the hills which bound the plain, which as the land rose or the sea retreated, must have left the plain covered with sand, shingle, and marine or brackish shells, of none of which is there the slightest trace, but, on the contrary, the ordinary rock strata with their disintegrated surface soil, occupy the whole plain and come up to the margin of the existing loch.

Now as to the inference from these facts.

The received theory of most glacialists is, that during the glacial period there was a great polar ice-cap extending over the whole of Scandinavia, Scotland, and a great part of England and Ireland. As a corollary of this many draw the inference that such an accumulation of ice, by displacing the earth's centre of gravity, would raise the level of the sea in the Northern hemisphere, and thus account for the higher levels relatively to the land at which it has undoubtedly stood.

Others contend that the glaciation was more limited and only extended in islands as it were, round each considerable mountain group in northern latitudes, and these attribute the phenomena of raised beaches, &c., to local elevations of the land rather than to general elevation of the sea.

Now here appears to me to be an opportunity of applying the *experimentum crucis* to these two conflicting theories.

If it be true that Orkney is not glaciated, and has no raised beaches, it seems to follow that the second, and not the first, of these theories must be the true one.

The second theory would account perfectly for the boulder-clay being found in Caithness, over the plain of which we may easily suppose the glaciers from the great mountain range which bounds it on the south and west, to have extended as far as Scrabster and the south shore of the Pentland Firth, while in Orkney there were no glaciers, because there was no great local mass of mountain region to produce them.

But, on the theory of a great ice-cap, I cannot see how Orkney could fail to have been planed by ice and covered by boulders, perched-blocks, and masses of glacial clays, sands, and gravels.

In any case the absence of raised beaches and of all traces of marine action above the present sea-level, seems to be inconsistent with any theory of a general and uniform rise of the ocean in these latitudes.

As regards the Shetland Islands I cannot speak with the same confidence, not being so intimately acquainted with them; still, having travelled over a great part of the principal islands, and coasted along their shores, I can assert that I have never seen any traces of glacial action, or of raised beaches. The latter must, I think, inevitably have shown themselves in the form of sea-caves at a higher level, such as those at Cromarty, had they ever existed, as the present line of exposed rocky coast is worn by the waves into innumerable caves and clefts.

As to boulders or boulder-clay, I do not believe they exist, and the only rounded or water-worn stones I have ever seen have been rolled in the Devonian and not in any modern seas, and result from the surface disintegration of the great conglomerate.

These are abundant in exposed situations, and they show the necessity for care in inferring modern glacial or marine action from the presence of rolled stones of foreign rocks.

In conclusion, I believe that these groups of islands, Orkney and Shetland, have never been subjected to glacial action or submerged and subsequently elevated, in any recent geological period, and that these facts are inconsistent with any theory of a great polar ice-cap, or of any uniform rise of the level of the ocean in northern latitudes.

S. LAING

Brahan Castle, Dingwall, N.B., August 25

Meteorological Effects of Eclipses

IN connection with certain variations of temperature observed during the total eclipse of the moon on August 24, 1877, by M. Berigny, and discussed at a late meeting of the French Academy of Sciences, as reported in NATURE (vol. xvi. p. 412), I am reminded of some observations made on board H.M.S. *Challenger* during the total eclipse of the sun on April 6, 1875. The position of the ship at noon of the day of the eclipse was in lat. 27° 13′ N., long. 137° 59′ E. about 400 miles south of Japan and 200 miles due west of the Bonin Islands. If my memory be correct, the eclipse was only partial for the part of the world we were in, a portion of the sun's disc being still visible in the shape of a thin crescent at the moment of maximum obscuration. The eclipse, occurred in the afternoon, and was heralded by a breeze from the south-west, which continued during the rest of the evening; but what at the time struck us as very remarkable was the fact that it was accompanied by a rise of the surface temperature of the sea, as will be seen from the following observations made at the time:—

April 6, 1875.	Temperature of sea-surface.	
4 A.M.	20·3° C.	
10 ,, ...	20·9 ,,	
Noon to 3 P.M.	21·1 ,,	
4 ,, ...	22·5 ,,	Time of the eclipse.
5 ,, ...	22·2 ,,	
6 ,, ...	21·9 ,,	
7 ,, ...	20·9 ,,	
8 ,, ...	20·0 ,,	

The *Challenger*, progressing at the rate of about three knots per hour, had just entered an area of alternate streaks of warm and cold water, the former due to the North Pacific equatorial current, known as the Kuro-Siwo or Japan current, the latter to the Arctic current which flows down off the east coast of Nipon, so that the observed rise of temperature, and perhaps also the south-westerly breeze which sprung up at the commencement of the eclipse may be a mere coincidence, and I give the observations for what they are worth.

During the discussion in the French Academy the theory suggested by M. Berigny that an eclipse of the moon might have an appreciable effect upon the temperature-conditions of our atmosphere, namely, by cooling the latter, does not seem to have met with much encouragement. It would be more extraordinary if such a phenomenon as a total eclipse of that luminary were found to exercise no disturbing influence of any kind upon the terrestrial atmosphere during the time of its occurrence.

J. J. WILD

The Development of Batrachians

IN reference to the article in NATURE (vol. xv. p. 491) on the development in certain instances of Batrachians without metamorphosis, Mr. B. G. Wilder writes to the *American Naturalist* (vol. xi. No. 8, August, 1877, p. 491) to point out that the author of the article in NATURE has overlooked Prof. Wyman's observations on the development of *Pipa americana*, published in the *American Journal of Science and Art* for 1854 (ser. 2, xvii. pp. 369-374).

Wyman has there stated that the eggs of *Pipa* are transferred by the male to the back of the female, which presents "a uniform surface throughout." "Their presence excites increased activity in the skin, which thickens, and is gradually built up around each egg, so as at length to inclose them in a well-defined pouch." On pages 370 and 371 he figures and describes the earlier embryos as having "three branchial appendages on each side of the head." "In a later stage the external branchiæ had disappeared, but a small branchial fissure was detected on each side of the neck, and within this on each side a series of fringed branchial arches."

In endeavouring to obtain some confirmation of Prof. Wyman's observations, Mr. Wilder suggested an examination of certain eggs of this singular Batrachian preserved in the Warren Anatomical Museum of Harvard University. The examination was made by Mr. C. S. Meriot, who reported as follows:—

"I have examined two eggs from the back of the *Pipa*, and found the embryos a little more advanced than that figured by Prof. Wyman; they are between 12 and 13 mm. in length. The gills were partly absorbed, but a single slit with the gills still projecting could be readily seen on each side at the back of the head. I could not make a more detailed examination, as the eggs were not well enough preserved."

It would therefore appear that Dr. Peters' remark (which was translated in the above-mentioned paper in NATURE on this subject) that "no one has detected branchiæ in the embryo of the Surinam toad" is not well founded. It would be very desirable, however, to have further observations on this interesting subject made, as likewise on the development of *Hylodes martinicensis*, which was the principal subject of the former communication to NATURE.

P. L. S.

Notes on the North East Australian Monotremata

ENGLISH naturalists seem to be "all abroad" on this subject, judging from some remarks in NATURE, vol. xv. p. 257.

P. L. S. states his conviction that Tachyglossus will be discovered in the ranges of N. Queensland when these have been properly examined, being evidently quite unaware that both Tachyglossus and Ornithorhynchus have been known to inhabit the northern part of this colony for several years, and that a discussion has been carried on for some months in the columns of the *Queenslander*, on the "Generation of the Echidna and Platypus," between Dr. Bancroft and Mr. Bennett. I merely allude to this subject to give English naturalists the latest discoveries made by Dr. Bancroft in his researches into this more than usual *prickly* subject.

Dr. Bancroft dissected a female specimen and found a quantity of milk in the stomach. He was unable to find any mammary glands, and came to the conclusion that the mother Echidna fed its young by regurgitation. This theory was combated by Mr. Bennett.

On dissecting a second female Dr. Bancroft discovered the mammary glands, but not like those of any other known mammal, for the nipples were inverted, the cavities thus formed being protected by stiff bristle-like hairs.

The young Echidna has to thrust its bill into the cavity to obtain its food. This is a curious adaptation to the wants of an animal, for it is certain, from the curious formation of the head and rostrum, that it would be impossible for the young to suck a nipple; as it is the forcing in of the bill expresses the milk which it is enabled to suck in when lying in the bottom of the cavity.

I secured a specimen of an adult female having a fine healthy young one in the pouch, and preserved both. On opening the stomach I noticed a quantity of a white substance which seemed to be inclosed in a thin membrane. I did not know what this was until I read Dr. Bancroft's letter on the subject, but unlike him I arrived at a different solution of the puzzle. Instead of the females sucking themselves (the way in which Dr. Bancroft accounts for the presence of milk in the stomach), I believe that, after a certain time, when the spines begin to grow on the young Echidna, the irritation causes the mother to take it out of the pouch, and to feed it by regurgitation, until its spines are sufficiently grown to protect it from its enemies. I was led to this belief by discovering a nearly adult male with no sign of any food in its stomach except milk.

I was encouraged to dig this individual out of its stronghold, by noticing several unusually large tracks going in and out of the burrow. These, undoubtedly, were the footprints of the female when she came to feed the young. The spines on this specimen were not at all stiff, especially at their bases, and would have offered little or no protection against the attacks of a native dog or eagle. This may seem a wild proposition, but I have only adopted it after mature thought, and observing four different females.

We must adopt some explanation to account for so strange a phenomenon, unless we jump the question by allowing that the females of Tachyglossus suck themselves, a most unlikely proceeding on their part, and a solution to the difficulty as unsatisfactory as it is improbable. We have only to guard against chronicling false facts which seem to me to be the greatest enemies which science has to contend with, and we are not so apt to go wrong. Mistakes are often made, but invariably meet with a correction, and should the above solution to a difficulty which has taxed, and is still employing, some of our wisest heads, prove wrong, I shall be only too glad to accept the correction, thankful that my blunder has assisted in rightly solving an interesting and vexed question. The blacks inform me that the Echidna lays a white egg, and the Platypus a black one, which are hatched in the abdominal pouch.

I trust that some of your many scientific contributors will come to our rescue in solving this point.

W. E. A.

The late discoveries by Goldie, D'Albertis, and MacFarlane, have produced a number of forms (botanical) identical with those obtaining in N.E. Queensland, thus further proving the original fundamental unity of the two countries. The Australian Dingo ought to be found in New Guinea as also our tiger cat.

W. E. A.

On Time

I HAVE deferred my answer to the remarks of Mr. J. J. Murphy (NATURE, vol. xvi. p. 182) till now, in order to see if my letter of June 14 would cause more discussion. But it seems that my views are not deemed worthy of much consideration in England; I shall therefore say only a few words in conclusion here, but hope to take up the question elsewhere.

