THURSDAY, NOVEMBER 30, 1871

ARCTIC EXPLORATION

IN 1865 Captain Sherard Osborn proposed an exploration of "the blank space around our Northern Pole," by a route which he and his brother Arctic explorers, from considerations based on the history of the subject during three centuries, and on their own experience in the ice, were convinced was the best, and the most sure to lead to useful scientific results.

Their reasons for adopting the views then set forth, the correctness of which has since been confirmed by Swedish and German explorers, were as follows :—

The immense tract of hitherto unvisited land or sea which surrounds the northern end of the axis of our earth, is the largest, as it is the most important field of discovery that remains for this or a future generation to work out. The undiscovered region is bounded on the European side by about the 80th parallel of latitude, except where Parry, Scoresby, and a few others have slightly broken through its circumference; but on the Asiatic side it extends south to 75° and 74°, and westward of Behring's Strait our knowledge is bounded by the 72nd parallel. Thus in some directions it is more than 1,500 miles across, and it covers an area of upwards of 2,000,000 square miles, with the North Pole towards its centre. Unlike the ocean-girt region of the Southern Pole, the northern Polar region is surrounded, at a distance of about 1,000 miles from its centre, by three great continents, while the glacier-bearing mass of Greenland stretches away towards the Pole for an unknown distance. There are three approaches by sea to this land-girt end of the earth, namely, through the wide ocean between Norway and Greenland, through Davis Strait, and through Behring's Strait. One wide portal and two narrow gates.

It was through the wide portal that men naturally sought, in the first instance, to reach the mysterious region of the Pole; and they continued to persevere in that direction until experience had taught those who were capable of learning from it that, as in other cases, the longest way round was the shortest way home. The first true Arctic voyager was William Barents, who sailed from the Texel in 1594. He discovered all we now know respecting the Spitzbergen seas; first, the open lane of water which almost always enables vessels to sail up the western side of that land; second, the impenetrable Polar pack to the north, and between Spitzbergen and Novaya Zemlia; third, that the young ice formed in the early autumn and rendered the sea unnavigable; and, fourth, that winds and currents caused open water even in the winter and early spring, but again drove the ice upon the coast at every change of wind. Hudson, in two voyages, explored the whole of the pack-edge from Greenland to Novaya Zemlia, and found it to be impenetrable; and many others followed him with the same result. In later years four expeditions sailed up the west coast of Spitzbergen beyond the 80th parallel, and Dutch and English whalers collected a vast mass of information, which has been ably brought together by Scoresby and Jansen, and which pretty well exhausts the subject.

During the winter and early spring the ice extends in a line from the east coast of Greenland to the northward of Jan Mayen Island, crossing the meridian of Greenwich between the 71st and 72nd parallel, then passing up north for several degrees, and leaving a deep bay, and finally stretching away to Novaya Zemlia. The deep bay in the ice, left to the eastward of the Greenwich meridian in the winter, is probably caused by the so-called Gulf Stream. It forms the route by which the whalers proceed to their fishing-ground, and is known as "the whale-fisher's bight." In the spring the Polar pack begins to drift to the southward and westward, so that the western or lee sides of large masses of land, such as Spitzbergen, are usually left with open navigable lanes of water; while the eastern or weather sides are generally close packed with ice. The pack, consisting of vast fields of thick ribbed ice, has never been penetrated, though whalers annually sail through streams of lighter floes until they reach its edge. The Polar pack is met with in different parallels according to the season and the meridian. Between Spitzbergen and Novaya Zemlia it is usually in 75° or 76°; but occasionally vessels have reached as far as 81° without encountering it, and in the very exceptional year when Parry attempted to reach the Pole, he was only coming in sight of it at his extreme point in 82° 43′, although he had been travelling for 92 miles over closely-packed floes of ice through which no steamer could have forced her way. In another exceptional year, that of 1806, Scoresby sailed along the edge of the pack for 300 miles, between the parallels of 81° and 82°; and at his extreme point in 81° 30′, on the meridian of 19° E., the margin of the ice trended to E.N.E., while to the eastward there was an open sea to the horizon, with no ice blink. Farther east a latitude of 82° or even 83° might possibly have been attained in that year, before arriving at the edge of the Polar ice. Analogous conditions of the ice were found by James Ross in the Antarctic sea. He sailed through pack ice met with in the 62nd parallel, which was drifting north, and then reached the edge of the impenetrable Polar pack which he found extending for 400 miles in a wall 150ft to 180ft. high in the parallel of 78° 30′ S. In the northern sea the Gulf Stream flows up until it meets the ice-laden Polar current between Spitzbergen and Novaya Zemlia. It keeps the ice off the shores of Norway and Lapland, but the parallel on which the warm current meets the ice-bearing stream, and is cooled down to 27°, varies in different seasons. Even if it were possible, by extraordinary luck, to force a steamer through the pack to the open water supposed to be left by its southerly drift, the autumn would be so far advanced by the time she reached it that young ice would be forming on the surface, and all navigation would be at an end. In 78° N. ice forms on the sea during eight months in the year, and Scoresby often saw it grow to a consistency capable of stopping the progress of a ship, even with a brisk wind blowing.

These facts, the results of thousands of observations extending over many years, proved that an attempt to force a vessel through any part of the Polar pack between Greenland and Novaya Zemlia was not the best way to explore the unknown region of the north.

Sir Edward Parry was the discoverer of the true method of Polar exploration, by sledge travelling. He proposed to attempt to reach the North Pole, in 1827, by travelling with sledge boats over the ice to the north of Spitzbergen; and he actually reached the farthest northern point that has yet been attained by civilised man. But the rainfall was exceptional that year; and the ice was in a very unfavourable condition. It was not until he reached 82° 43′ N. that he descried the strong yellow ice blink overspreading the northern horizon, and denoting the vast ice fields over which he hoped to travel. His provisions then only sufficed to take him back to his ship, and he was obliged to return. He made a mistake in the route and in the time of year; but he has the credit of having been the pioneer of Arctic travelling, and of having pointed out the true way of exploring the unknown Polar region.

In deciding upon the best route, Sherard Osborn had his own great experience in the ice, and the recorded observations of Parry and Ross, and of generations of previous explorers to guide him. The first Arctic canon is, "Never take the pack if you can possibly avoid it, but stick to the land floe." The second is, "Reach the highest possible parallel in your ship, and then complete the exploration by sledge travelling." A glance at a Polar chart will show that the first canon can only be followed by passing up the west coast of Spitzbergen, or the west coast of Greenland. But the Greenland coast reaches a higher parallel than that of Spitzbergen. Therefore the Greenland coast is the route to follow,—up Smith Sound and Kennedy Channel to the farthest point attainable. A vessel can almost always reach Smith Sound in one season, for the same reason that a vessel seldom finds it difficult to sail up the west coast of Spitzbergen, namely that she is to windward of the ice. She sticks to the land floe and lets the pack drift past her. Out of thirty-eight exploring vessels that have gone up Baffin's Bay from 1818 to 1860, only two have failed to reach the open water at its head which leads to Smith Sound, before the navigable season was over. From the position that may thus always be reached by an exploring ship, sledge parties could be despatched to the North Pole and back—a distance of 968 miles—a distance often exceeded by the Arctic sledge travellers in search of Franklin; as well as to complete the exploration of the northern coast of Greenland, and of the land to the westward. Such was the plan proposed by Osborn in 1865. It was feasible; it promised useful scientific results; it ensured a vast accession of new geographical knowledge; and the Government could scarcely have refused to adopt it if there had been unanimity in the counsels of geographers nd explorers.

But a fatal apple of discord was thrown into their midst by the eminent geographer of Gotha; and the Admiralty seized on this want of unanimity as an excuse for postponing indefinitely the consideration of the subject. Dr. Petermann has done serious injury to the cause of Arctic exploration by thus forcing his theories into notice at a time so extremely inopportune. It was in 1852 that he first brought forward the theory that there is an open navigable sea between Spitzbergen and Novaya Zemlia leading straight to the Pole especially late in the autumn. He assured the Admiralty that the *Erebus* and *Terror* were somewhere near the Siberian coast, and that they could be reached without serious difficulty by this wonderful route. Had he been listened to, and had our gallant countrymen been then alive, it makes one shudder to think of the consequences if the searchers had thus been led off the true scent. That time no harm was done. But in 1865 Dr. Petermann found more willing listeners. He again declared that the sea between Spitzbergen and Novaya Zemlia was the easiest and most navigable entrance to the unknown region; and he added two new discoveries; first, that Parry, at his farthest point, found a perfectly navigable sea extending far away to the north; and second, that Smith Sound is a *cul de sac* (of which he published a map), and unconnected with the Polar Ocean. The first discovery is surely a dream, for Parry himself saw a strong ice blink overspreading the northern horizon at his farthest point. The second exists only in Dr. Petermann's imagination, and, before he announced it, he should have called to mind the fate of a certain range of mountains named after the late Mr. Wilson Croker. The only tangible grounds for believing in an open Arctic ocean navigable to the Pole, are that the Russian explorers Hedenstrom, Anjou, and Wrangell, saw patches of open water and rotten ice off the northern coast of Siberia in March and April, and that Dr. Kane's ship's steward reported having seen a wide extent of open water in June to the north of Smith Sound. The Russian *polynias* or water holes are in all probability caused by winds and currents acting on a shallow sea, and, so far as we yet know, they are merely local. The same thing was observed by Barents off Novaya Zemlia in November, and an off-shore wind will carry the ice from the head of Baffin's Bay at all seasons. But this does not make the sea navigable. The open water of Dr. Kane's steward in June was only what might be expected at that season, though Dr. Hayes found the same spot covered with ice within a few days of the same time of year, in 1861. Dr. Petermann's arguments unfortunately had the effect of destroying that unanimity, without which it was hopeless to attempt a successful representation of the importance of Arctic exploration at the Admiralty.

The ostensible reason given by the Duke of Somerset for postponing the question, was in order that the results might be learnt of a Swedish expedition then engaged in exploring Spitzbergen, under the direction of Professor Nordenskiöld. Those results fully confirmed the correctness of Sherard Osborn's views. Nordenskiöld reported that no vessel could force its way through the closely-packed ice north of Spitzbergen; but that the ice moves, after long southerly winds, considerably to the north. "All experience seems to prove," adds Nordenskiöld, "that the polar basin, when not covered with compact, unbroken ice, is filled with closely-packed, unnavigable drift-ice, in which some large apertures may be found; though in favourable years it may be possible to sail a couple of degrees north of the 80th parallel in September or October."