Mr. Murphy thus summarises a part of my letter:—"The postulate that a velocity, *e.g.*, that of the earth's rotation continues unchanged, is arbitrary, incapable of proof, and justified only by practical convenience." I should wish that he had added, "and to be settled by definition." Mr. Murphy goes on to say, "It seems to me, on the contrary, that the postulate is not necessarily arbitrary but may be absolutely justified by fact." I do not believe there is a great difference between "justifying something by practical convenience" and "justifying it absolutely by facts." Perhaps, in the opinion of Mr. Murphy, the constancy of the velocity of the earth's rotation is proved by the pendulum. But it is universally admitted that the pendulum is controlled by the earth and not the earth by the pendulum.

Mr. Murphy, in admitting that he sees no way of proving that the force of gravitation continues unchanged, acknowledges that in natural philosophy many things are taken for granted which call for closer consideration, and this was precisely my motive for writing my letter.

Though Mr. Murphy does not agree with me in all points I am thankful for his remarks.

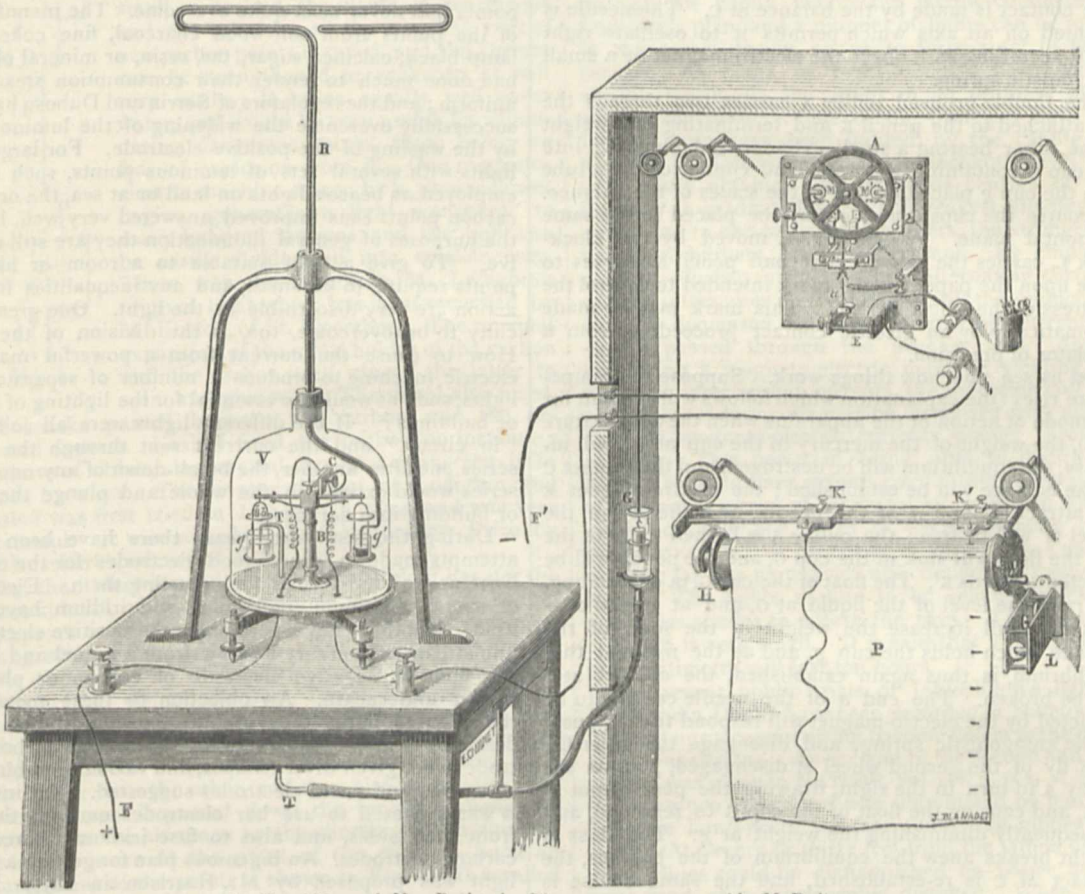
V. A. JULIUS

Breda, Holland, August 29

A NEW REGISTERING THERMOMETER[1]

THE registration of temperature is one of the most difficult of meteorological problems. Among the registering instruments employed the thermometer is certainly that to which most attention has been devoted, and yet no solution has hitherto given results altogether satisfactory. The extreme mobility of the temperature of the air and the small force at our disposal for acting upon the registering apparatus, are special hindrances to the solution of the problem. In England, in the various observatories, the photographic method is used. The reservoir of the thermometer is placed outside under cover, and the tube, entering the wall, is re-curved vertically in the interior; a photographic apparatus placed opposite this column of mercury registers the different heights. This process necessitates a thermometric reservoir of considerable volume in order that the displacements of the column of mercury may be appreciable for very small variations. These exigencies affect the sensitiveness of the apparatus; it is not a less serious inconvenience that the reservoir must be placed near the wall of the shelter where the self-recording photographic apparatus is arranged. In Switzerland the metallic thermometer is employed, and is more easily managed, but here again the metallic spiral must be placed very close to the registering apparatus.

The new registering thermometer which M. Hervé Mangon has sought to construct by utilising the differential wheelwork of M. Redier, seems to us based upon a sound principle. It consists of a mercurial thermometer with weights so arranged that the thermometer may



M. Hervé Mangon's New Registering Thermometer, constructed by M Redier.

be placed at such a distance from any dwelling as not to be subject to the influence of surrounding objects. Communication between the thermometer and the registering apparatus is established by means of electricity.

The instrument consists of two quite distinct parts:—1. The thermometer proper, and the balance which serves to indicate the differences of weight which are the result of variations of temperature. 2. The registering apparatus. The thermometer, the diameter of the mercurial column of which we have considerably amplified in our illustration, to render it appreciable, is composed of a very fine tube, R; it presents a large surface, containing in reality only a very thin column of mercury. This tube R is supported by a cast-iron frame-work, and is connected with a bell-glass V; its very slender extremity is plunged into a small cup g', containing mercury, and placed upon one of the scales of the balance B.

The balance B is an ordinary balance of precision; it bears above the beam a small metallic disc which determines a contact at C every time the equilibrium is broken in consequence of an increase of temperature. The second scale also bears a cup g, containing glycerine. A glass tube T T, connected with the registering apparatus, dips into this cup g, and communicates at its other extremity with another cup, G, which forms a vessel communicating with the former. The bell-glass V covers the balance, and permits the exposure, without danger, of that part of the instrument to the inclemencies of the air. It will be at once seen how to arrange things in order to put the instrument

[1] From an article in *La Nature* by M. Gaston Tissandier.

in working order. After having fixed in its support the tube filled with mercury, and being assured that the fine extremity dips well into the cup g', we place the balance in equilibrium by adding weights to the other scale. The bell-glass V, which has been raised for this operation, is then put in its place, and the instrument is ready for action.

The registering apparatus is composed of the double differential wheelwork of M. Rédier, which works as follows :—Two wheels M and M′ moving in opposite directions, are terminated by small flies, very delicate, and turning very swiftly ; they are connected by a differential train, the axis of which carries a pulley with a double groove A. Between the two flies oscillates a needle, one extremity of which serves to arrest alternately one of the two flies. At the other extremity a, of the needle, is a soft-iron pallet on which acts an electro-magnet E, every time contact is made by the balance at C. The needle is mounted on an axis which permits it to oscillate right or left according as it obeys the electro-magnet or a small antagonistic spring.

The double-grooved pulley A carries two threads the one attached to the pencil K and terminating in a weight O, the other bearing a small cylinder and plunging into the cup G containing glycerine and connected by a tube with the cup g placed on one of the scales of the balance. Of course the cups G and g must be placed in the same horizontal plane. A cylinder H, moved by the clockwork L, carries the paper. A second pencil K′ serves to trace upon the paper a small mark intended to control the progress of the wheel-work L. This mark may be made automatically by an electric contact proceeding from a regulator of precision.

Let us see now how things work. Suppose the temperature rises (the explanation which follows will account for the mode of action of the apparatus when the temperature falls), the weight of the mercury in the cup at g' will increase, the equilibrium will be destroyed, and the contact C of the balance will be established ; the electro-magnet E will attract the end a of the needle, and the fly of the wheel M′ will be free ; the pulley A will then turn to the left, the float will sink in the cup G, and the pencil will be directed towards K′. The float of the cup G, in descending, will raise the level of the liquid at G, and at g, and consequently will increase the weight in the scale of the balance which holds the cup g, and at the moment that equilibrium is thus again established, the contact at C will be broken. The end a of the needle ceasing to be attracted by the electro-magnet will respond to the appeal of the antagonistic spring, and disengage the other fly. This fly of the second wheel M disengaged, permits the pulley A to turn to the right, drawing the pencil from K′ to K, and causing the float of the cup G to reascend, and consequently diminishing the weight at g. That loss of weight breaks anew the equilibrium of the balance, the contact at C is re-established, and the same course is repeated as we have explained above.

It will be seen from what we have said that the clockwork is always in motion—now to the right, now to the left—even when the temperature does not vary ; the curve obtained has then the aspect of a small zigzag, but so fine that it is difficult to detect it. This arrangement permits, so to speak, the double wheel M M′ to test the balance for the slightest change in the conditions of equilibrium.

The tube T T connecting the two cups G and g may be placed underground, and the electrical communication between the balance and the electro-magnet E is easily established at any distance desired.

On the prolonged axis of the pulley A we may place a rigid needle, and indicate by a simple transmission the temperature on a large card placed outside.

This apparatus has been constructed in a thoroughly artistic manner by the able constructor, M. Redier.

NEW ELECTRIC LIGHTS

AN examination of the voluminous records of the Patent Office discloses the fact that the activity in a particular line of invention periodically waxes and wanes. After slumbering for a number of years the problem of procuring effective electrodes for the production of the luminous electric arc has of late been revived, and with a success hitherto unattained. The immediate cause of this has probably been the recent improvements of magneto-electric machines culminating in the Gramme and the Siemens machines. An efficient source of electricity for the production of the light having been supplied by these and other machines of a similar kind, a stimulus was given to the invention of electrodes or *wicks* which would employ the magneto-electric current to best advantage in giving out light. The old faults of the carbon points had never been quite overcome. The manufacture of the points from soft-wood charcoal, fine coke dust, lamp-black, calcined sugar, tar, resin, or mineral oil, &c., had done much to render their consumption steady and uniform ; and the regulators of Serrin and Dubosq had very successfully overcome the widening of the luminous arc by the wasting of the positive electrode. For large fixed lights with several sets of luminous points, such as are employed as beacon-lights on land or at sea, the ordinary carbon points thus improved answered very well, but for the purposes of general illumination they are still defective. To give a light suitable to a room or hall the points require to be small, and any inequalities in their action are very discernible in the light. One great difficulty to be overcome, too, is the division of the light. How to cause the current from a powerful magneto-electric machine to produce a number of separate small lights, such as would be essential for the lighting of streets or buildings ? If the different lights were all joined up "in circuit" and the currrent sent through the whole series one after another, the break-down of any one of the series would extinguish the whole and plunge the street or building into darkness.