Dr. Petermann has since promoted the equipment of Arctic expeditions, which were expected to prove his theory, and to disprove the opinions of Captain Osborn. But he has sent prophets to curse his opponent, and behold, they have blessed him altogether! In 1868 the first German Arctic Expedition sailed under the command of Captain Koldewey, with instructions to penetrate as far north as possible along the east coast of Greenland, or to try to reach Gillis Land, east of

Spitzbergen. They made four attempts to press through the ice, and failed, as all their predecessors had failed. But it is stated by German writers that this expedition attained the highest point ever reached by a sailing vessel, namely, 81° 5′ N. This is a mistake. Parry reached 81° 5′ N. in the *Hecla*, and 81° 13′ in his boats, and Scoresby reached 81° 30′ N. in 1806, on board the *Resolution* of Whitby. In 1869 the second German expedition sailed, also under command of Captain Koldewey, with instructions from Dr. Petermann to penetrate through the belt or girdle of ice which encircles the open polar basin of his imagination, to winter at the pole, and then to sail across it and explore the Siberian islands. All very easy to write at Gotha! But, as usual, Captain Koldewey was stopped, as all his predecessors had been, by the closely-packed ice, and wintered on the east coast of Greenland, at a part which was visited by Sabine and Clavering in 1823. The German explorers made careful scientific observations, and partly examined a very interesting navigable fiord running into the heart of Greenland. The expedition returned to Bremen in September 1870, and the experience acquired by two seasons in the ice has enabled its talented and energetic commander to orm an authoritative opinion on the best route for north polar exploration. Captain Koldewey, the first German authority on Arctic navigation, fully concurs with Captain Osborn that the way to explore the unknown region is by sending an expedition up Smith Sound.

The other Arctic voyages that have been made since 1865 are of minor importance. In 1869 Dr. Bessels crossed the sea between Spitzbergen and Novaya Zemlia, and met with field ice between 76° and 77° N. in August. Norwegian fishermen named Ulve, Carlsen, and Johannesen, found the Sea of Kara comparatively free of ice in 1869—70, and the latter is said to have sailed round Novaya Zemlia. In 1870 Count Zeil and von Henglin made some useful observations on the east side of Spitzbergen during a yacht voyage, and obtained a sight of the still more eastern Gillis Land. In the present year Lieut. Payer, who served under Captain Koldewey, made a voyage towards the Polar pack, between Spitzbergen and Novaya Zemlia, and he reports having nearly reached the 79th parallel, between the 40th and 42nd meridians east from Greenwich, and again in 60° E., finding open water. But Mr. Smith, an English yachtsman, in the same season, was more lucky or more adventurous. He reached the latitude of 81° 13′ N., the highest that has ever been ever observed on board a ship. Scoresby, indeed, reached an *estimated* latitude of 81° 30′ on May 24, 1806, but his highest *observed* latitude was 81° 12′ 42″ on the 23rd. These voyages merely confirm the observations of Nordenskiöld and earlier explorers, that, though the pack is usually met with, east of Spitzbergen, between 75° and 77° N., it may not be reached in exceptional years until the 81st, or even the 82nd parallel is attained.

Such have been the results of Arctic exploration since Sherard Osborn submitted his proposal in 1865. They fully confirm the correctness of his views; and the best English and German Arctic authorities are now in complete accord. There is, therefore, no longer any reason for postponing the consideration of this question. Six years have been wasted, and the men who were available to lead an expedition in 1865, may be unable to do so now. But the navy of England still abounds in the same stuff that made a Parry, a James Ross, a McClintock, and an Osborn in former years: and it must always be remembered that it is out of young Arctic explorers that Nelsons are formed. The arguments for Osborn's scheme of exploration by Smith Sound are now strengthened by the experience of Nordenskiöld and Koldewey. The same evidence of the important scientific results to be obtained by an Arctic expedition that was produced by the highest authorities in 1865, is forthcoming now. The argument that such enterprises in the pursuit of Science have an excellent effect upon the naval service is as strong now as it was then. We may, therefore, reasonably hope that (the Duke of Somerset's reason for postponing the question having been entirely removed) the Admiralty would take the subject of Polar exploration into favourable consideration, if the scientific societies once more submitted it, with the same arguments as were used six years ago.

C. R. MARKHAM

ORD'S NOTES ON COMPARATIVE ANATOMY

Notes on Comparative Anatomy: a Syllabus of a Course of Lectures delivered at St. Thomas's Hospital. By W. M. Ord, M.B. (Churchill, 1871.)

DR. ORD may be congratulated on having put together this compact, lucid, and well-arranged Syllabus. It is well adapted to serve as a framework, for lecturers on Comparative Anatomy to fill up, and students may also use it to refresh the memory when once stored with more slowly acquired information. The abuse of it will be for men to bolt this condensed extract of scientific food in order to produce it again under examination. The author seems to have foreseen this danger, and not only warns against it, but has been careful to preserve the bald and dry style which ought to repel those who do not know how to use the book as he intends. Still, experience of the way in which Prof. Huxley's "Introduction to Classification" is misused by being literally learned by rote, shows to what ill uses such compendia may be put.

The Syllabus begins with a short summary of the distinctive characters of the organic and of the animal kingdoms, followed by a scheme of classification which follows that of the introduction just referred to. The several animal classes from Protozoa to Mammalia are then treated, so that the arrangement is a zoological one. It would perhaps have been better if the author had devoted less space to the enumeration of the characters of orders and classes, since these are found in other manuals, and if anatomical points of difficulty had been more fully explained. For example, more detailed exposition of subjects like the morphology of the compound Hydrozoa, the development of Echinoderms, and the formation of the placenta, would have been exceedingly valuable. For such an object, however, diagrams are almost essential, and, accepting Dr. Ord's plan, it must be admitted that he has carried it out with a due regard to symmetry. The only subject which the Syllabus appears comparatively to neglect is the difficult but important one of Embryology. The account given of the Annulata and Entozoa is particularly clear and excellent. The following extract is a fair specimen of the author's style and method:—

"CL. BRACHIOPODA.—Solitary bivalves, in which the valves are dorsal and ventral, like the two parts of a cabriolet in relation to the animal within, instead of lateral (wing-like) as in Lamellibranchs. Valves joined by hinge or not; never with elastic spring. When not hinged, the valves imperforate; when hinged, one, the larger, is perforate for the transmission of an anchoring ligament, in the non-hinged the ligament passes out between the valves. The class is divided into two orders or subclasses, —the Articulate and the Inarticulate. The Articulate, of which Terebratula is type, have usually curious shelly processes developed from the inner surface of the imperforate valve for the support of the arms, and have in the adult condition no anus; the Inarticulate, of which Lingula is type, have no arm-supporting processes and have no anus."

The account given of the vertebrate skeleton, and especially of some disputed questions of homology, is not so satisfactory as most other parts of the Syllabus. It may be doubtful whether it is desirable to introduce into elementary lectures the difficult subject of the representatives of the tympanic bones in the lower vertebrata; but if so, it is quite useless for men to learn to repeat the "views" of Owen, Huxley, Peters, Parker, and Humphry, and to assign the right view to the right man, unless they are familiar with the facts of embryology, on which alone a judgment can be formed. Now, whether the incus belongs to the first visceral arch, as here stated (p. 113), or to the second, as is believed by some original observers, makes all the difference as to the correctness or incorrectness of the statements which follow. Again, whatever doubt still remains as to the homologies of the pelvis and shoulder girdle, surely no one who has read Prof. Flower's paper on the subject and his subsequent remarks in the "Osteology of the Mammalia," can accept the correspondence of the pubes with the clavicle. The former may very probably answer to a procoracoid, as Gegenbaur and other anatomists suppose, but its mode of development its position in reptiles, and its relation to the great nerves and vessels of the hind limb, are all conclusive against the homology given in p. 116, and more fully in p. 146. No reason is assigned for the query affixed to the statement (p. 171) that the elephant's placenta is deciduous and zonary, which zoologists have hitherto accepted on the testimony of more than one careful and independent observer. The statement as to the number of the cervical vertebræ in mammalia (p. 172) is not exact. No Cetacean has yet been found in which the full number cannot be distinguished, however much fused together the vertebræ may become. On the other hand, the manati has never more than six, and the same appears to be true of one species of *Cholopus* (not Cholœpus).

No mention is made of the order Dipnoi in the classification of fishes taken from Müller (p. 117), or again in the characters of the orders (pp. 133-135). So remarkable a form as *Lepidosiren* should not have been omitted, even if Dr. Ord accepts the conclusion which Dr. Günther has very lately stated in these columns (vol. iv. Nos. 99 and 100). The new genus *Ceratodus*, now that its anatomy has been so fully investigated, forms no doubt a very complete link between the Ganoids and the Dipnoi, and many zoologists will agree with the classification proposed in the admirable paper just referred to; but books intended for students should scarcely pursue the "latest views" so closely.

In conclusion it is only fair to repeat that these Notes deserve commendation for their general accuracy, and contrast very favourably with some other manuals for students on the same subject. They will, if well used, be valuable to learners, and perhaps still more so to teachers.

P. H. PYE-SMITH

OUR BOOK SHELF

Note-book on Practical Solid or Descriptive Geometry, containing Problems with help for Solutions. By J. H. Edgar, M.A., Lecturer on Mechanical Drawing at the Royal School of Mines, &c., &c., and G. S. Pritchard, late Master for Descriptive Geometry, Royal Military Academy, Woolwich. (London and New York: Macmillan and Co., 1871.)

WHEN our Civil and Military Engineering Examinations are daily making larger demands for geometrical proficiency a new and exceedingly lucid Note-book on Descriptive Geometry comes well-timed. Though much has been done to expand this collateral offshoot of geometrical science since M. Monge, of the Ecole Polytechnique, first started it, the co-ordinative characteristic of a science has hitherto been wanting; it has contained, doubtlessly, all the abstract principles of orthographic projection, but principles, to be available, must be interdependent and derivative. Messrs. Edgar and Pritchard have felt this deficiency, and have done much to remove it. Their book, unlike the majority of cheap hand-books, is neither "patchy nor scrappy," but a continuous and coherent whole. "Elementary Explanations, Definitions, and Theorems" come first, followed by twenty-eight problems on "The Straight Line and Plane;" to these succeed Solids, first singly, and then in "Groups and Combinations." In like logical order we next have "Solids with the inclinations of the plane of one face, and of one edge or line in that face given," and then "Solids with the inclinations of two adjacent edges given," and, lastly, in this category, "Solids with the inclinations of two adjacent faces given." So far we have the principles of projection in a much more perfectly co-ordinated arrangement than we have hitherto found them in, and we must say that the mere act of mentally assimilating this interdependence of principles would be wholesome discipline, even if it did not, as it unquestionably does, facilitate each successive step in progress, and, most of all, conduce to an integral entertainment of the subject. Again, as naturally derivable from the consideration of the inclined faces of solids, we arrive at "Sections by oblique planes," and "Developments," or the spreading out in one plane of the adjacent faces of such solids; and, finally, the development of curved surfaces. "Miscellaneous Problems" now have place, and amongst them we notice one from the "Science Examinations" of last year. The sequence of the four next chapters is judicious. "Tangent Planes," "Intersections of solids with plane surfaces," "Intersections of solids with curved surfaces," "Spherical Triangles." A short chapter on Isometric Projection (quite as long as it deserves) ends the work, the authors of which we rejoice to find (in these days of "result-seeking") much more desirous of results actual than results visible, and accordingly, foregoing a somewhat too popular profusion of diagrams, which, while it undoubtedly facilitates the bare apprehension of subject-matter, by no means enforces that comprehension of the subject which attends upon the act of accomplishing a mental diagram for ourselves. In this expression of their conviction the authors, we observe, are at one with Mr. Binns, who, with the same sincerity, and for like reason, resisted the systematic use of models in the teaching of "mechanical drawing."