During the last thirty years there have been many attempts made to secure good electrodes for the electric light as well as devices for adjusting them. Electrodes of spongy platinum, palladium, and iridium have been used. Another plan was to make the positive electrode a fine stream of mercury flowing from a funnel and breaking upon a negative electrode of carbon or platinum placed underneath. An objection to these metals was the coloured lights they produced owing to the incandescence of their vapours in the arc. The carbon electrodes were given divers shapes, and various combinations of carbon and metal electrodes suggested. For instance, it was proposed to use bar electrodes emitting the light from their sides, and also to fuse iridium between two carbon electrodes. An ingenious plan for getting a steady light was proposed by Mr. Harrison in 1857. It consisted in giving a rotary motion to the positive electrode and pointing the negative electrode at right-angles to it and giving the latter a motion of translation, so that fresh surface of the positive carbon was always appearing in front of the negative carbon. A similar idea was again patented in 1874 by Messrs. Wildman and Whitehouse. About twenty years ago there was a great deal of activity in this direction, but up till quite lately the usual carbon points have always been fallen back upon.

Within the last five years, however, two notable new lights have made their appearance, namely, the lights of Lodighin and of Jablochkoff. M. Alexandre Nicolævitch Lodighin is a Russian engineer of St. Petersburg. His plan was first publicly tried there in 1873, and patented in England in the previous year. It is designed to facilitate the use of the electric light for general lighting purposes. The great defect of the ordinary carbon points is the flickering of the light caused by the consumption

of the carbon points, a great portion of which is due to the combustion of the points in the air. M. Lodighin's plan is to employ not two but a single stick of carbon, inclosing it in a hermetically sealed glass chamber from which all air has been exhausted, and an azotic gas which does not combine with carbon at a high temperature, such as nitrogen, let in. When the current from a magneto-electric machine, such as Wilde's, Gramme's, or Noble's, is passed through this carbon it gradually gets heated to a white heat, and emits a brilliant, and at the same time soft and steady light. Fig. 1 shows the form of the carbon used; the light is given off at the narrow central part. The advantages of this plan are that there is a continuous circuit, so that any number of lights may safely be joined up in series to form one or more lamps. The lights can be made as small as desired, the flame is continuous and not injurious to the eye, the cost of new carbon points is saved, and the current can be strengthened or weakened at will very easily. It burns equally well under water, and would be very useful for illuminating dangerous mines, there being no fear of explosion from it. One magneto-electric machine driven by a 3 horse-power engine, generates a light equivalent to many hundred lanterns, and the light can be easily divided up into smaller ones. There was one defect in M. Lodighin's original light which has been remedied by M. Kosloff, of St. Petersburg. The unequal expansion of the metal holder of the carbon and the carbon itself caused the latter to split and give way. The metal also fused, and sparks passed between the carbon and the expanded sockets. Kosloff fixed the carbon on insulating supports of china, clay, crystal, &c., and connected it in circuit by wires. The improved light of Lodighin and Kosloff was first tried in London in 1874, and was very successful. It was awarded the Lomonossow Prize by the Russian Academy of Sciences.

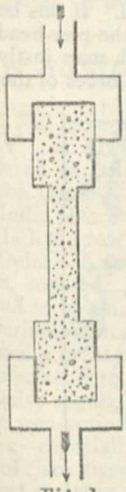


Fig. 1.

But the "electric candle" of M. Jablochkoff has, for the nonce at least, quite cast Lodighin's light into the shade. It appears to be one of those lucky inventions crowning a long series of more or less unsuccessful ones in the same direction. In the electric candle the two carbon points are not dispensed with. They are placed side by side and separated from each other by a slip of an insulating substance such as porcelain, brick, magnesia, but preferably kaolin or pure clay. One of the points is a little longer than the other, and may also be stouter. The positive current is passed down the longer carbon, and leaps across the air space to the shorter carbon, forming the luminous arc at the point of the candle. Such an arrangement of the points is shown in Fig. 2. It is called

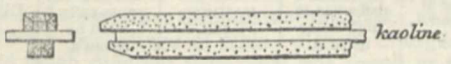


Fig. 2.

a candle because it can be burned upright in a support like a candlestick. The kaolin plays an important part besides insulating the carbons from each other. It becomes incandescent, emitting a beautifully soft, steady, light, and melts away like wax at the same rate as the carbons, just as a candle is consumed with the wick. No mechanism is required for the adjustment of this electric candle. The discovery that kaolin becomes intensely incandescent under the current also enables M. Jablochkoff to dispense with the carbon points for small and medium lights. He made the discovery, we believe, in studying the effect of a succession of sparks from the secondary coil of an induction machine on refractory bodies. He first heated a plate of kaolin to incandescence, but did not fuse it. Then he led the induction current along the edge of the plate by means of a more conductive coating. This caused the edge to fuse and emit a splendid band of light as soft and steady as any known source. This discovery disclosed a feasible system of lighting towns and dwellings by dividing the electric light. It would be possible to generate lights of all sizes by means of the kaolin; and by employing a number of separate secondary coils, one to each candle, for one primary, the current could be simply and effectively divided. By having the carbon candles for large warehouses and public buildings, and a very simple pincher holding a kaolin wick for offices and corridors; and by having separate secondary circuits to each set of lights, electricity could be laid on for illuminating purposes as easily as gas. The passage of the current through the kaolin makes the circuit complete as in Lodighin's plan, and a number of lights can be joined up in the same circuit, so as to form a set of luminous centres. As many as eight candles have been kept steadily burning in the circuit of an ordinary magneto-electric machine. Some of the principal halls of the Louvre have have been lighted by the candle in this way. MM. Denayrouze and Jablochkoff have, we are told, easily obtained fifty luminous centres of various intensity in graduated series, the weakest yielding a glow equivalent to one or two gas burners, the strongest equal to fifteen burners, from one current. By employing a magneto-electric machine giving alternating currents the current interrupter and condenser of the induction coil may be dispensed with, the alternating currents being simply passed through the primary coil. Again, by employing a magneto-electric machine yielding several powerful intermittent currents, the induction coil with its several secondary coils may be dispensed with altogether and the magneto-electric currents passed through the candles. This power of being able to divide up the current so as to have several circuits with several candles of various degrees of illuminating effect in the same circuit, or only one, gives to electric lighting the convenience of gas. It cannot be so expensive as gas, and it must be far less pernicious and dangerous than gas in a house. The lights require to be shaded by ground or opal glass shades to diffuse the rays. The consumption of kaolin is very small. It is said that a piece the length of a centimetre will last ten hours.

The recent public trials of Jablochkoff's light at the West India Docks have been recorded in NATURE. The first was unsuccessful owing to some defect in the magneto-electric apparatus. An account of the second and successful trial was given in NATURE, vol. xvi. p. 152. A large tent inclosing 900 square feet was illuminated by four candles fixed on lamp-posts and surrounded by globes of opal glass. At twenty or thirty feet from the lamps very faint pencil lines could be distinguished on paper, and small print read at a considerable distance. When common candles were substituted for the electric lights the effect was most marked, and the light a sickly yellow. In the electric illumination the most delicate colours retained their purity of tint. A warehouse was also lighted up by three naked candles; and a ship lying alongside a wharf by two, in order to show that lading or unlading could be carried on at night.

J. MUNRO

REDUCTION OF THE HEIGHT OF WAVES BY LATERAL DEFLECTION UNDER LEE OF BREAKWATERS[1]

WHEN a wave encounters an obstacle such as a breakwater, the portion which strikes it is either entirely destroyed or reflected seawards, while the portion which is not so intercepted passes onwards, and spreading

[1] By Thomas Stevenson, F.R.S.E.

laterally under lee of the barrier, suffers a reduction of its height. In the second edition of my book on Harbours, I expressed regret that no attempt had been made, so far as I was aware, to obtain any numerical value of this reduction of height derived either from theory or experiment, although the extent of shelter which is to be gained by the erection of our great national breakwaters depends entirely upon its amount.

From a few observations taken in the sea under lee of the breakwater in Wick Bay, and from some experiments made in a large brewer's cooling vat, it appeared that after passing round an obstruction *the reduction in the height of waves varied as the square root of the angle of deflection.* The approximate formula given in my book was—

$$x = 1{\cdot}00 - {\cdot}06\sqrt{a}$$

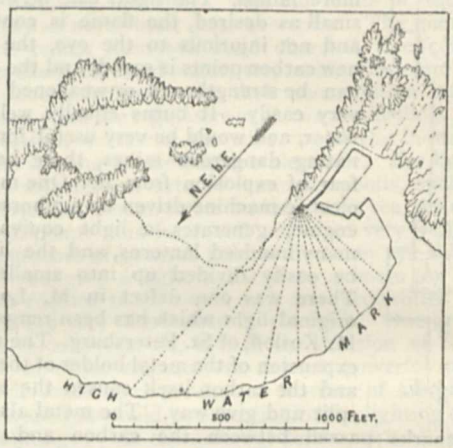
where x represents the ratio of the reduced to the unreduced wave, and a the angle of deflection.

On a recent visit to North Berwick, the finely-curved storm and tide marks traced out on the sandy beach under lee of the promontory at the harbour, reminded me of some observations I had made many years ago at other parts of the Firth of Forth. These observations, which were, however, very imperfect, had for their object the determination of the reduction of the waves by ascertaining the positions in reference to the centre of divergence of different parts of the line of high water mark where, of course, all the wave forces become *nil.* If a beach throughout its whole extent consist of easily moved materials such as sand or gravel, the incursion made at any one place by the sea will obviously depend upon the force of the waves which reach the shore at that place, providing the materials of the beach are homogeneous. In other words, the heavier the waves at any part of the shore the farther inland will the high-water margin retire beyond the tide mark of more sheltered places. And where the waves vary in height owing to some local cause, as, for example, the existence of a sheltering promontory, the high water mark instead of being straight and parallel to the prevalent waves will assume a curved outline.

At North Berwick, the projecting promontory at the harbour, shelters a small bay or rather *bight* from the heaviest waves that fall on that part of the coast. The waves, therefore, are deflected at the pierhead, from which point as a centre, each section of every wave taking its own divergent direction, runs its course till its energy is expended at high water mark. The maximum effect on the beach will consequently be in the line of direction of the undeflected swell, and the minimum effect will be in the direction of the landward end of the promontory where the waves are most deflected from their natural course. Under these conditions, supposing the particles of sand to be of uniform size and of the same specific gravity, the high water margin must assume, as it does at North Berwick, a curved outline owing to the inequality produced by deflection on the height of the waves.

If the distance between the pierhead and the high-water mark measured parallel to the usual direction of the undeflected swell (shown by the arrow in the diagram) be assumed as unity, that distance may be regarded as the measure of the amount of work that the undeflected part of the wave has been able to do, inasmuch as its force has been wholly expended within that distance in driving the beach landwards. The varying lesser distances between the same point and other parts of the high water mark, may in like manner be regarded as representing the work that has been done by the varying lesser forces exerted by the different parts of the wave after being deflected. It is, no doubt, true that the undeflected wave has the full force of the wind to help it, while the deflected has not; but in so far as relates to the engineering aspect of the question, this effect, even though it had been much greater than it is, would be of no importance, as the same conditions hold true with an artificial as with a natural breakwater.

I may mention in corroboration of the views that have been expressed that in the course of my practice as an engineer I have, at different exposed parts of the coast, had occasion to fill up a small creek with soft materials produced by works of excavation at an adjoining part of the shore. In the course of time the whole of these artificial deposits have, in every instance, been removed by the waves, and the former line of high-water been restored. By analogy, therefore, we must believe that if the bay at North Berwick were in like manner filled up artificially with sand as far seawards as the pier-head we should find, after a certain number of storms had occurred, that the whole of the sand had been washed out and the former line of high-water reproduced. If this be true, then the different distances between the pier-head and the high-water mark at North Berwick may justly be regarded as the measures of the varying forces of the



different sections of the deflected wave under lee of the promontory.

The first column in the accompanying table shows the angles of deflection, while the second gives the measurements from the pier-head to the high-water mark as taken from the Ordnance map of North Berwick. The directions in which these measurements were taken are represented by dotted lines on the accompanying woodcut. The third column shows the ratios of those measurements to unity. The fourth column gives the ratios of the heights of the deflected wave calculated by the formula $x = 1 - {\cdot}06\sqrt{a}$, and the last the *plus* and *minus* differences. Though the employment of the *square-root of the angle* may perhaps be regarded as somewhat unusual, the formula as given is nevertheless more convenient for use than a logarithmic spiral formula, which might give nearly the same results.

Angles of deflection θ.	Distances from centre of deflection to high-water mark v.	Ratios of measurements.	Ratios of Heights of waves calculated by formula.	Differences.
°				
0	1150	1·00	1·00	·00
10	1000	·87	·81	− ·06
20	920	·80	·73	− ·07
30	840	·73	·67	− ·06
40	735	·64	·62	− ·02
45	700	·61	·60	− ·01
50	675	·59	·58	− ·01
60	600	·52	·53	+ ·01
70	570	·50	·50	·00
80	555	·48	·46	− ·02
90	530	·46	·43	− ·03

Although it is possible that the agreement of the measurements with the results calculated by the formula

may turn out to be to some extent accidental, yet the results can hardly be regarded as very far from correct. And in a case of such importance to the maritime engineer where we have so very few direct observations of the waves in the open sea to guide us, and where it is undeniable that all such observations are invariably found to be excessively difficult to get, and even when got prove often unsatisfactory, any contribution to our knowledge, however imperfect, may be considered of some value; and all the more when, as in this case, the curve traced out on the beach is the result of long-continued action produced by innumerable storms.

A RUSSIAN ACCOUNT OF SCIENTIFIC PROGRESS IN INDIA[1]

WE have already noticed the meteorological journey of M. Wojeikoff round the world. The volume referred to below contains a series of letters written to Baron Osten-Sacken and M. Rykatcheff during his stay in India (December, 1875, to February, 1876).

He had great hopes of the development of meteorology in India. A series of stations working upon one uniform plan, together with a system of weather-warnings, was about to be established throughout the country under the superintendance of Mr. Blanford. That gentleman expected a great deal from a thoroughly organised system of weather-forecasts, owing to the periodicity and comparative regularity of meteorological phenomena in India. The non-periodical fluctuations are yet certainly very large—especially as to rains—but they are less complicated than elsewhere, and it was likely to be easier to detect the laws they obey. Already in 1874 the Government asked Mr. Wilson whether it was probable that the rainy period would be as short that year as it was in 1873; Mr. Wilson answered that he expected heavy rains at the end of the monsoons, and October was in fact very rainy. The importance of such forecasts may be seen at a glance, as the rice-crops depend entirely upon the quantity of rains and the time when they finish, the rice-fields giving the best crops when they remain under water during the first two months after the sowing.

A subject treated at greater length by M. Wojeikoff is the Black Earth of India. This fertile soil appears mostly in the western and southern parts of the country, especially on the table-land of the Deccan, whilst on the plains of Bengal and in the north-western provinces it is, on the contrary, nearly wanting. It attains its largest development on traps, being found only as smaller patches on the bottoms of valleys in the districts of crystalline rocks. Altogether, it does not occupy in India such extensive uninterrupted spaces as in Southern Russia, and even in the provinces where it is most developed, it covers but from fifty to seventy per cent. of the surface of the land. The data as to its thickness are few; six feet is not unusual, but thicknesses of twenty feet must have been observed on some deposits washed down from the slopes of the hills. A few analyses show a percentage of from 7·7 to 9·2 of organic matters, not much different from what was found in the black earth of Russia.

As to its origin, the most curious opinions continue to prevail among Indian geologists. Some suppose it to be merely a product of the disaggregation of traps; others continue to support the old opinion as to its origin in marshes. Dr. Oldham, who was the first to renounce an erroneous view long established in Western Europe, in a letter to M. Wojeikoff, adopted the theory of the origin of black earth from "a dense vegetable growth, principally herbaceous, but partly arborescent," although there are localities where it may have come "from jheels and marshes." M. Wojeikoff supports the opinion now prevailing in Russia, that Black Earth is the result of a herbaceous steppe-vegetation accumulated during long centuries. He points out that its marshy origin is contradicted by the facts that, 1, the percentage of organic matter in its upper and lower parts is much the same, while in marshy deposits it constantly decreases in the upper parts; and 2, Black Earth never contains a large amount of acids, as is always the case in marshy deposits. Therefore, Black Earth mostly covers the surface of the lower table-lands, and is of far rarer occurrence in the bottoms of valleys. As to these latter deposits many misconceptions still prevail. Many of them are secondary, being washed down by rains from the tops and slopes of hills, and M. Wojeikoff supposes that the black-earth in the lower parts of the Nerbudda, Taptee, Godavery, Kistna valleys, &c., has mostly such a secondary origin. There are many instances when the black-earth of low levels is not a secondary deposit. It is then the product of a grassy meadow-vegetation, grown upon the former marshy deposit *after* the total draining up of the marsh.

We notice, also, his remarks upon the interest afforded by India for ethnographical and anthropological explorations. There is much to do in these departments. An official report says that not less than two-thirds of the old monuments of India remain unexplored; and there are large parts of the country, as, for instance, the Central Provinces, where almost nothing was done in this direction. The question as to the origin of some of the aborigines of India is still very obscure. The origin of the Dravidians, for instance, seems to be very uncertain, and M. Wojeikoff had much trouble to procure for Dr. Hochstetter some twenty photographs of this interesting people. He warmly recommends India as a field for anthropologists.

[1] *Isvestia* of the Russ. Geogr. Soc., 1876, No. 3.

METEOROLOGY AND THE INDIAN FAMINE

THE following letter appeared in the *Times* of Saturday last:—

In a recent article on the Indian Famine you asked whether science could do nothing to foresee and provide for these appalling calamities. I think that, as regards Madras at any rate, science may safely accept your challenge. The present famine was foreseen on meteorological grounds last year, and the continued drought during the present summer (an unusual feature in Indian famines) was indicated in a printed research as early as February. Meteorologists have for some time been aware that the eleven years' cycle of sun-spots is coincident with a cycle of atmospheric conditions producing ascertained terrestrial effects. Thus the minimum periods of sun-spot activity are coincident with the minimum appearances of the aurora and with the minimum number of cyclones, while the maximum periods of sun-spot activity are contemporaneous with the maximum activity of the aurora and of cyclones. The coincidence between the sun-spot cycles and the variations in the indications of the magnetic needle has also been affirmed, and a periodic connection between solar activity and terrestrial magnetism is now an accepted fact of science. A similar connection between the eleven years' cycle of sun-spots and the temperature and rainfall had also been suspected, and various researches had been undertaken to show that the supposition was well founded. It was at this stage of the inquiry that Dr. W. W. Hunter, the Director-General of Statistics to the Government of India, commenced his investigations last year into the rainfall of Madras. During this century six years of minimum sun-spots had occurred (1810 to 1867); and for practical purposes the present year, 1877, may be taken as the seventh period of minimum sun-spots within this century. Dr. Hunter also found that six great scarcities of sufficient gravity to be officially returned as "famines" had occurred during the same period (1810-77). Of these six famines five were caused by years of drought coincident with, or adjoining to, the periods of minimum sun-

spots, and within Dr. Hunter's "minimum group." He further showed that the rainfall at Madras passed through an eleven years' cycle, corresponding with the cycle of sun-spots. That is to say, the rainfall reaches its minimum in the eleventh year, rises to its maximum about half-way through the cycle in the fifth year, and then declines again to its minimum in the eleventh year. The following condensed table shows the results of the six cycles for which records exist, from 1810 to 1876, the Madras register only having been kept, however, from 1813 :—

Eleven Years' Cycle of Sun-Spots and Rainfall at Madras for Six Cycles, from 1810 *to* 1876.

	Average rainfall in inches, registered at Madras. (1813-76)		Average relative number of sun-spots (Wolf). (1810-60.)
Eleventh series of years in the cycle of eleven years	37·03	...	10·9
First and second series of years in the cycle of eleven years...	42·07	...	10·0
Third and fourth series of years in the cycle of eleven years	49·12	...	39·8
Fifth and sixth series of years in the cycle of eleven years	54·64	...	73·4
Seventh and eighth series of years in the cycle of eleven years ...	52·36	...	53·7
Ninth and tenth series of years in the cycle of eleven years	49·02	...	33·5
Eleventh series of years in the cycle of eleven years	37·03	...	10·9

The general average of rainfall for sixty-four years, from 1813 to 1876, is 48·51 inches.

The average relative number of sunspots, calculated on the fifty-one years then available to Dr. Hunter, from 1810 to 1860, is 38·68.

This statement forms one of a series of eleven tables by which Dr. Hunter exhibited the coincidence of the two cycles. In my opinion, and I believe in the opinion of the other professional meteorologists in this country who have examined the evidence thus submitted, Dr. Hunter has established his conclusions as regards Madras, but he carefully abstains from hasty generalisations with reference to other parts of India. I may add, however, that from a careful examination of the rainfall at Bombay, it is evident that there are the clearest indications of a similar general coincidence, while evidence has recently been adduced of a cyclic character of the Calcutta rainfall, complementary to (although different from) the cycle at Madras. But, adopting Dr. Hunter's cautious estimate of the degree of certitude warranted by his examination (necessarily a partial one) of the Indian rainfall, I think that science may safely make the following replies to your challenge :—

1. That a period of deficient rainfall may be expected to recur in cycles of eleven years at Madras.

2. That the deficiency is of so serious a character that in five out of the seven of these cycles occurring within this century up to the present date, the deficiency has sufficed to cause a great famine in Madras.