Messrs. Edgar and Pritchard have produced an inexpensive, but a well-digested, comprehensive, lucid, and typographically attractive *vade mecum.*

On the Constitution of the Solid Crust of the Earth. By Archdeacon Pratt, F.R.S. (Phil. Trans., 1871.)

ANOTHER contribution to a subject on which the author has laboured for many years—never perhaps very brilliantly, but always in the main soundly. Such unmitigated nonsense has been talked on the subject of the thickness of the solid crust of the earth, even by scientific men of real power—generally mere mathematicians, sometimes geologists, rarely indeed physicists—and such extravagant views on the subject are still propounded and defended by men like Delaunay, who have done good work in closely allied questions, that it is really refreshing to read Archdeacon Pratt's paper. Yet its tone is somewhat hesitating, almost apologetic, and he finally arrives at the conclusion that what seems to us to be at least a natural assumption to make at starting (viz., that a level surface may be drawn, not very many miles under the surface of the earth, such that in spite of hills and ocean beds the amount of matter shall be the same in every vertical line between these two surfaces) leads to results not after all very inconsistent with those derived from actual pendulum observations made over the Indian Continent. Sir W. Thomson's bold investigation of the tides in the solid earth, due to elastic yielding, furnishes us with by far the most powerful mode of attacking the general question which has been devised since Hopkins's celebrated suggestion of the information to be derived from precession and nutation; and it is to be hoped that the labours of the Tidal Committee of the British Association will soon furnish, from observation, the data required for its numerical application.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Instruction in Science for Women

IN thanking you for the useful account given in your last number of the various attempts being made in different parts of England to improve the scientific education of women, may I give you a few more details of the effort now being made at Cambridge to assist the training of those ladies who live too far from any educational centre to be able to get oral instruction?

Correspondence classes have been formed in some of the subjects selected for the University Examination of Women, and the teachers (chiefly resident fellows of colleges) are attempting to assist the reading of their correspondents by means of advice, examination papers at fixed intervals, and free criticism.

Of course this scheme cannot offer the advantages which the lecture systems of London, Edinburgh, and Cambridge itself afford; but that it does meet a real want in what I may venture to call the "rural districts" is shown by the fact that more than seventy women have joined the scheme within a month. Among the subjects of which you take notice in your article, Mr. Stuart of Trinity has undertaken the higher mathematics, Mr. Hudson of St. John's the arithmetic (how woefully ill-taught in the average girls' school no one but the examiner can appreciate), Mr. Bonney of St. John's the geology, and myself the botany. I should add that it is not at all the wish of the promoters to limit the scheme to possible candidates for the Cambridge examinations, but as far as possible to assist any woman who may be struggling with the difficulty of reading a new subject by herself.

All women who wish to avail themselves of this scheme are requested to communicate with the Hon. Sec., Mrs. Peile, of Trumpington, near Cambridge. F. E. KITCHENER

Rugby, Nov. 25

True and Spurious Metaphysics

DR. INGLEBY is evidently a strategist of no mean order. The appalling suddenness of his totally unexpected personal attack, and the skill with which he has almost made it impossible for me to reply without laying myself open to the charge of Egotism (second only in gravity to a charge of Immorality), shows that he is a good deal more than a mere metaphysician. Of metaphysics anon—meanwhile about mathematicians.

I altogether repudiate the Trichotomy, as Dr. Ingleby gives it. The man is either a Mathematician or a Non-Mathematician. There is no intermediate class. Merely to be able to integrate, to solve differential equations, to work the hardest of Senate-Houes Problems, &c., &c., is *not* to be a Mathematician. To deserve the name a man *must* have some of the creative faculty; must be the Ποιητής, if ever so little. And to be a Creator in this sense it is not necessary that one should have devised a new Calculus. Are Stokes, Thomson, Clerk-Maxwell on the one hand, or Cayley, Sylvester, Clifford on the other mere Experts? Yet there can be no doubt that, in Dr. Ingleby's classification, this is their rank.

As regards Hamilton's having placed Metaphysics higher than Mathematics, I may avail myself of the remark, which I heard not long ago in conversation, that "what Hamilton thus exalted was the Metaphysics of the great thinker (and Mathematician) Kant, not the common Cant of Metaphysicians." The distinction implied in this poor pun is one of enormous importance. For there are Metaphysicians and Metaphysicians. Here I am happy so far to agree with Dr. Ingleby, and I shall dichotomise, but not quite as he proposes.

Metaphysicians A. The genuine article. To this class all men worthy of the name of Mathematicians necessarily belong, as do the higher Physicists, &c., &c., such as Faraday. Hence, of course, Archimedes, Descartes (Cartesius, not *Cartes!*) D'Alembert, Hamilton, &c., &c., appear in the list. Leibnitz was, I fear, simply a thief as regards Mathematics, and in Physics he did not allow the truth of Newton's discoveries; so he does not belong to this class.

Metaphysicians B. The spurious article, which has somehow managed to arrogate to itself the title belonging of right to the genuine one. Test this class by what it has to show "even in the present advanced state of metaphysics" (as Dr. Ingleby has it): what have we but stagnation, ropes of sand, bitter quarrels as to the meaning of unintelligible words, and, above all, complacent pride in being "not as other men" but dwellers in a sublimer sphere? Even Longfellow's idiotic "Youth," who ascends the Matterhorn when "the shades of night are falling fast," carrying a pompous "banner with a strange device," does not so ridiculously contrast with the practical Whymper and Tyndall carrying their ropes and ice-axes, as do the Metaphysicians B with the Metaphysicians A:—the Drones with the Working-Bees.

When I asked for the name of a Metaphysician who was also a Mathematician, it was of course of Class B that I spoke, the class containing Hegel and Sir William Hamilton, Bart. (the former of whom proved that Newton did not understand Fluxions nor even the Law of Gravitation, while the latter asserted that the pursuits of the Mathematician reduce him either to passive Credulity or to absolute Unbelief!), the class which is popularly, and (almost *therefore*) erroneously, known by the name. P. G. TAIT

"Wormell's Mechanics"

I REQUEST to make a few observations upon Mr. Wormell's letter in your last number. I shall refer to the paragraphs he has numbered.

1. It is true that, by a collation of two passages, a really intelligent student might be able to eliminate the error from the first statement in Mr. Wormell's book to which we have taken exception. I consider that such collation should be unnecessary in a text-book.

2. A mathematician would, of course, understand what Mr. Wormell means, however he might disapprove of its logic; but Mr. Wormell writes for beginners, and should state his demonstrations without ambiguity.

4. "Curious" is not the adjective we are tempted to apply to such a blunder as that on p. 112. This has not been corrected in even the second edition of the book, notwithstanding the "schoolboy's" aid.

5. We had read Sec. 71, and consequently made the remark about the block and tackle to which Mr. Wormell objects. We now re-assert that the effect of friction upon the mechanical powers is too important to have been omitted in a book professing to treat of Theoretical and *Applied* Mechanics.

Nov. 25 THE REVIEWER

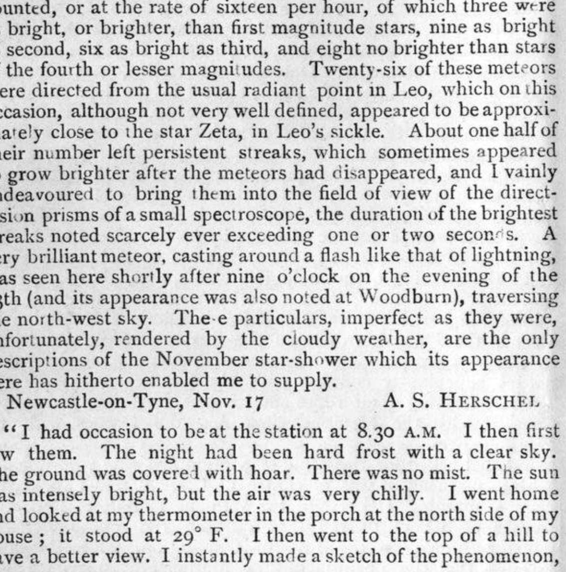
Solar Halo

THE following description and drawing of a solar halo and mock suns seen on the morning of the 13th inst., by the Rev. J.

A. Lawson, at Brancepeth, near Durham, is so perfectly similar to its appearance as drawn and described to me by another observer at Woodburn, at the same hour on the same morning, about twenty-miles north-west from Newcastle, and about thirty miles from Durham, that its unusually bright appearance near Durham may not impossibly correspond with equally favourable views of it obtained by observers at more distant places. The sky, which remained clear during the day, clouded over towards midnight on the 13th, and the stars were completely hidden during the remainder of the night. A slight rain, which began in the morning, also continued to fall during the day of the 14th, and the sky here remained entirely overcast on that evening until after midnight. Shortly before four o'clock on the morning of the 15th the clouds cleared off, and the appearance of several meteors, one of which was as bright as Jupiter, gave evident signs of the progress of the November star-shower. The perfect clearness and darkness of the sky, in the absence of the moon, at the same time gave especial brightness to the meteors and to their phosphorescent streaks. Between four o'clock and the first approach of daylight, at six o'clock, thirty-two meteors were counted, or at the rate of sixteen per hour, of which three were as bright, or brighter, than first magnitude stars, nine as bright as second, six as bright as third, and eight no brighter than stars of the fourth or lesser magnitudes. Twenty-six of these meteors were directed from the usual radiant point in Leo, which on this occasion, although not very well defined, appeared to be approximately close to the star Zeta, in Leo's sickle. About one half of their number left persistent streaks, which sometimes appeared to grow brighter after the meteors had disappeared, and I vainly endeavoured to bring them into the field of view of the direct-vision prisms of a small spectroscope, the duration of the brightest streaks noted scarcely ever exceeding one or two seconds. A very brilliant meteor, casting around a flash like that of lightning, was seen here shortly after nine o'clock on the evening of the 13th (and its appearance was also noted at Woodburn), traversing the north-west sky. These particulars, imperfect as they were, unfortunately, rendered by the cloudy weather, are the only descriptions of the November star-shower which its appearance here has hitherto enabled me to supply.

Newcastle-on-Tyne, Nov. 17 A. S. HERSCHEL

"I had occasion to be at the station at 8.30 A.M. I then first saw them. The night had been hard frost with a clear sky. The ground was covered with hoar. There was no mist. The sun was intensely bright, but the air was very chilly. I went home and looked at my thermometer in the porch at the north side of my house; it stood at 29° F. I then went to the top of a hill to have a better view. I instantly made a sketch of the phenomenon,



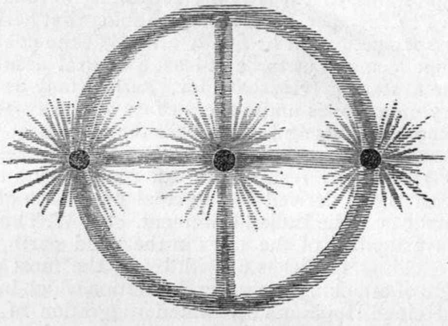
a copy of which I enclose. The lower part of the circle was hidden by a bank of dark clouds. The upper part presented the most marked appearance, and was intensely white. The lump to the north side was more intense in colours than the southern, but both were distinct as to quantity of reflected light. The colours were prismatic, but a bright amber prevailed. The disappearance began at a few minutes before ten, and by five minutes past ten all had cleared away. With the exception of the bank of clouds beneath, there were only a few pencils of cirrus cloud in the sky.

"Brancepeth, Durham, Nov. 13"

Paraselene

IN NATURE, Nov. 9, there appeared the description of a remarkable paraselene observed at Highfield House on the 25th of Oct. A similar phenomenon was seen at Penrith the same night from about 10.30 to 11. As this, however, differed altogether in detail from that observed by Mr. Lowe, I now offer a sketch of what we saw.

Thin mists and white flying scuds travelled across the sky. A luminous ring of perhaps at a guess 150° radius encircled the moon. Within this was a cross of the same brightness as the encircling ring. The bars of the cross were to the eye horizontal



and vertical, intersecting in the moon. Where the horizontal bar cut the luminous ring there were bright patches of light (mock moons), rivalling the moon, as seen through the mist, in brilliancy, but without its defined outline. Where the vertical bar cut the ring there was no increase of brightness. Such a portent in ages gone by might well have filled crusaders with hope, and perhaps thus turned the tide of battle on the morrow. We may make a useful note for future guidance by remarking what followed its appearance in this district. Up to the 25th we had for some time had very fine weatherr After the 25th we had five stormy days of wind and rain. T. McK. HUGHES

The Solar Parallax

PROF. NEWCOMB wishes apparently to make this discussion as personal as possible. Though I do not intend to follow him in this respect, I must answer him.

He asserts that my abstract of his notes was inadequate; that I "hid the point of the most remarkable of" my "inaccuracies, and ignored the imperfections entirely." This is not so. My abstract was strictly accurate and very much fuller than the utter triviality of his objections warranted. I distinctly stated why I did not discuss the matters which he is pleased to regard as imperfect—his comments being too vague. But this was not ignoring them. His memoranda were not in a state to be printed in full, nor did he even hint that he wished them to be.

As he himself characterises my mistake about his own researches as "the most remarkable of my inaccuracies," it is fortunate that this mistake is also one I am forced to explain at length, owing to the tone Prof. Newcomb has taken respecting it. I certainly did omit a part of Prof. Newcomb's charge; but in his own interest, for it was worded in the very tone to which I now take exception.

In the first place, it is not to be inferred that, because an author comments on such and such a work, he thereby wishes it to be understood that he has himself studied the original memoir in which the work was presented to the world. For instance: many very eminent men have commented on the work of Adams and Leverrier in the matter of Neptune who have not read a line of the original reasoning of these astronomers. That I, of all men (who have expressed something like contempt for memoir-hunting, and have always cared rather to explain methods and describe facts than to write the history of astronomy), should be expected to read every memoir to which I refer, is preposterous in the extreme. It may seem only natural to Prof. Newcomb that when I heard of his having discussed the transit of Venus, I should hurry to obtain his memoir that I might study it *ab initio usque ad finem*; but, as a matter of fact, a paper of the sort, even if placed in my hands, would scarcely tempt me to take up my paper-knife.

Here are the facts of the case.

I read in the *Astronomical Register* a letter which may be called anonymous, if we please, but which was referred by every one who read it to the Astronomer-Royal for Scotland, who showed not the slightest wish to conceal his identity. Doubtless on hearsay evidence (in which, however, he placed, I am sure, as much reliance as I placed in his own statement), Prof. Smyth asserted that Newcomb had anticipated Stone's labours. I took it for granted that it was so, since I saw no room or reason for doubt. There was my error. But, says Prof. Newcomb, whence comes the value 8″·87 "*which it will be noted is Mr. Petrie's pyramid value?*" and on what does Mr. Proctor found his comments "about my treatment of contacts? I am as much in the dark as ever." I will tell him. The value 8″·87 has nothing on earth to do (so far as I am concerned) with Mr. Petrie's pyramid value. It is simply the value insisted upon by Prof. Newcomb in a paper which appeared in the *Monthly Notices* of the Royal Astronomical Society for November 1868; respecting which Mr. Stone remarked (see the same number of the *Notices*) that "the point Mr. Newcomb has raised is a question of only 0″·04, viz. between my value and 8″·87—a question, therefore, of comparative insignificance." Most just remark! With my belief as to Prof. Newcomb's prior work, was it wonderful that I concluded that 8″·87 was his own pet figure for the parallax? Then it chanced that the Royal Astronomical Society, venturing to ignore Prof. Newcomb's objections, bestowed on Mr. Stone, in 1869, the Gold Medal of the Society for his researches into the Venus transit; and in the remarks which accompanied the presentation, it was stated that all preceding researches were imperfect in this respect, that (to use my own words) "no fixed rule had been adopted for interpreting the observations of internal contact." Prof. Newcomb cannot fail to see how this statement accounts for the estimate (not *my* estimate) of his supposed researches.

As a matter of fact, however—apart from the inference to which Prof. Newcomb is so anxious to give point—I am somewhat hardly treated in this matter. When I came to the part of my book where Prof. Newcomb's supposed researches should be dealt with, I thought thus in my mind: "Assuredly Newcomb has done this thing, for Prof. Smyth says so. Shall I leave his researches unnoticed because I can find no trace of them? That would be scarcely fair. Moreover, he is an American, and to omit all notice of his work will be so much the more objectionable. Verily I will repeat the statement of my esteemed friend at Edinburgh, and I will combine with it the weighty judgment of my friends at the council-board of the Astronomical Society. Thus will the researches of Newcomb be recorded, and due credit be assigned to him for his industry and skill, while yet no undue weight will be given to the numerical result of his labours."

That I thus fell into error I have already admitted. But the error is venial in its nature, and utterly insignificant in its effects. As I am conscious that it arose chiefly from my desire (shown in other ways and places) to do justice to our American fellow-workers in science, I am in no way ashamed of it; and I conceive that Prof. Newcomb should have been the last to comment in the manner he has done on the subject.

I shall not follow him in his discussion respecting irradiation, leaving Mr. Stone to deal, in his own good time, with the arguments by which two Continental astronomers (and one American mathematician) have sought to deprive him of his justly-earned credit.

I would submit, in conclusion, that February 1869 (the date of the presentation of the Astronomical Society's medal to Mr. Stone) can scarcely be described as "five years" ago even now, and my treatise on the sun was published in February 1871, Chapter I. being in type in November 1870. Nor has the council of the Astronomical Society (or any member of it) expressed any doubt, as yet, regarding the justice of the decision arrived at in 1869. Yet not a few members of the council have paid marked attention to Prof. Newcomb's attacks upon Mr. Stone. *Verbum sat.*

RICH. A. PROCTOR

Brighton, Nov. 24

The Density and Depth of the Solar Atmosphere

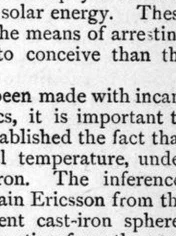
THE demonstration relating to the density and depth of the solar atmosphere, published in NATURE October 5, 1871, page 449, has been entirely misconceived by Mr. Ball. The volume of the terrestrial atmosphere is an element which obviously has nothing to do with the question. Atmospheric air, if raised to a temperature of 3,272,000° Fah., will expand 6,643 times; hence a vertical column forty-two miles high will reach a height of 279,006 miles, if brought to the stated temperature. The basis of computation adopted by Captain Ericsson being an area of one square inch, he shows that a medium similar to the terrestrial atmosphere containing an equal quantity of matter for corresponding area, transferred to the solar surface, will, owing to the superior attraction of the sun's mass, exert a pressure of $14·7 \times 27·9 = 410$ pounds. And that, if the said medium be heated to a mean temperature of 3,272,000° Fah., it will expand to a height of $\frac{279·006}{27·9} = 10,000$ miles above the solar surface. But, if a gas composed chiefly of hydrogen 1·4 times heavier than hydrogen the specific gravity of which is $\frac{1}{14}$ of that of air, be substituted, the height will be $\frac{14 \times 10,000}{1·4} = 100,000$ miles. Admitting that the ascertained coefficient of expansion, 0·00203 for 1° Fah., holds good at the high temperature before referred to, the stated altitudes of the solar atmosphere cannot be disputed. Mr. Ball's announcement concerning the properties of spheres, it is scarcely necessary to observe, has no bearing on the foregoing calculations. With reference to the effect of intense heat, it will be well to bear in mind that the before-mentioned rate of expansion holds good for atmospheric air—within an insignificant fraction—under extreme rarefaction as well as under high temperatures. We have no valid reason, therefore, to suppose that any deviation from the ascertained law of expansion takes place in the solar atmosphere, sufficient to alter materially the before-mentioned computations of its depth.

Mr. Ball, in expressing the opinion that we shall not gain much correct knowledge of the solar atmosphere by the inquiry instituted by Captain Ericsson, forgets that the retardation which the radiant heat suffers in passing through our atmosphere has been ascertained, and that the properties of atmospheric air with reference to temperature and expansion are nearly identical with those of hydrogen, now admitted to be the chief constituent of the solar atmosphere. It is evident that Mr. Ball does not comprehend the object of adopting the terrestrial atmosphere as a means of determining the extent and depth of the solar atmosphere, since he does not perceive that the comparison instituted by Captain Ericsson has brought out the fact that either the depth of the sun's atmosphere exceeds 100,000 miles, or it contains less gaseous matter than the earth's atmosphere for equal area. The importance of this conclusion with regard to the determination of the retardation of the radiant heat in passing through the sun's atmosphere is self-evident to all who regard solar radiation as energy which cannot be absorbed unless an adequate amount of matter be present. Mr. Ball's suggestion that the retardation depends on the "chemical, *i.e.* molecular-constitution" of the solar atmosphere, calls to mind how glibly some physicists talk of "arresting" one half, or more, of the solar energy. These reasoners apparently do not perceive that the means of arresting such stupendous energy is more difficult to conceive than the means of producing it.