3. That the duty imposed by the laws of Nature on the Indian Government is not to make a series of costly spasmodic and unsatisfactory efforts, but to deal with the water-supply in such a way as to meet a regularly recurring deficiency.

4. That the discovery of the cyclic character of the rainfall clearly points, as regards Madras, to the method to be adopted for this end. In the eleven-years' cycle there is a period, at the extremities, of greatly deficient water-supply—namely, in the eleventh, first, and second years of the cycle. There is also a period of excessive water-supply in the middle of the cycle—namely, in the fifth, sixth, seventh, and eighth years; and half way between these two periods—that is to say, on each side of the maximum central period—there are years of intermediate but ample water-supply—namely, in the third and fourth years on the one side of the central maximum period, and in the ninth and tenth on the other side of it. The following table, taken from Dr. Hunter's paper, very clearly illustrates this :—

	Average rainfall in inches, registered at Madras. (1813-76.)		Average relative number of sun-spots (Wolf). (1810-60.)
Minimum group—eleventh, first, and second years	40·39	...	10·32
Intermediate group—third and fourth with tenth and ninth years	49·07	...	36·71
Maximum group—fifth, sixth, seventh, and eighth years ...	53·50	...	63·61

5. That the permanent remedy for famine in Madras is, therefore, to deal with the rainfall in its cyclic aspect, and to husband and equalise the water-supply, not merely of the individual year, but of the cycle.

It is beyond my province to offer any opinion upon the form of hydraulic engineering best adapted to secure this end. But I would point out that while some of our modern Indian canals are principally useful in husbanding and distributing the water-supply of the year, the old native system of great embanked lakes or reservoirs unconsciously hit the true solution of the difficulty by husbanding and equalising the water-supply of the cycle.

I need hardly say that we are only at the beginning of this inquiry. What science asks from the Indian Government is the means of prosecuting it, and foremost among such means is a small solar observatory, for which it is understood that the necessary instruments were sent out to India some years ago, although they have not yet been utilised for this purpose.

ALEXANDER BUCHAN, Secretary of the Scottish Meteorological Society.

THE IRON AND STEEL INSTITUTE

THIS Association, one of the most active in the kingdom, and which has already done so much to bring the discoveries of science to bear on the iron and steel industries, commences its annual autumn meeting at Newcastle, on Monday, as we have already intimated. As usual, while several important papers are down for reading, much of the time of the meeting, between September 17 and 21, will be devoted to visiting some of the many industrial establishments in and around Newcastle.

The president of the meeting will be Dr. C. W. Siemens, F.R.S., and we notice that in succession to the late Mr. Jones, Mr. James S. Jeans has been appointed general secretary. On the first day the usual formal business will be transacted, the real work of the session commencing on Tuesday, when the Mayor of Newcastle will receive the members in the lecture-room of the Literary and Philosophical Society at half-past 10 A.M., and during the forenoon a selection of papers will be read. After luncheon the remainder of the day will be devoted to visits to various establishments, including Consett Ironworks, the works of Stephenson and Co., R. and W. Hawthorn, Hawks, Crawshay, and Co., the Newcastle Chemical Works, and others. A number of collieries will also be open to the inspection of members, and should a sufficient number be found willing to join in an excursion to the Roman Wall, it is proposed to organise a party, on Tuesday afternoon, to visit that interesting object, near the residence of Mr. John Clayton, the well-known antiquarian, who has kindly promised to receive the members.

The forenoons of Wednesday and Thursday will also be devoted to the reading of papers, and the afternoons to visits and excursions. On Wednesday the New Swing Bridge, one of the largest of its kind in the world, will be opened, and afterwards two steamers will take the

members on excursions up and down the Tyne, the first steamer proceeding up the river as far as the New Cut, for the purpose of affording members an opportunity of witnessing the extensive dredging operations of the Tyne Improvement Commissioners, and thence sailing down again to the shipping spouts, the new Coble Dene Dock, and the piers, while the second steamer will take another party to some of the most important works down the river, as Leslie's and Mitchell's ship-building yards, Forster and Co.'s lead-works, the Jarrow chemical works, &c. On Wednesday evening a *conversazione* will be held in the Town Hall, Newcastle, when it is hoped that the telephone will be exhibited.

Doubtless one of the most interesting excursions will be that of Thursday afternoon, when a special train will convey the members to the Elswick Works (Sir W. G. Armstrong and Co.), thence proceeding to the Steel Works of Messrs. John Spencer and Sons, at Newburn. Friday will be entirely devoted to an excursion to Middlesbrough and the works on Tees-side. In the forenoon the new Browney Colliery Works and the Clarence Works of Messrs. Bell will be visited, and the Eston Steel Works and Blast Works of Bolckow, Vaughan and Co. After luncheon in the Royal Exchange, Middlesbrough, ten different works will be visited, including the Tees-side Iron Works, where the first Danks' rotary furnaces constructed in this country will be seen in full operation; the Ayresome Iron Works; the Tees Iron Works; the Tees-side Engine Works (Hopkins, Gilkes, and Co.); the Linthorpe Iron Works (Lloyd and Co.); the Newport Rolling Mills (Fox, Head, and Co.); the Ayrton Rolling Mills (Jones, Brothers, and Co.); the Middlesbrough Wire Works (Hill and Co.); the Newport Ironworks (B. Samuelson and Co.); the Middlesbrough Tube Works.

Among the papers to be read are the following: I. L. Bell, M.P., F.R.S.—Part II. of paper on the Separation of Carbon, Silicon, Sulphur, and Phosphorus in the Refining and Puddling Furnace and in the Bessemer Converter. Dr. Percy, F.R.S.—On some Scientific Facts connected with the Manufacture of Iron, &c. R. Howson.—On Mechanical Puddling. T. W. Plum, Old Park, Salop.—On Improvements in Blast Furnace Water-Cooled Tuyeres. A. L. Steavenson.—On the Manufacture of Coke in relation to the Iron Trade of the North of England. Mr. Greenwell.—On the Geological Features of the Great Northern Coal Field. Chas. Wood.—On Four Years' Improvements in the Utilisation of Slag. F. Giesbers.—On the Removal of Phosphorus from the Materials used in Smelting Pig Iron under M. Stein's Patent. A. Thomas.—On the Latest Improvements in Belgian Merchant Rolls. William Walker.—On a New Machine for Drilling Ironstone. M. Gautier, C.E.—Results of Experiments with Cannon manufactured from Steel without Blows.

When we state that in addition to what we have mentioned, an exhibition of various objects connected with the Iron and Steel Trades will be held in the Wood Memorial Hall, it will be seen that the members of the Institute have plenty of work before them, and that the meeting is likely to be one of great interest and practical importance.

OUR ASTRONOMICAL COLUMN

THE OUTER SATELLITE OF MARS.—As a guide to those who may be examining the immediate vicinity of Mars, with the view to detecting the exterior satellite, an ephemeris of its positions from September 8 to 18, for 8h. 30m. and 11h. om. each evening is subjoined. It will enable an opinion to be formed as to the chance of any object glimpsed within ninety seconds' distance from the centre of the planet, being the satellite or not. The elements employed in the calculation are the following:—

Passage of Ascending Node, 1877, Aug. 11·7495 Greenwich M.T.

Longitude of the node	82 48
Inclination of orbit to ecliptic	25 24
Daily motion in orbit	285 26·928
Logarithm of the radius of orbit in seconds, at the mean distance of Mars from the sun	1·32795

The angles of position in the ephemeris are reckoned as in double-star measures—

		At 8h. 30m. P.M.		At 11h. om. P.M.	
		Pos.	Dist.	Pos.	Dist.
		°	″	°	″
Sept.	8	82	76	71	85
,,	9	199	30	125	40
,,	10	251	85	240	74
,,	11	298	37	269	65
,,	12	60	73	40	46
,,	13	89	66	76	83
,,	14	218	44	149	28
,,	15	256	82	246	79
,,	16	325	28	277	53
,,	17	65	77	50	56
,,	18	96	54	81	76

The apparent diameter of Mars according to Kaiser's measures is 25″·0 on the 8th and 24″·0 on the 18th.

M. Leverrier characterises Prof. Asaph Hall's discovery of the satellites of Mars as "une des plus importantes observations de l'astronomie moderne." It is in the highest degree an honour to American science. The magnificent instrument with which they have been detected, a masterpiece of mechanical skill, is of American construction, and we think every astronomer must admit that since it was mounted at the Naval Observatory, Washington, the national astronomical institution, admirable discernment has been shown in the selection of a class of observations upon which its extraordinary optical power could be brought to bear with the greatest advantage in the actual state of the science. Already our knowledge of the motions of the four satellites of Uranus and of the satellite of Neptune has been greatly advanced, and tables to facilitate the calculation of their positions have been skilfully prepared by Prof. Newcomb, with the aid of measures made with this instrument. The period of rotation of Saturn has been determined, and a series of observations of all the eight satellites of this planet has been vigorously prosecuted, which must soon allow of a much more intimate acquaintance with their motions than we yet possess. The notable discovery of two satellites of Mars is a fitting achievement in the same interesting branch of astronomy.

In striking illustration of the truth of the assertion of Sir W. Herschel, that when a very faint object has been once discovered with a large telescope, it may be seen with a much smaller one, we receive, since the above was written, a communication from Mr. Wentworth Erck, of Sherrington, Bray, dated September 8, in which he writes: "The outer satellite has been seen here three times; 1st, on September 2, at 22h. 40m. G.S.T., when the position was about 290°, and distance from limb something less than three diameters of the planet; 2nd, on September 3, at 23h. om. G.S.T., when the position was 64°; this position is pretty accurate; on this occasion I watched the satellite for two hours, during which I saw it move from 64° to 55°; at the latter position its distance from limb was equal to two diameters of the planet; 3rd, on September 8, at 22h. 35m. G.S.T., when the position was about 78°. It was steadily visible with 7-inches aperture on my Alvan Clark, and was, I should say, something brighter than Enceladus, the second satellite of Saturn."

On comparing these observations with positions calculated from the above elements (which closely represent the Paris observation of August 27), it is evident the object observed on September 2 was a star, the satellite at the time being on an angle of 325°, and only fifteen seconds from the limb, but it appears beyond doubt that

Mr. Erck observed the outer satellite on the following night, when the position at the time named would be 65°, distance from centre of planet seventy-nine seconds, and two hours later the angle would have diminished to 53°, and the distance to sixty-one seconds, or roughly two diameters from the planet's limb as observed. On September 8 the angle was 71°, distance eighty-five seconds, so that the satellite may have been seen again this evening. So far as we know these are the first observations of a satellite of Mars in these islands, and it is singular that they have been made with an instrument constructed by the same optician as the great Washington telescope with which the satellites were discovered.