Respecting the experiments which have been made with incandescent cast-iron spheres, and inclined discs, it is important to mention that previous experiments had established the fact that the radiant heat of flames transmits equal temperature, under similar conditions, as incandescent cast iron. The inference, therefore, which has been drawn by Captain Ericsson from the results of his experiments with incandescent cast-iron spheres regarding the feebleness of radiant heat emanating from the sun's border is not unwarrantable as supposed by Mr. Ball.

New York, Nov. 10 THULE

An Aberrant Foraminifer



I CHANCED upon an aberrant form of Peneroplis the other day, in which the free terminal series of chambers of this Foraminifer, ordinarily single, is constricted into two distinct tubes.

Though new to me, it may not be so to some of your readers; Dr. Carpenter, however, does not mention it in his monograph.

St. John's College, Cambridge W. JOHNSON SOLLAS

"New Original Observation"

ERNST FRIEDINGER, of Vienna, begins a communication on the subject of "which cells in the gastric glands secrete the pepsine?"* as follows:—"Kölliker erwähnt zuerst das Vorkommen von zweierlei Zellen in den Pepsindrüsen des Hundes." On referring to Kölliker I find, "Bei Thieren sind, wie Todd-Bowman zuerst beim Hunde, *ich* und Donders bei vielen andern Säugern gezeigt haben, die Magendrüsen überall doppelter Art," &c. In Todd and Bowman, published some years before this, the two kinds of glands are figured (the drawings being better than those of Kölliker), the difference between them in anatomical characters, the difference of the two parts of the gland, and the difference in the function discharged by the two kinds of cells of each of the two kinds of glands, pointed out. Friedinger does not even mention the names of the English observers. L. S. B.

* Aus dem lxiv. Bande der Sitzb. der k. Akad. der Wissensch. II. Abth. Oct.-Heft. Jahrg. 1871.

New Zealand Forest-Trees

In your paper of Nov. 9 I observed a letter about New Zealand Forest-Trees, signed by Mr. John R. Jackson of Kew.

Mr. Jackson refers to several of the magnificent varieties of forest trees belonging to the natural order of Coniferæ, which are widely distributed in New Zealand; omitting, however, some of the most common and most valuable, especially the Kahikatea or "white pine" of the settlers. This tree affords timber of a white colour, much like yellow deal in appearance and quality, which is admirably adapted for use as weather-board, flooring-boards, and scantling for all in-door work as well as for ordinary furniture. It is most extensively used for all those purposes. The "Totara" is particularly used for making shingles, which form a good substitute for slates as a covering for roofs.

The Rimu is used for such work as requires a more durable wood, and for the making of superior furniture, the wood being much harder and more difficult to work, than that of the Kahikatea, while its beautiful colour renders it very suitable for ordinary cabinet work.

Varieties of the acacia, called Kowai by the natives, supply timber which is specially adapted for the making of pales and fencing, and which is as durable as English oak; and there are many varieties of trees suitable for all purposes.

It is, however, in reference to that which is mentioned as the "Makia" that I think it worth while to trouble you, as I believe that I may be able to suggest what the word so referred to really is. I know of no tree or shrub so called, but Manuka, pronounced Manooka, is the name of the tree from which the natives in former times used to make all sorts of implements, especially the spears, which formed at once the weapons and the sceptres of the chiefs. That hardly deserves to be called a forest-tree, as it rarely attains any great size.

It belongs, I believe, to the family of "Diosma," and its wood is used to make axe-handles, ramrods for guns, &c. The leaves have a pleasant aromatic odour, and an infusion of them forms a passable substitute for tea, to which we were frequently glad to resort in the early times of New Zealand settlements. The fresh twigs form an elastic couch, which constituted our favourite bed on exploring parties and in temporary dwellings.

Braintree, Nov. 20 WILLIAM DAVISON

The Food of Plants

Your reviewer takes exception to my empirical description of carbonic acid in "Notes on the Food of Plants," p. 23. I readily admit—and I should have thought it was unnecessary to do so—that to describe carbonic acid as "carbon dioxide combined with water" is not *strictly* correct; but I think it is much more likely that I should have led my unscientific readers astray, had I explained, in more accurate language, the supposed composition of this acid. CUTHBERT C. GRUNDY

The Germ Theory of Disease

In NATURE, October 5, p. 450, Prof. Bastian, *versus* the Germ Theory, says:—"Such germs when present would be sure to go on increasing until they brought about the death of their host." Now, is it not well known that the larvæ of *Trichina spiralis* become encysted in the muscles of the animal infested by them, and are then perfectly harmless to their host, the fever, sometimes with fatal results, being produced by the migration of the parasites from the alimentary canal through the tissues to their favourite muscles.

Is it necessary, for the support of the germ theory, that the organism must be found in the *blood?*

GEORGE DAWSON

Balbriggan, Ireland, Nov. 20

The Origin of Species

Some months since a letter appeared in NATURE, asking the author of the article on "The Origin of Species," published in the *North British Review*, 1867, to explain the following passage which occurs in the article:—"A million creatures are born; ten thousand survive to produce offspring. One of the million has twice as good a chance as any other of surviving, but the chances are *fifty to one* against the gifted individuals being one of the *hundred* survivors." There is an error in this passage; the word "hundred" should be altered to "ten thousand." I presume that with this correction the writer of the letter will have no difficulty in following the argument. I am much obliged to him for drawing my attention to the slip.

THE AUTHOR OF THE ARTICLE

NEW VOLCANO IN THE PHILIPPINES

The island of Camiguin is situated to the north of Mindanao, at some six or eight miles from the coast, is only a few miles in circumference, and consists principally of high land. On the slopes and in the valleys is grown a large quantity of one of the most important staples of the Archipelago, the well-known Manila Hemp—the fibre of the *Musa textilis*.

On the first of May, 1871, after a series of violent earthquakes, a volcano burst out in a valley near the sea. The earth is said to have swelled, cracked, and then opened, ejecting large quantities of stones, sand, and ashes, but no liquid lava. The mischief done by the eruption was limited to a small area of two or three miles in extent, and the loss of life did not exceed eighty or ninety persons, who might have escaped if they had been less anxious to save their little property.

As the eruption and volcanic disturbances continued for some time, the alarmed natives abandoned the island in great numbers, and took refuge in the neighbouring islands of Mindanao, Bohol, &c., from which, after some weeks, the eruption having subsided, most of them returned. During the month of June the volcano ejected smoke and scoria, which latter are said to have been slowly pushed up as it were out of the crater, sliding down the sides over an underlying mass of fine grey ashes which were thrown out in the first instance; and a feeble action has continued by the latest accounts (August).

The eruption, instead of bursting from the top or sides of the higher hills, occurred in a valley between two spurs of high land near the sea and in the immediate neighbourhood of one of the principal villages, which the inhabitants abandoned, and do not seem disposed to reoccupy, though the damage done there was trifling.

As is usual here, the stories circulated were of the most exaggerated kind, and it is only by sifting and comparing the accounts of reliable eye-witnesses that I have been able to write an account at all worthy of attention. The observations made by two intelligent persons, who visited the island expressly for the purpose, have furnished the materials for this memorandum. The accounts as to the height of the cone are mere guesses—from 300 to 1,500 feet. H.M. surveying steamer *Nassau*, Captain Chimmo, is said to have visited the island in June, and we may therefore hope for a careful and scientific account of this phenomenon.

The present year has been remarkable for the extent and frequency of earthquakes over the whole of the Archipelago, though, with the exception of the case of Camiguin, they were not followed by any very serious consequences.

Manila, Sept. 25 WM. W. WOOD

SPECTROSCOPIC NOTES *

On the Construction, Arrangement, and best Proportions of the Instrument with reference to its efficiency.

THE spectroscope consists essentially of three parts—a prism, or train of prisms, to disperse the light; a collimator, as it is called, whose office is to throw upon the prisms a beam of parallel rays coming from a narrow slit; and a telescope for viewing the spectrum formed by the prisms.

Supposing the slit to be illuminated by strictly homogeneous light, the rays proceeding from it are first rendered parallel by the object-glass of the collimator, are then deflected by the prisms and finally received upon the object-glass of the view-telescope, which, if the focal lengths of the collimator and telescope object-glasses are the same, forms at the focus a real image of the slit, its precise counterpart in every respect except that it is somewhat weakened by loss of light and slightly curved.†

If the focal length of the view-telescope is greater or less than that of the collimator, the size of the image is proportionally increased or diminished.

This image is viewed and magnified by the eye-piece of the telescope.

If now the light with which the slit is illuminated be composite, each kind of rays of different refrangibility will be differently reflected by the prisms, and form in the focus of the telescope its own image of the slit. The series of these images ranged side by side in the order of their colour constitutes the spectrum, which can be perfectly pure only when the slit is infinitely narrow (so that the successive images may not overlap), and accurately in the focus of the object-glass of the collimator, which object-glass, as well as that of the telescope, must be without aberration either chromatic or spherical, and the prisms must be perfectly homogeneous and their surfaces truly plane.

Of course, none of the conditions can be strictly fulfilled. An infinitely narrow slit would give only an infinitely faint spectrum; and no prisms or object-glasses are absolutely free from faults. A reasonably close approximation to the necessary conditions can, however, be obtained by careful workmanship and adjustment, and it becomes an important subject of inquiry how to adapt the different parts of the instrument to each other so as to secure the best effect, and how to test separately their excellence, in order to trace and remedy as far as possible all faults of performance.

With reference to the battery of prisms, several questions at once suggest themselves relative to the best angle and material, the number to be used, the methods of testing their surfaces and homogeneity, and the most effective manner of arranging them.

Angle and Material of the Prisms.—As to the refracting angle, the careful investigation of Prof. Pickering, published in the *American Journal of Science and Art* for May 1868, puts it beyond question that with the glass ordinarily employed an angle of about 60° is the best. For instruments of many prisms there is an advantage as regards the amount of light in making the angle such that the transmitted ray at each surface shall be exactly perpendicular to the reflected. For ordinary glass, the refracting angle determined by this condition somewhat exceeds 60°; for the so-called "extra-dense" flint it is a little less.

The high dispersive power of this "extra-dense" glass is certainly a great recommendation. But it is very yellow, powerfully absorbing the rays belonging to the upper portion of the spectrum, and is very seldom homogeneous. It is so soft also, and so liable to scratch and tarnish, that it can only be safely used by casing it with some harder and more permanent glass, as in the compound prisms of Mr. Grubb, and the direct vision prisms of many makers.

For many purposes these direct vision prisms are very convenient and useful, but they are hardly admissible in instruments of high dispersive power designed to secure accurate definition of the whole spectrum, the violet as well as the yellow.

Test for Flatness of Surface.—For testing the flatness of the prism surfaces, probably the best method is to focus a small telescope carefully upon some distant object (by preference the moon or some bright star), and then to scrutinise the image of the same object formed by reflection from the surface to be tested. Any general convexity or concavity will be indicated by a corresponding change of focus required in the telescope; any irregularity of form will produce indistinctness, and by using a cardboard screen perforated with a small orifice of perhaps ¼ inch in diameter, the surface can be examined little by little, and the faulty spot precisely determined.

Test for Homogeneity.—It is not quite so easy to test the homogeneity of the glass. Any strong veins may, of course, be seen by holding the prism in the light, and if the ends of the prism are polished, the test by polarised light will be found very effective in bringing out any irregularities of density and elasticity in the glass. A blackened plate of window glass serves as the polariser; a Nicol's prism is held in one hand before the eye in such a position as to cut off the reflected ray, and with the other hand the glass to be tried is held between the Nicol and the polariser. If perfectly good it produces no effect whatever; if not it will show more or less light, usually in streaks and patches.

On the whole, however, the method of testing which has been found most delicate and satisfactory is the following:—

A Geissler tube containing rarefied hydrogen is set up vertically, and illuminated by a small induction coil.

A small and very perfect telescope of about six inches focus is directed upon it from a distance of seventy-five or one hundred feet, and carefully adjusted for distinct vision.

The prism to be tested is then placed in front of the object-glass of the telescope with its refracting edge vertical, adjusted approximately to the position of minimum deviation, and telescope and prism together then turned (by moving the table on which they stand), until the spectrum of the tube appears in the field of view. This spectrum consists mainly, as is well known, of three well-defined images of the tube, of which the *red* image, corresponding to the C line, is the brightest and best defined, and stands out upon a nearly black background.

Supposing then the *flatness* of the prism surfaces to have been previously tested and approved, the goodness of the glass may be judged of by the appearance and behaviour of this red image; and by using a perforated screen in the manner before described, inequalities of optical density are easily detected and located. Irregularities, which would hardly be worth noticing in a telescope object-glass, where the total deviation produced by the refraction of the rays is so small, are fatal to definition in a spectroscope, especially one of many prisms, and it is very difficult to find glass which will bear the above-named test without flinching. Of course it must be conducted at night, or in a darkened room.

Number and Arrangement of Prisms.—The number of prisms to be employed will depend upon circumstances. If the spectrum to be examined be faint, and either continuous or marked with dark lines, or by diffuse bands, either bright or dark, we are limited to a train of few prisms.

The light of the sun is so brilliant that, in studying its spectrum, we may use as many as we please. The light is abundant after passing through 13, and I presume would still be so if the train were doubled.

Spectra of fine well-defined *bright lines* also bear a surprising number of prisms. The loss of light arising from the transmission through many surfaces is nearly, if not quite, counterbalanced by the increased blackness of the background, and the greater width of slit which can be used.

As to the best arrangement for the prisms, this also must be determined by circumstances.

Where exact measurements are aimed at, as, for instance, for the purpose of ascertaining the wave-length of lines, or the dispersion co-efficient of a transparent medium, the prism or prisms ought to be firmly secured in a positive and determinable relation to the collimator. A train of many prisms can hardly be safely used in such work on account of the difficulty in obtaining this necessary fixity, and if high dispersion is indispensable, it can only be obtained by enlarging the apparatus.

But for most purposes it is better that the prisms, instead of being fixed, should be mounted upon some plan which will secure their automatic adjustment to the position of minimum deviation.

Having now thoroughly tried the plan which I proposed

* By C. A. Young, Ph.D., Professor of Natural Philosophy and Astronomy in Dartmouth College. Reprinted from advance-sheets of the Journal of the Franklin Institute, by permission of the Editor.

† The curvature arises from the fact that the rays from the extremities of the slit, though nearly parallel to each other, make an appreciable angle with those which come from the centre. They therefore strike the surface of the prisms under different conditions from the central rays, and are differently refracted, usually more. The higher the dispersive power of the instrument and the shorter the focal length of the collimator, the greater this distortion, which is also accompanied by a slight indistinctness at the edges of the spectrum.

published in this Journal last November, I am prepared to say that I cannot imagine anything more effective and convenient.

The arrangement of Mr. Browning and its extension by Mr. Proctor, are equally effective so far as the adjustment of the prisms is concerned, but are less compact and simple, and do not afford the same facility in changing the number of prisms in use.

In my instrument the light, after leaving the collimator, falls perpendicularly upon the face of a half-prism, passes through the train

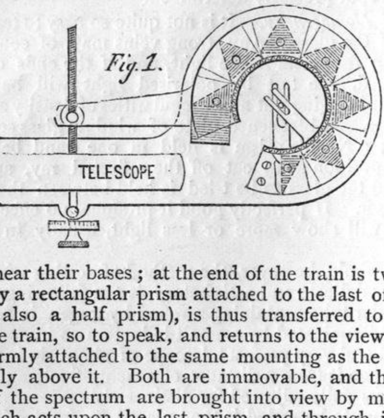


Fig. 1.

of prisms near their bases; at the end of the train is twice totally reflected by a rectangular prism attached to the last of the train (which is also a half prism), is thus transferred to the upper story of the train, so to speak, and returns to the view-telescope, which is firmly attached to the same mounting as the collimator and directly above it. Both are immovable, and the different portions of the spectrum are brought into view by means of the screw, which acts upon the last prism, and through it upon the whole train. The adjustment for focus is by a milled head, which carries the object-glasses of both collimator and telescope in or out together. Since they have the same focal length, this secures the accurate parallelism of the rays as they traverse the prisms.

The annexed diagram, taken from the paper already alluded to,* exhibits the plan of the arrangement, and requires no explanation, unless to add that, to avoid complication in the figure, I have represented only two of the radial forks which maintain the prisms in adjustment; also, that the prisms are connected to each other at top and bottom, not by hinges, but by flat springs, preventing all shake.

By adding another tier of prisms and sending the light back and forth through a third and fourth story, the dispersion can be easily doubled with very small additional expense, except for the prisms themselves; the mechanical arrangements remaining precisely the same.

I desire, in this connection, to call attention to the great ad-

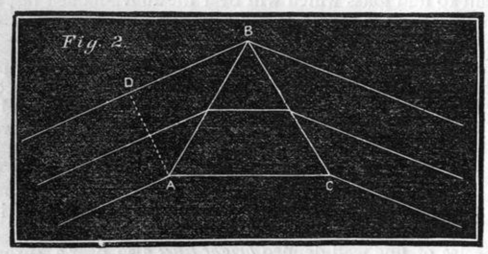


Fig. 2.

vantages gained by the use of the half prism at the commencement of the train, a point which hitherto seems to have escaped notice.

With a prism of 60°, having a mean refractive index, μ, 1·6, and placed in its best position, the course of the rays is as shown in Fig. 2. The side *a b* is just $1\frac{2}{3}$ times the cross section, *a d*, of the transmitted beam. In other words a prism of the same material and angle described, in order to transmit a beam one inch in diameter, must be one inch high and have sides $1\frac{2}{3}$ inches long.

But when the light is received perpendicularly upon the face of a half prism, as in Fig. 3, then, since $bc = be \div \cos 30°$, the length of the prism side, *b c*, requires to be only 1·155 times as great as the diameter of the transmitted beam.

Thus a train of prisms each 1 inch high, and having the sides of their triangular bases each 1·155 inches long, led by an initial half prism in the way indicated, would transmit a beam 1 inch in diameter, while without the initial half prism the sides would

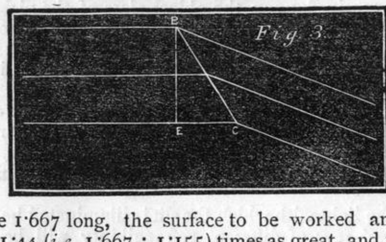


Fig. 3.

have to be 1·667 long, the surface to be worked and polished would be 1·44 (*i.e.* 1·667÷1·155) times as great, and the quantity of glass required 2·08 (*i.e.* $1{\cdot}44^2$) times as great. With a higher index of refraction the gain is still greater.

This advantage of course is not obtained without losing the dispersive power of one half prism. But where the train is extensive this loss is comparatively insignificant, and may be made up by a slight increase of the refracting angles. Indeed, in an instrument of the form above described, it is necessary, if the train is led by a *whole* prism, to reduce the refracting angle from 60° to about 55°, in order that the reflecting prism at the end of the train may not interfere with the collimator, while with the initial half prism the full angle of 60° can be used, so that in this case there is practically no loss whatever.

It would seem to deserve consideration, whether in the construction of spectroscopes to be used with some of the huge telescopes now building, it may not be advisable to carry the principle still further, by employing *two* or more half prisms at the beginning of the train in order to economise material and weight.

Dispersive Efficiency.—The dispersive efficiency of the spectroscope is its ability to separate and distinguish spectral lines whose indices of refraction differ but slightly; it is closely analogous to the *dividing power* of a telescope in dealing with double stars. It depends* not only upon the train of prisms, but also upon the focal lengths of the telescope and collimator, the width of the slit, and the magnifying power of the eye-piece.

As has been said before, each bright line is an image of the

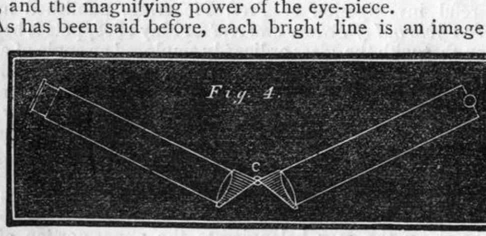


Fig. 4.

slit whose *magnitude*, referred to the limit of distinct vision, depends upon the telescope and collimator, but is independent of the prism train. The *distance* between the centres of two neighbouring lines, on the other hand, depends upon the number and character of the prisms, the focal length of the telescope, and the magnifying power of its eye-piece, but is totally independent of the collimator.

In order that two lines may be divided, it is necessary that the *edges* of their spectral images should be separated by a certain small distance—a *minimum visibile*, whose precise value is of no particular importance to our present purpose, but which I suppose to be about $\frac{1}{500}$ of an inch.

* After the appearance of the article referred to, I found that Mr. Lockyer had anticipated me by some months, not only in respect to the method of making the rays traverse the prism train twice, but also in the use of a half prism at the beginning of the train, and the employment of an elastic spring in the adjustment for minimum deviation. In all essential particulars his instrument is the same as mine, though in some matters of detail there are differences which have proved to be of practical importance in favour of my own.

Mr. Lockyer has, however, never printed an account of his instrument, and at the time of my publication I knew only the fact (which I then mentioned), that he intended to send the light twice through the prism train by a total reflection.