In the elements of the satellites transferred to this column last week from the Washington Circular, for major and minor axes of the apparent orbit it is necessary to read semi-axes.

VARIABLE STARS. — The following are geocentric minima of Algol and S Cancri, which will be observable in this country during the last quarter of the present year. The epochs are in Greenwich time, and depend upon Prof. Schönfeld's elements.

ALGOL.

	h. m.		h. m.		h. m.
Oct. 2 ...	15 19	Nov. 11 ...	18 42	Dec. 4 ...	17 14
,, 5 ...	12 8	,, 14 ...	15 31	,, 7 ...	14 3
,, 8 ...	8 57	,, 17 ...	12 20	,, 10 ...	10 52
,, 11 ...	5 45	,, 20 ...	9 9	,, 13 ...	7 41
,, 22 ...	17 0	,, 23 ...	5 58	,, 24 ...	18 57
,, 25 ...	13 49			,, 27 ...	15 46
,, 28 ...	10 38			,, 30 ...	12 36
,, 31 ...	7 27				

S CANCRI.

	h. m.		h. m.
Oct. 16 ...	13 27	Dec. 12 ...	11 6
Nov. 4 ...	12 40	,, 31 ...	10 20
,, 23 ...	11 53		

MINOR PLANETS.—On August 11 M. Borrelly detected a new planet, which, it may be presumed, is identical with one seen by Prof. Watson on the 8th, though not identified as a planet until the 16th; this will be No. 174. The latter astronomer has since announced the discovery of No. 175 on September 3, in R.A., 23h. 10m., N.P.D. 89° 15', eleventh magnitude.

Of the small planets which come into opposition during the last quarter of 1877, Iris attains the greatest degree of brightness, her magnitude in the middle of November being a little higher than the seventh. This planet, from proximity to the earth, will afford a favourable opportunity of applying Prof. Galle's method of determining the solar parallax, and with the view of facilitating observations, an ephemeris from Prof. Brünnow's tables will be given in this column before the end of the present month. The rough ephemeris of the *Berliner Jahrbuch* is not sufficient for practical purposes.

NOTES

THE health of M. Leverrier is so far restored that he is daily expected at the Paris Observatory to resume his official duties. The glass of the large refractor has been put in position, after having undergone repairs, and will be tested again before being silvered. Bischofsheim's transit instrument is in use, and works admirably. The magnetic instruments are also in operation in the new grounds given by the municipality. Magnetical observations are also taken at Montsouris Observatory with similar instruments, and at a distance of two kilometres. Both establishments are satisfied with eye observations.

ON August 14 Denmark celebrated the centenary of one of her most eminent sons—Hans Christian Oersted, born August 14, 1777, known all over the world as the discoverer of the laws of electro-magnetism. It was in 1813 that Oersted first published his investigations.

AT the recent biennial meeting of the German Astronomical Society, which was held at Stockholm, the members received the news of the discovery of the two satellites of Mars with manifestations of grave doubts. The president at their request telegraphed to the Berlin Observatory, and in reply received a copy of the original telegram as it was sent from America. The next meeting of the Society is fixed to take place at Berlin in 1879.

WE have received the "Programme et Règlement" of the International Congress of the Medical Sciences, which commenced its fifth session at Genoa on Sunday and will conclude on Saturday. This programme contains a feature which we have not noticed before in connection with any similar congress. All the usual information as to meetings of various kinds, sectional proceedings, excursions, &c., is given in a well-arranged form. In addition to this, under each section is given along with the titles of the papers to be read, a summary of the conclusions come to by the author on each question treated. These summaries are sometimes of considerable length, and we cannot but think that it is an advantage both to speaker and to hearers that the latter are thus instructed and interested beforehand, and so able to follow intelligently a speaker's line of thought. Although the association is to meet during a whole week, there are only twenty-four papers in all to be read, thus allowing ample time for discussion.

THE inaugural address of the meeting of German naturalists at Munich on the 17st inst. will be delivered by Dr. von Pettenkofer. The following is the latest list of the general lectures announced:—Prof. Dr. Waldeyer (Strassburg), on C. E. von Baer and his influence upon the history of evolution; Prof. Dr. Ernst Haeckel (Jena), on the evolution theory of the present day in its relation to science in general; Prof. Dr. G. Tschermak (Vienna), on the early history of the terrestrial globe; Prof. Dr. Klebs (Prague), on the revolution in medicinal views during the last decades; Dr. G. Neumayer (Hamburg), on meteorology in daily life; Dr. R. Avé Lallemant (Lübeck), on animal life in the Amazon River; Prof. Dr. S. Günther (Ansbach), on the latest researches made on the mathematico-historical domain; Prof. von Virchow has not yet fixed his subject.

THE third annual conference of the Cryptogamic Society of Scotland will be held at Dunkeld during October 10, 11, and 12. The president is Col. H. M. Drummond Hay, C.M.Z.S., and the secretary Dr. F. Buchanan White, F.L.S., Perth. The business of the conference will consist mainly in excursions, *conversazioni*, and an exhibition of specimens. The Society is now prepared to issue a First Century of "Fungi Scotici Exsiccati," which will contain many of the new species and rarities recently discovered. The subscription price is 1*l.* 1*s.*

THE Munich Society of Antiquaries has resolved to hold yearly exhibitions after the manner of those of our South Kensington Museum. Each exhibition will be devoted to a different branch of industry. A commencement will be made with glass articles.

ALTHOUGH the late M. Thiers was not himself a man of science he was anxious to possess some knowledge of the several sciences in order to the writing of a work on philosophy on which he was engaged during a number of years. His teachers were chosen from amongst his brother academicians; M. Leverrier being his instructor in astronomy and M. Charles Saint Claire-Deville in chemistry. He began to write his work under Napoleon's rule, desisted when he resumed his political career, and worked it up again when he resigned his presidentship. It is not yet known whether it will be published in its present imperfect form. At the time of his death he was revising what had been written in order to bring it up to the level of new scientific discoveries. Although Thiers was more than eighty

years of age he was not the oldest member of the whole French Institute. The dean by age is now M. Chevreul, a man of extraordinary debating power, and who the very day of Thiers' death read before the Academy of Science an admirable chemical paper referred to in this week's report of the Paris Academy.

MR. LAYARD, the British ambassador at Constantinople, has received a firman from the Sultan authorising excavations at Nineveh.

SEVERAL members of the enterprising Birmingham Natural History Society spent last week in a dredging excursion at Arran, Brodick being made the headquarters. The excursion was eminently successful, and several objects of considerable rarity were obtained. An interesting account of the excursion appears in the *Birmingham Daily Post* of September 10.

AT the meeting of delegates held to discuss the formation of a Midland Union of Natural History Societies on August 28, at the Midland Institute, a basis of union was unanimously agreed to. The Union is to be governed by a council composed of two members from each society included within it, one of these members to be a secretary of the society. The annual meetings are to be held in the various towns in which are located the societies forming the Union. The president of the society in association with which the annual meeting is held shall be president of the Union for that year, and each annual meeting shall decide where the next is to be held. The levy from each society is to be 1*d.* per annum for each member, unless the members shall be less than twenty-four in number, when it shall be 2*s.* for the whole of the society. A monthly journal is to be published by the Union similar to the *West Riding Naturalist*, to be called the *Midland Naturalist*. The following Sub-Committee was appointed to arrange various matters:—Messrs. Lawson Tait, James Bagnall, John Morley, Egbert D. Hamel, and Charles Perks. The first meeting of the Council will be held at the Midland Institute, Birmingham, on Tuesday, October 2, at 5 P.M.

LONDON now possesses an aquarium tank believed to be the largest in existence. By removing the partitions between several of the tanks in the Westminster Aquarium, the present naturalist, Mr. Carrington, has arranged one capable of holding 94,000 gallons. It is 150 feet long, 20 feet broad, and the depth of the water will vary according to circumstances. The tank is intended for the exhibition of large fish.

A SHOCK of earthquake was felt at Bagnères de Bigorre at 2 P.M. on Friday, its direction being east to south-east, and its duration five seconds.

LOCAL societies have organised in Switzerland a large number of district museums so arranged that the natural characteristics of the country are always open to the inspection of the public. The extent of these collections is sometimes astonishing. We have been favoured with a catalogue of the Vevey Cantonal Museum, from which we learn that it possesses 415 zoological objects, three different herbariums, four mineralogical collections, fifteen objects of ethnography, twenty-five archæological relics found in the country, 650 pieces of money or medals, complete laboratories of physics and chemistry, and a library. Vevey is a small country place having only 8,000 inhabitants.

THE Council General of Guadeloupe have offered a premium of $20,000 for the best new process of extracting juice from sugar-cane, the cost not to exceed forty per cent. of the market value of the product. Applications may be made up to June 1, 1880.

WE have referred to the expedition to Cambodia, headed by Dr. Harmand, on behalf of the French Government. A large parcel containing a number of natural history specimens has arrived at Paris for the Museum, from the expedition.

THE Germanic Museum at Nürnberg celebrated the twenty-fifth anniversary of its existence on the 16th ult. The celebration was simple, dignified, and in good keeping with the national character of the institution. The foundation-stone of a new wing of the building of the museum was laid, the funds for this enlargement having been supplied by the German Government. The director, Herr Essenwein, addressed the company assembled, and gave an account of the development of the museum, pointing out that the institution was the result of common efforts made by the whole nation; that princes and people had equally contributed towards the furtherance of the work, and that the new wing would bear the Imperial arms upon its façade as a sign of its origin.

THE European staff for the first international station to be established in Africa has been completed. It consists of Messrs. Cambier, Crespel, and Mais. The Austrian traveller, Ernst Marno, will accompany the expedition in the capacity of naturalist. The expedition will proceed to Natal in the Union Company's Royal Mail steamship *Danube*, appointed to leave Southampton on October 18 next, direct for Algoa Bay and Natal. The expedition will remain at Natal for a week or ten days, perfecting their arrangements, and will then go on to Zanzibar, for Tanganyika, in the same Company's steamship *Natal*.

AMONG the papers in the just-published part of the *Zeitschrift* of the Berlin Geographical Society are letters from Dr. Erwin von Bary to Baron von Richthofen on the travels of the former in North Africa; the itinerary of Dr. Pogge from Kimbundo to Quizemene, the Mussumba or residence of Muata Jamwo, and further eastwards to Inchibaraka, from September 16, 1875, to February 28, 1876; two papers on Persia, one by Dr. Kiepert on Dr. Stolze's journey in South Persia in 1875, and a description by Gen. Schindler of little known routes in Chorassan. Capt. von Schlienitz contributes a paper of much interest on the geographical and ethnographical observations in New Guinea, the New Britannia and Solomon's Archipelago, obtained by the Austrian *Gazelle* expedition. To the *Verhandlungen* (Nos. 5 and 6) of the same Society Baron von Richthofen contributes a paper of much historical value on the Central Asiatic silk routes up to the second century of our era.