The beautiful instrument recently constructed for Dr. Huggins by Mr. Grubb differs mainly in using compound prisms, and in producing the adjustment for minimum deviation by an arrangement of link work, which, though not theoretically exact, is practically accurate.

* It is very common to describe the dispersive power of a spectroscope as being equivalent to a certain number of prisms, or a certain number of degrees from A to H. But either method fails entirely to convey an idea of the appearance of the spectrum in the instrument, and it is much better to name the closest double line which it will divide, or else to give the distance between the two D lines, either linear (referred of course to the limit of distinct vision), or angular. If we know, for example, that the D lines are separated 1′, or, what comes to the same thing, appear to be one-sixth of an inch apart, we have a definite idea of the power of the instrument.

From these principles it is easy to deduce a formula which will express the dispersive efficiency of a given instrument, and enable us to judge of the effect of variations in the proportion and arrangement of the parts.

Let f be the focal length of the collimator.

f^1 ,, ,, ,, telescope.

m the magnifying power of the eye-piece (which is found by dividing the limit of distinct vision by the equivalent focal length of the eye-piece and adding unity to the quotient).

n the number of prisms in the train.

w the width of the slit.

k the *minimum visibile* above alluded to.

d μ, the difference between the indices of refraction for two adjacent lines; and finally

δ, the co-efficient of dispersion for each prism (which, r being the refracting angle of the prism, is given by the equation

$$\delta = \frac{\sin \frac{1}{2} r}{\sqrt{1 - \mu^2 \sin^2 \frac{1}{2} r}})$$

If, now, we put D for the distance between the centres of the two lines, and b for their breadth, we shall have

$$D = m\ n\ s\ \delta f^1 .\ d\ \mu, \text{ and}$$
$$b = m\ w\ f^1 \div f.$$

But the distance between the edges of the lines equals $D - b$; and this, for two lines as close as the instrument will divide, must equal k.

Hence $k = m\ n\ \delta f^1 .\ d\ \mu - \frac{m\ w\ f^1}{f}$. Finding from this the value of d μ, taking its reciprocal as a measure of the dispersive efficiency of the instrument, and calling it E, we get

$$E = m\ n\ \delta\ \frac{f f^1}{kf + mwf^1} \qquad (1)$$

This formula, in which m, n, and δ appear as simple factors, of course supposes that the perfection of workmanship and intensity of the light are such that there is no limit to the magnifying power and number of prisms which may be employed.

My special object, however, in working it out has been to exhibit clearly what is evident from its last term, the dependence of the dispersive efficiency upon the focal lengths of collimator and telescope.

Differentiating equation (1) with respect to f and f^1, we obtain

$$d\ E = m.\ n.\ \delta \left\{ \frac{kf^2 (df^1) + mwf^1 (df)}{(kf + mwf^1)^2} \right\} \qquad (2)$$

which shows that any increase in either f or f^1 adds to the dispersion. If f increases, both D and b increase in the same proportion, and so, of course, does the width of the interval between the adjacent lines; while every augmentation of f^1 decreases the width of the spectral images without in the least affecting the distance between their centres.

This principle seems to have been often overlooked, and collimators and telescopes of short focus employed when longer ones would have been far better.

In spectroscopes designed to be used for astronomical purposes, at the principal focus of a telescope, there is, of course, no advantage in making the angle of aperture of the collimator much greater than that of the equatorial itself; accordingly a collimator of one inch aperture ought to have a focal length of 10 or 12 inches, or, if special reasons determine a focal length of only 6 inches, then it is needless to make the collimator and view telescope much over half an inch in diameter, and the prisms may be correspondingly small.

If, on the other hand, the focus of telescope or collimator is lengthened for the purpose of securing increased dispersion, object glasses and prisms must also be correspondingly enlarged, in order to transmit the same amount of light.

It is, perhaps, worth noting that when f and f^1 are equal, formula (1) becomes simply

$$E = \frac{m.\ n.\ \delta.\ f}{k + mw}. \qquad (3)$$

Luminous Efficiency.—The extreme faintness of many spectra greatly embarrasses their study, so that it becomes a matter of interest to examine how the different dimensions and proportions of a given instrument stand related to the brightness of the spectrum produced.

It appears to be necessary, for this purpose, to distinguish two classes of spectra, those composed of narrow and well defined *bright lines*, and those which are not, the light being spread out more or less evenly and continuously.

The brightness of a spectrum of the latter kind is evidently directly proportional to the amount of light admitted, diminished by its subsequent losses, and inversely to the area over which it is distributed; similar considerations apply in the first case, only as the lines are exceedingly narrow images of the slit, their brightness, being independent of their distance from each other, is inversely proportional to the length of the lines simply—*i.e.*, to the *width* of the spectrum, having nothing to do with its *length*.

Using the same notation as before, merely adding

i = intensity of source of light.

l = length of the slit.

a = linear aperture of the collimator object glass;

and supposing the prisms and view telescope of a size to take in the whole beam transmitted by the collimator, and that the angular magnitude of the luminous object, as seen from the slit, is sufficient to furnish a pencil large enough to fill the collimator object glass, we shall then have for the quantity of light transmitted to the prisms the expression

$$i\ l\ w \frac{a^2}{f^2}.$$

This is afterwards diminished in passing through the prism train and telescope.

To estimate the precise amount of this loss is very difficult, and the algebraic expression for it is of so complicated a character that it would be of little use to attempt to introduce it into our formula. Calling it S, however (which of course is a function of the number and refracting angle of the prisms, as well as of the optical character of the glass), we may write for the quantity of light effective in forming the spectrum,

$Q = i\ l\ w \frac{a^2}{f^2} - S$. And this expression applies to both kinds of spectra—bright line and continuous.

In the continuous spectrum this light is spread out over an area whose length is the angular dispersion of the train * $\triangle$, multiplied by the magnifying power of the eye-piece and by the focal length of the view telescope, and whose breadth is the width of the spectrum. Putting A for this area, we have

$$A = \frac{l\ m^2\ n.\ \triangle .\ f_1{}^2}{f}.$$

And for the intensity of light in the continuous spectrum, which equals $Q \div A$, we get finally

$$L = \frac{i\ l\ w\ a^2 - f^2\ S}{l\ m^2\ n\ \triangle\ f_1{}^2 f} \qquad (4)$$

If we neglect the loss of light in transmission, nd take $f = f^1$, the formula simplifies itself to

$$L^1 = \frac{i\ w\ a^2}{m^2\ n\ \triangle\ f^3}. \qquad (5)$$

Either of these formulæ shows how rapidly the light is cut down by any increase of the dispersive power, whether by adding to the prism train or by enlargement of the linear dimensions of the apparatus.

Our only resource in dealing with spectra of this kind, when the limit of visibility on account of faintness is nearly attained, seems to be either to increase i or a. If the luminous object be a point (like a star) we can do the former by concentrating its light on the slit with a lens; if it be diffuse, like the light of the sky, I know no means for producing the desired concentration, and we can only gain our end by increasing the angular aperture of the collimator.

For the discontinuous bright-line spectrum, the case is quite different. Q, *i.e.* the quantity of light which goes to form the spectrum, remains unchanged, but instead of A the whole area covered by the spectrum we have only to consider its width, *i.e.* the length of the lines.†

* $\triangle = n \left(\text{Sin}^{-1} (\mu_H \times \text{Sin} \frac{1}{2} r) - \text{Sin}^{-1} (\mu_A \text{ Sin} \frac{1}{2} r) \right)$ where μ_A and μ_H are respectively the indices of refraction for the lines A and H; the prisms being supposed to be so mounted as to maintain the position of minimum deviation.

† So long as the opening of the slit is small enough to secure accurate definition of the lines, it is not necessary to take into account either this or the magnifying power as diminishing the brightness of the lines by increasing their breadth, since irradiation alone gives them a sensible width sufficient to render the effect of other causes comparatively unimportant.

We then have $A^1 = \frac{l m f^1}{f}$;

and for the brilliance of the bright line spectrum, we get

$$\Lambda = \frac{Q}{A'} = \frac{i l w a^2 - f^2 S}{l m f f^1} \qquad (6)$$

If we neglect S, the loss of light in transmission through the apparatus, and suppose $f = f^1$, this becomes

$$\Lambda' = \frac{i w a}{m f^2} \qquad (7)$$

These formulæ show that with a spectrum of this kind we may, without diminishing the brightness of the lines, increase the dispersive power of our instrument to any extent by increasing its linear dimensions; if we increase the dispersive power by adding to the prism train, the case is different, since S is a function of n, the number of prisms.

New form of Spectroscope.—I close the article with the suggestion of a new form for a chemical spectroscope, which seems to present some advantages in the saving of material and labour as well as of light.

The figure (Fig. 4) sufficiently illustrates it, except that it may be necessary to add that I have not represented any of the many possible convenient arrangements for reading off the positions of lines observed. The centre of motion for the telescope is at *c*, the collimator remaining fixed.

The half prisms of heavy flint-glass are concave at the rear surface, and directly cemented to the single crown glass lenses, which form the object-glasses of telescope and collimator. There is thus a saving of two surfaces over the common form; and, what is more important, the prisms to fit telescopes of a given aperture are considerably smaller on the face, and can be made from plates of glass of less than half the thickness required by the ordinary construction, a circumstance which greatly reduces the difficulty of obtaining suitable material.

NOTES

WE learn by British-Indian cable that the English Government Eclipse Expedition arrived at Galle on Monday last; all well. The authorities in India and in Ceylon are doing everything they can to assist the party. M. Janssen has gone to the Neilgherries. Mr. Lockyer is in communication with Colonel Tennant. The weather was at that time fine.

PROFESSOR JOHN YOUNG has written to the *North British Daily Mail*, detailing the reasons for the notice of motion which he gave in April last to the General Council of the University of Glasgow, relative to the division of the chair of Natural History in that University. The duties of the chair would render it ncumbent on its occupant to teach, if required to do so, Zoology, Comparative Anatomy and Physiology, Geology and Palæontology, Mineralogy, Mining, Metallurgy, and possibly Meteorology. Actually, Professor Young gives instruction in Comparative Anatomy and Geology. He is naturally extremely anxious that he should no longer be called upon to teach subjects which, in the present state of science, it is impossible can be efficiently combined. It is to be hoped that, before long, the University will see the necessity of instituting a separate chair of Geology, as has recently been done at Edinburgh; but where will be found a Sir Roderick Murchison to endow it in so munificent a manner?