AT the last meeting of the Niederrheinische Gesellschaft für Natur und Heilkunde of Bonn, Herr Siegfried Stein reported on some new mirrors made of rock crystal and agate, and used for reflecting sextants. Dr. H. Eylert, the astronomer to the Deutsche Seewarte at Hamburg, had pointed out to him that glass mirrors lose their correct shape in course of time, or turn dim and render impossible the exact determination of the sun's altitude. The new mirrors are free of these faults.

THROUGHOUT the past week, says the *Sussex Advertiser*, Col. A. Lane Fox has been engaged, with several workmen, in making some interesting excavations into Mount Caburn, on behalf of the combined committees of the British Association and Anthropological Institute. A number of pits were found in the interior of the camp, and some of them have been opened. They are of different sizes, and between six and seven feet deep, and are of a square, oval, and round shape. They were evidently human habitations, and would contain perhaps two persons crouched up together, there not being room for them to lie extended. They were found to contain the bones of a great variety of animals used for food, but chiefly of the ox, pig, and goat, and the remains have been sent to Prof. Rolleston, of Oxford, for identification. The filling in of the pits appears to be of the late Celtic period, but whether the pits themselves are of the same age it is difficult to determine. A large basin-shaped shaft, sixteen feet deep, has been cleared on the south side of Mount Caburn. In this case it is also difficult to decide the

object of the pit, but it appears in all probability to have been sunk by the inhabitants of an earlier period for the purpose of obtaining flints similar to those of Cissbury. A vein of flints was found near the bottom of the shaft, but there are no galleries, as is the case at Cissbury, where they are perfect in the shafts that have been discovered. Probably in the present instance the flints were found to be unsuitable, and the works were abandoned. On Saturday a section was cut through the rampart in order to ascertain by the pottery whether it was of the same age. Large quantities of pottery were found, which was of an earlier period to that in the pits in the interior, indicating that the rampart is probably of an earlier date, and that the fort was subsequently occupied by a later race of people in the Celtic age. At the bottom of the pits were discovered several implements of the late Celtic type—amongst other things a knife, battle-axe, and a kind of iron spud; also a bone comb.

THERE have just been placed at the entrance to the South Kensington Museum four magnified drawings of different stages of the Colorado beetle, drawn by Mr. Andrew Murray, F.L.S., naturalist to the Science and Art Department. They show the pupa—the "grub," as it is labelled, at full growth, the beetle at rest, and the beetle on the wing. This last is the most interesting drawing to people in England, as the appearance of the beetle at rest is now somewhat familiar through the many drawings and the models that have been issued. As Mr. Murray has studied the beetle in America, not only the shape, but the hue of the wings may be taken as correct. These are of a delicate pink, and look so beautiful that it might be welcomed in England as an addition to our insects were its ravages not so expensive. Of all the drawings of the beetle yet made public these are the most carefully drawn, but it is surely a mistake to place them where they are at present. They are really outside the turnstiles, as if not forming a portion of the museum.

A THIRD edition is announced by Hartleben, the Vienna publisher, of Brommy and von Littrow's work "Die Marine," a comprehensive treatise on the ocean and on navigation.

THE prospectus of a new work entitled "Ergebnisse physikalischer Forschung," by Dr. C. Bohn, Professor of Physics in Aschaffenburg, is being circulated by Engelmann of Leipsic. The work aims at giving the facts ascertained in physics, leaving out, as far as practicable, the processes by which they have been reached (a mode of treatment which offers certain advantages). Theories, hypotheses, and methods of experimentation are not wholly excluded, but the attention is limited to what seems useful and necessary in order to confidence in the correctness of the results. The work is designed especially as a preparation-book for examinations; also as a work of reference, for which purpose it will be fully indexed. The first part, just published, treats of I. Bodies and forces in general (as Introduction). II. General mechanics and gravitation. III. Physical mechanics. IV. The theory of heat (Part 1). Part 2 will also treat of IV. The theory of heat (second part). V. Radiation (light and heat). Part 3 will be devoted to VI. Magnetism and electricity.

THE *Kölnische Zeitung* publishes some interesting details regarding an excursion made by Herr Nikolai Sograf, a member of the Moscow Society of Naturalists, to the peninsula of Kanin in the Samoyede district. It appears that the natives showed themselves rather diffident towards the Russian traveller, and their want of confidence was still further increased when he proceeded to take measurements of their heads, extremities, &c. At last they evidently arrived at the conclusion that their reindeers and their tundras were to be taken from them and they themselves were to be transported far away, perhaps to the war now raging. The consequence of this conviction was a somewhat unpleasant intermezzo for Herr Sograf and his excursion. On one fine morning the traveller was aroused by a great noise and found that the Samoyedes were packing up their tents in great haste and preparing for an immediate departure into the interior of the country. All representations on his part were in vain, and he had to submit to being carried off. His position among these natives was, of course, a rather unpleasant one; his collections of insects, which were preserved in alcohol were destroyed, the preserving fluid finding its way into the stomachs of the Samoyedes. Herr Sograf was rescued at last by two fishermen from the Kanin Tundra coast, who had heard of his awkward situation. He arrived safely at Mesen after some time, and thence addressed a narrative of his adventures to the Russian newspaper the *Golos*. His courage and spirit seem, however, to be quite undaunted, as he has the intention to start at once upon another expedition to Cape Sswyatoi-Noss.

IN compliance with a suggestion from M. Engelhard, a member of the Municipal Council of Paris, the Prefect of the Seine has ordered photographs to be taken of every existing plan of the city of Paris, so that it will be possible to see all the series of transformations experienced by the city from the most remote period when such plans were made up to the present age.

FLAGS have been hoisted on the principal buildings of the Paris International Exhibition, which, according to the habit of French working-men, is an indication that the external part may be considered as having been quite completed. The part allotted to England has been given over to the architect of the English Government.

THE *American Journal of Science* records the death in Utah of Dr. Charles F. Winslow, formerly of Boston, at the age of sixty-six. Dr. Winslow has written numerous articles on physical science, relating more especially to earthquake phenomena, which he observed extensively during his residence of many years in California, South America, and elsewhere.

DRS. YARROW AND COUES have lately published a list of the fishes found at Fort Maçon, North Carolina, in which 108 species are enumerated; of these eleven are sharks and rays.

IN a paper by Prof. Wright, of Yale College, published in the early part of this year, a method was described of producing metallic films on the inner surface of exhausted glass tubes, by the action of a succession of energetic electrical discharges. Prof. Wright has been continuing this investigation, and has arrived at important results, both theoretical and practical. It seemed probable that the surface of deposit would be dull, but this proved incorrect, and the films when removed from the receiver presented surfaces of exquisite perfection, the most brilliant of which were comparable only to the surface of clean liquid mercury. This suggested the production of specula for optical purposes by this method, and Prof. Wright's subsequent inquiries have been directed to this end. Platinum seems to be the most suitable metal for the purpose; it is not readily tarnished, and can be cleaned with water or acids. By the new method it can be deposited on glass surfaces very easily, and a mirror of the most perfect surface produced at once. The adherence of the film seems very close. With silver, too, the process succeeds well, but it is more difficult to obtain good surfaces than with platinum, or gold, the metal being volatilised with extreme ease by the action of the current. The experiments, *inter alia*, showed it to be true of platinum and bismuth (as well as gold), that the light which has passed through a layer of metal varies somewhat with the thickness of the film. Platinum, with progressively thickening film, varies from a grayish int to brownish, brownish yellow, deep yellow, and orange. This last colour is almost exactly complementary to that transmitted by silver, and Prof. Wright succeeded in getting a peculiarly white and brilliant reflecting surface by depositing first a thin stratum of silver, then one of platinum. The specula of a small

Gregorian telescope was covered with platinum by the method referred to, and with entire] success. The larger mirror was about 4 ctm., and the time required for covering was about three hours, with a battery power equivalent to four or five Grove cells.

IT is an interesting point to determine, even though only approximately, what amount of heat meteoric masses develop in their motion through the atmosphere. M. Schiaparelli has proved that to calculate the loss of velocity of a body which penetrates the atmosphere, it is not necessary to know the law according to which the density of the air varies in the different layers traversed, but it is sufficient to know the barometric pressure at the two extremities of the course, or (which comes to the same) the weight of air displaced by the body whose initial velocity is known. Starting with this theorem, and taking the average velocity of falling stars as 50,000 metres per second (it varies between 16,000 m. and 72,000 m.), M. Govi estimates, in a recent paper, that a falling star, on reaching a part of the atmosphere where the barometric pressure is about 1 mm., will have its velocity already reduced to about 28,000 m.; coming to a region where the pressure is 10 mm., its velocity will be about 5,916 m., and at a pressure of 100 mm. (should the meteorite reach so far), the velocity will not be more than 506 m. Thus the initial velocity of bolides diminishes very rapidly, and may be almost entirely lost on reaching earth. Now, knowing the loss of velocity of a moving object of given mass, the quantity of heat developed can easily be deduced. Taking a bolide of 14·66 kilogrammes reaching an air layer where the pressure is about 1 mm., M. Govi finds the loss of *vis viva* of the object to correspond to the enormous number of 2,921,317 calories, which would readily explain all the accompanying phenomena of heat and light, and also mechanical effects.

WITHIN the last year or two no spot on the American continent has furnished such an amount and variety of archæological material as the Santa Barbara Islands and the coast of California opposite to them. Dr. Yarrow, in Wheeler's report for 1876, describes his "Big Bonanza," as he calls it, on the main-land, near Santa Barbara; and Prof. Hayden has published an elaborate account of Mr. Paul Schumacher's researches made upon the islands. The crania and skeletons are counted by hundreds, and tons of stone implements, many of them of most beautiful workmanship, have been revealed by the winds blowing the sand from the burial-places. During the summer of 1877 Mr. Bowers has continued these explorations on behalf of the Smithsonian Institution, with the greatest success, and has found many new varieties of objects of stone, and in large numbers.

MR. GUNN writes with reference to our report last week (p. 406) of a paper read by him at the late British Association Meeting:—"The new Silurian beds discovered near Widdybank Farm were stated in the paper to belong to the volcanic series of the Lake Country. It is the Cronkley Pencil Mill Shale which was referred to the Stockdale Shales *or* Pale Slates."

THE additions to the Zoological Society's Gardens during the past week include a Mandrill (*Cercopithecus mormon*) from West Africa, presented by Mr. Francis Lovell; a Purple-faced Monkey (*Semnopithecus leucoprymnus*) from Ceylon, presented by the Misses Rowney; a Common Fox (*Canis vulpes*), European, presented by Mr. R. Hayssen, an Angolan Vulture (*Gypohierax angolensis*), a Vociferous Sea Eagle (*Haliaëtus vocifer*) from Africa, presented by Mr. I. A. Solomon; a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, a Great Anteater (*Myrmecophaga jubata*), two Mealy Amazons (*Chrysotis farinosa*) from South America, a Short-toed Eagle (*Circaëtus gallicus*), a Common Genet (*Genetta vulgaris*) from Southern Europe, an Egyptian Vulture (*Neophron percnopterus*) from Africa, deposited,

THERMOMETRIC OBSERVATIONS MADE AT RAMA ON THE COAST OF LABRADOR

TWO years' thermometric observations made three times a day at Rama, Labrador, about 60° north latitude, furnish the following monthly and annual means. The degrees are Centigrade.

	Monthly mean of temperature.	Absolute monthly minima. (Dates in parentheses.)	Absolute monthly maxima. (Dates in parentheses.)
	°	°	°
1874, August	+ 7·7	+ 2 (3)	+ 23 (8)
September ...	+ 4·9	− 1·5 (6, 7)	+ 16 (9)
October ...	− 0·7	− 8·5 (30)	+ 9 (5)
November ...	− 6·5	− 15·0 (27)	+ 7 (9)
December ...	− 15·2	− 22·0 (23, 24)	− 5 (6)
1875, January ...	− 17·8	− 27 (23, 24, 27, 28)	− 5 (26)
February ...	− 19·6	− 35 (19)	− 5 (13)
March	− 17·9	− 33 (8)	+ 2 (19)
April	− 8·1	− 20 (5, 6)	+ 3 (20, 21)
May	− 3·7	− 13 (1, 2, 3)	+ 10 (17)
June	+ 4·2	0 (1, 9, 14, 17, 18, 20, 23)	+ 15 (24)
July	+ 5·2	+ 1·5 (20, 22, 26, 28)	+ 17 (19)
August	+ 7·0	+ 1·0 (28, 31)	+ 16 (4, 20)
September ...	+ 2·3	− 7·0 (28)	+ 15 (1)
October ...	− 2·0	− 7·5 (30)	+ 4 (1, 8)
November ...	− 6·1	− 21 (26)	+ 2 (7)
December ...	− 15·4	− 31 (28)	+ 2 (6)
1876, January ...	− 20·5	− 30 (17)	− 7 (11)
February ...	− 19·1	− 32 (8)	+ 3 (25, 26)
March	− 14·8	− 34 (6)	+ 1 (23)
April	− 2·3	− 21 (4)	+ 10 (9)
May	+ 1·7	− 8 (7)	+ 10 (15)
June	+ 3·5	− 9 (6)	+ 11 (10, 30)
July	+ 6·5	+ 0·5 (7)	+ 20 (27)

The annual means resulting from these tables are—

For the first year, from August, 1874, to July, 1875, − 5°·51,
" second " " 1875 " 1876, − 4°·93.

The annual extremes are—

In the first year, min. − 35°, Feb. 19; max. + 23°, Aug. 8,
" second " − 34°, March 6; " + 20°, July 27.

The first year was sensibly more cold than the second; if we compare their means to those of the two preceding years—

1872 to 1873, − 4°·0; 1873 to 1874, − 5°·3;[1]

their results as the mean of the four consecutive years counting from the month of August, − 4°·93.

The observations were made at Rama by M. and Mme. Weiz, Moravian missionaries, with a thermometer sent from the observatory of Geneva. A barometer was recently sent from Kew to Naïn, another station of Labrador, to solve the question of the variations of atmospheric pressure in these regions.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

LONDON.—Prof. Morris, who for more than twenty years has held the chair of geology and mineralogy at University College, has resigned his appointment. The Rev. T. G. Bonney, fellow of St. John's College, Cambridge, and Prof. H. G. Seeley, of King's College, are mentioned as candidates.

BIRMINGHAM.—We have received the programme of the Birmingham and Midland Institute, which is quite as satisfactory as usual. Prof. Tyndall, the president, will deliver the inaugural address on the evening of Monday, October 1.

UPSALA.—The celebration of the 400th anniversary of the foundation of the University of Upsala was brought to a termination on Saturday. The celebration, which lasted nearly the whole week, seems to have been thoroughly successful, and was enthusiastically joined in by all, both "town and gown," from the king downwards. Many foreign delegates were present. We hope to be able to give a detailed account of the event shortly. It is stated that the king has made the University a donation of 40,000 crowns, the yearly revenue from which is to be distributed as premiums to young authors of scientific works.

[1] NATURE, vol. xiii. p. 60.

SCIENTIFIC SERIALS

merican Journal of Science and Arts, August.—Discovery of ygen in the sun by photography, and a new theory of the olar spectrum (with plate), by H. Draper.—Action of certain organic substances in increasing the sensitiveness of silver haloids, by M. C. Lea.—Critical periods in the history of the earth and their relation to evolution, by J. Le Conte.—Notes on the internal and external structure of palæozoic crinoids, by C. Wachsmuth.—Chemical composition of Hatchettolite and Samarskite, by O. D. Allen.—Relations of the geology of Vermont to that of Berkshire, by J. D. Dana.—A proposed new method in solar spectrum analysis, by S. P. Langley.—Note on the exactitude of the French normal fork, by R. König.

Annalen der Physik und Chemie, No. 7, 1877.—The polarisation of refracted light, by M. Fröhlich.—Note on the dispersion-curve of certain media with more than one absorption-band, by M. Ketteler.—On a new photometer, by M. Glan.—On electric induction on non-conducting solid bodies, by M. Wüllner.—On the electric behaviour of metals immersed in water or salt solutions in radiation from sun or lamplight, by M. Hankel.—Note on a change in the direction of the polarisation-current after passage of alternately opposite galvanic currents, by M. Hankel.—On vapour tensions of homologous series and Kopp's law of constant differences of boiling-point, by M. Winkelmann.—On the absorption of gases by salt solutions, by Mr. Mackenzie.—On the theory of the action of cylinder spirals with variable number of windings, by M. Wallentin.—On diamonds, by M. von Baumhauer.—On the history of the invention of the telescope, by M. Wolf.—Note relating to natural science among the Arabs, by M. Wiedemann.

No. 8.—Experimental investigation of weakly magnetic bodies, by M. Silow.—On a general proposition with reference to electric induction, by M. Clausius.—On the electric conductivity of electrolytes, by M. Berggren.—Determination of the electric conductivity of liquids with constant current, by M. Tollinger.—On the so-called unipolarity of flame conduction, and on truly unipolar electric phenomena, by M. Herwig.—Further remarks on the action of cylinder-spirals with variable number of windings, by M. Wallentin.—Contributions to an adequate determination of the plane of vibration of polarised light, by M. Ketteler.—On the specific heat of water according to experiments of M. von Münchhausen, by M. Wüllner.—On the physical nature of articulate sounds, by Mr. Grassmann.—On a convenient form of the mercury-pump on Sprengel's principle, by M. Hüfner.—Bunsen in a tellurium mineral, by M. Krenner.

Journal de Physique, August.—Researches on photography, by M. Angot.—On attractive and repulsive forces, and the action of the medium, by M. Jannery.—New electric lamp with oblique circular rheophores, by M. Reynier.—Polarising microscope, by M. Nodot.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, September 3.—M. Peligot in the chair.—M. Villarceau gave an outline of his and M. De Magnac's new work, entitled "Nouvelle navigation astronomique."—The following papers were also read:—On the combinations of chlorhydrate of ammonia with the chlorides of potassium and of sodium (extract from memoir), by M. Chevreul. He was led to study these from having found in guano cubical crystals formed of chloride of sodium and chlorhydrate of ammonia; also a similar compound in a piece of sealskin taken from this guano. Some peculiarities in crystallisation are mentioned.—Considerations on the interpretation which should be given to the conditions of maxima relative to calculations of electro-magnetic forces, by M. Du Moncel (a reply to M. Raynaud).—On the discovery of a terrestrial plant in the middle part of the Silurian system, by M. De Saporta. He was shown at Caen a plate from the slatey schists of Angers, presenting evident traces of a large fern. The vegetable substance had been replaced by sulphide of iron, and much of the contour was interrupted and lacerated as if the plant had been long under water. The fern appears to rank among the Neuropterideæ; it recalls *Cyclopteris* and *Talæopteris*, observed in the Upper Devonian. The Silurian system in Europe having only furnished, hitherto (of plants) algæ, and of somewhat problematic nature, this fern may be regarded as the oldest terrestrial plant yet found on our continent; and it indicates a floral already comparatively rich and complex, therefore distant probably from the first origin of plants. M. Lesquereux has also, quite lately, found terrestrial plants in the Silurian system in America (at the base), and M. De Saporta assigns priority in this discovery to him.—Researches on the phosphoric acid of arable lands (extract from memoir), by MM. Corenwinder and Contamine. In forty-eight hours a saturated solution of carbonic acid sufficed to render assimilable a quantity of phosphoric acid greater than that furnished to the soil by introducing 1,000 kilogrammes of super-phosphate. The phosphates disseminated in arable land are not in the same degree soluble in water charged with carbonic acid. Their capacity depends on their molecular state and the source whence they come. The phosphates pre-existing in liquid manures are probably more attackable than others.—On the invariability of the great axes of planetary orbits, by M. Haretu. This invariability, which several geometers, and Poisson himself, believed to be quite general, exists only for the first and second powers of the masses.—On an insect destructive to phylloxera, by M. Laliman. This larva, or worm, which (the author says) might be called the *cannibal* of phylloxera, devours the latter most voraciously; in ten minutes he saw ninety-five disappear. He found it in the interstices or tissue of galls on the leaves of the vine.—Remarks on M. Laliman's communication, by M. Balbiani. The observation is not wholly new; the larva is that of a dipterous insect belonging to the genus *Syrphus*, or an allied one. All the larvæ of Syrphi are aphidiphagous; their habits have been fully studied by M. Reaumur, who remarked their voracity and the indifference of taste they showed for all kinds of pucerons. M. Balbiani recommends a continuation of these researches, and cultivation of the insect.—Invasion by phylloxera of the vineyards in the environs of Vendome, by M. Prillieux.—Satellite of Mars observed at the observatory of Paris, by MM. Paul and Prosper Henry.—New stellar system in rapid proper motion, by M. Flammarion. This is perhaps still more important than the former; for it consists of two couples of stars carried along in space by the same movement of translation, and with a velocity much above the average of ordinary proper motions. The two couples are those of 17 χ Cygnus and 2576 Σ. The motion is almost perpendicular to the direction of that of the sun in space.—On the wind system in the region of the Algerian chotts, by M. Angot.—Study of some derivatives of ethylvinyle, by M. Nevolé.—On a mode of transmission of the disease ergot, by M. Duplessis. The ergot appeared in a part only of a field of winter wheat. The previous crop having been a weeded crop and the field having borne, before that, trefoil and vetch (plants in which ergot has not hitherto been observed), M. Duplessis infers that the ergot must have been imported by a natural vehicle; probably the waters of the Loire, which overflowed this spring, brought it from some fields further up, which were affected by the disease last year.

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