AT the second M.B. Examination for Honours at the University of London, Mr. William Henry Allchin, of University College, has taken the Scholarship and gold medal, and Mr. Henry Edward Southee, of Guy's Hospital, the gold medal in Medicine; Mr. Richard Clement Lucas, of Guy's Hospital, the gold medal in Obstetric Medicine, and Mr. Ernest Alfred Elkington, of the General Hospital, Birmingham, the gold medal in Forensic Medicine. At the second B.A. and second B.Sc. Examination, Mr. Thomas Olver Harding, of Trinity College, Cambridge, obtained the Scholarship in Mathematics and Natural Philosophy. No gold medals were awarded in Animal Physiology, Chemistry, Geology and Palæontology, or Zoology.

MR. LAZARUS FLETCHER, of the Manchester Grammar School, was on Saturday last elected to the vacant scholarship at Balliol College, on the foundation of Miss H. Brakenbury, for the encouragement of the study of Natural Science. Mr. Hainsworth, of the same school, and Mr. Greswell, of Louth School, were also mentioned by the examiners as worthy of commendation. The scholarship is worth 70*l*. a year, and is tenable for three years.

WITH reference to the destruction of the Museum at Chicago, we learn that Dr. Stimpson's own collection of North American shells formed part of the Smithsonian Museum; and that the collection made by Professor Agassiz and Count Pourtales, in their deep-sea explorations of the Gulf of Mexico, belonged to the Cambridge Museum. Many of Dr. Stimpson's MSS. and drawings have been published. Mr. Gwyn Jeffreys was, as our readers are aware, fortunately the means of saving some of the shells from the Gulf of Mexico, which he is now engaged in working out before returning. Many valuable specimens which Mr. Jeffreys took to Chicago of course shared the fate of the remainder; some of them, however, he hopes to be able to replace. Professor Agassiz has offered Dr. Stimpson a place at Cambridge, Mass., and to give him the means of again carrying on dredging operations in the Gulf of Mexico.

A FINE young pair of the Grey seal (*Halichœrus grypus*) has just been added to the Zoological Society's living collection. This species, although not uncommon on some parts of the British coast, has never previously been received alive by the Society. The present specimens were obtained near St. David's in South Wales, where this seal is said to be of not unfrequent occurrence. Besides this seal, the Society's collection also contains examples of three other Phocidæ—namely, the sea-lion (*Otaria jubata*), the Cape eared seal (*Otaria pusilla*), and the common seal (*Phoca vitulina*).

IN the Northern United States the richest marine fauna is to be found in the vicinity of Eastport, Maine, the adjacent region of the Bay of Fundy having become classic ground through the labours of Stimpson, Verrill, Packard, Morse, Webster, Hyatt, &c. It is rumoured, according to *Harper's Weekly*, that Mr. J. E. Gavit, of New York, president of the American Bank-note Company, and at the same time an eminent microscopist, has it in contemplation with some friends to erect a building at Eastport, to be suitably endowed and maintained for the use of any naturalists who may wish to avail themselves of the facilities it may afford. We can only hope that so excellent an idea may be realised at an early day.

THE latest advices from Captain Hall's expedition were dated at Upernavik, September 5, being somewhat later than the information brought back by the *Congress*. After parting with the *Congress* at Disco, Captain Hall sailed nearly north until he reached the harbour of Proven, where he landed and endeavoured to obtain dogs. In this, however, he was not very successful, procuring only eighteen, most of which were not well fitted for service. From Proven the *Polaris* proceeded to Upernavik, arriving there on the 30th of August. He left that port on the 5th of September, and continued on his polar journey.

AMONG the movements of naturalists abroad, we understand that Mr. J. Matthew Jones, F.L.S., President of the Nova Scotian Institute of Natural Science, intends spending the winter months in the Bermudas, for the purpose of more thoroughly investigating the marine zoology of the group.

MESSRS. WESTERMANN, of Brunswick, announce for early publication, in two volumes, a rendering into German, by Herr Schellen, of the French translation of P. Secchi's "Le Soleil."

THE *Feuille des Jeunes Naturalistes*, to which we called attention some time ago, has entered on its second year of existence in a somewhat enlarged form. Aiming at the development of an intelligent love of nature amongst French schoolboys, it claims the sympathy of all those amongst ourselves who, by means of school museums and natural history societies, are labouring in the same field. The editor solicits contributions from English boys, on any subject connected with natural science, which he promises carefully to translate and publish.

ON the 5th of January, 1872, will be published, in Bombay the first number of a monthly journal, the *Indian Antiquary*, intended as a medium of communication between Oriental scholars in India, Europe, and America, and a repertory for information on the Antiquities, History, Geography, Literature, Religion, Mythology, Natural History, Ethnography, and Folklore of India and adjoining countries, and thus embracing a similar variety of subjects to the English *Notes and Queries*, the plan of whieh the *Indian Antiquary* will, to some extent, follow. The most eminent Orientalists in India, Europe, and America, it is expected, will become contributors to the pages of this journal, and it will be edited by Mr. J. Burgess, M.R.A.S., F.R.G.S. The London agents will be Messrs. Trübner and Co.

WE have received the first number of "The Garden," a weekly newspaper, edited by Mr. W. Robinson, F.L.S. It contains original articles by the editor and other correspondents on gardening topics, illustrated by wood-cuts, instructions for gardeners suited to the time of the year, descriptions of new plants, &c.

MR. W. F. DENNING, the Honorary Secretary of the Observing Astronomical Society, publishes "Astronomical Phenomena in 1872," a complete guide to the astronomer for the more important phenomena to be looked for during the year.

MR. ROTHSCHILD, of the Rue des Saints Pères, Paris, has commenced publishing, in large folio numbers, a magnificent work upon the Trajan Column at Rome. A complete series of mouldings was executed in 1862, by order of the Emperor, for the Louvre Museum. A cast was taken of these mouldings in galvano, by the Procédé Oudry, and from these casts phototypographic plates have been done. There will also be many woodcuts interspersed through the work. The letterpress will be by M. W. Frochnor, the conservator of the Louvre Museum. It will be finished in 1873.

MR. CUTHBERT COLLINGWOOD, M.A. and B.M., Oxon, F.L.S., &c., author of "Rambles of a Naturalist on the Shores and Waters of the China Seas," &c., announces, as in the press, "A Vision of Creation," a poem, with an introduction, geological, and critical.

PROF. HUXLEY, in his address at the distribution of prizes at the Oxford Local Examination at Manchester, spoke as follows: "He believed that he was speaking entirely within measure when he said now that there was nowhere in the world a more efficient or better school, so far as it went, for teaching the great branches of physical science than was at the present time to be found in the University of Oxford. He thought it right that he should here state what had come to his knowledge as a member of the Royal Commission connected with these matters. That noble University had within the last ten or fifteen years devoted no less than about 100,000*l.* to the endowment and equipment of physical science and physical science only.

M. JOLY, a distinguished member of the French Academy of Medicine, has recently read a paper before that learned society, in which he attributes the enervation of the nation, as evinced during the late war, to the combined effect of alcohol and nicotine upon the national character. "Tobacco," says Dr. Joly, "although of only recent introduction, has gained upon its older rival. Imitativeness and 'moral contagion' have done their work, until the use of this poison has penetrated everywhere—has enslaved the nation, caused personal and racial degeneracy, enervated the entire army, and made it slow to fight and powerless in action. The use both of spirits and tobacco has frightfully increased, and human depravity could scarcely devise a worse compound than the mixture of brandy and tobacco, which is the latest liquid novelty patronised by Parisian sensualists. The French consume more tobacco than any other nation."

THE *Gardener's Chronicle* states that a series of photographs devoted to the illustration of Linnean relics has been recently issued in Sweden, and copies are to be procured in London. They consist of photographs of Linné's statue in the Botanical Garden at Upsala, of the Botanical Garden itself, the monument in Upsala Cathedral, his country seat and museum at Hammarby, a portrait, one of his letters, and other objects of interest in connection with the great naturalist.

AN interesting contribution to the supposed "Serpent Worship" in Scotland is stated to have been lately discovered near the shores of Loch Fell, near Oban, where the form of a monstrous serpent three hundred feet in length has been disinterred. From the accounts which have been published it would appear that the figure of the serpent was excavated in the rocks above the lake, and had become overgrown.

SOME interesting experiments have lately been tried at the Crystal Palace to improve the illuminating power of ordinary gas. The inventor, by mixing a certain proportion of oxygen with the gas as it issues from the burner, claims to have found both a more economical and a more wholesome method of burning gas. There is no doubt that the light is much more brilliant, the only question is whether it is not too expensive. The oxygen is generated by passing supersaturated steam over red manganate of soda previously heated in dry air. The steam absorbs the oxygen from the manganate, and on being condensed the oxygen passes over alone and is mixed with the gas at the burner.

THE *Indian Medical Gazette* says that a report furnished by the Inspector of Police to the Bengal Government shows that of 939 cases of snake bites in which ammonia was administered by the police 702 are reported to have recovered, and the average length of time between the bite and the application of the ammonia is said to have been in fatal cases 4h. 12m. 13s., and in cases of recovery 3h. 28m. 14s.

ON the 29th of September a slight shock of earthquake was felt at Memoodabad in the Ahmedabad Collectorate, Bombay.

IT is stated that an aerolite weighing 127lb. fell lately near Montereau (Seine-et-Marne) in France. It appears to have come from the east, and burst with a loud explosion, giving a bright blue light. It is of an irregular spheroid shape and black, and is to be sent to the Academy of Sciences.

A VERY violent typhoon raged at Hongkong on the 2nd of September, doing an immense amount of damage both on land and sea.

ON October 16th a terrific hurricane swept over Halifax, New Brunswick, and caused a large amount of damage. It was accompanied by an extraordinary high tide, which was unexampled in the history of the city for damage and violence. On the same and the following day, very heavy storms were experienced on Lake Superior and Lake Huron, which caused the destruction of many vessels and the loss of numerous lives.

IN Ecuador there have been discovered in the forests of Santa Helena the trees yielding the red guinea bark.

An earthquake took place in the beginning of October on the Isthmus of Chiriqui near Panama.

Dr. Robert Brown, in a communication on the "Interior of Greenland," states that all the results of the attempted explorations of the interior serve to show that this is one huge *mer de glace*, of which the outlets and overflow are the comparatively small glaciers on the coast, though when compared with the glacier system of the Alps, they are of gigantic size. The out-skirting land is, to all intents and purposes, merely a circlet of islands of greater or less extent. There are, in all probability, no mountains in the interior—only a high plateau, from which the unbroken ice is shed on either side to the east and west, the greater slope being toward the west. No mountains have been seen in the interior, the prospect being generally bounded by a dim, icy horizon. Dr. Brown considers Greenland susceptible of being crossed from side to side with dog or other sledges, provided the party start under experienced guides, and sufficiently early in the year.

Occasional glimpses of pre-historic times are afforded to us. One of the Indian papers records the deeds of a mad elephant, which made its way from the Rewah territory into the Mundla district. The first day it attacked the village of Tarraj, when the inhabitants took refuge on the roofs, but it killed a woman and child. The next night it went to the village of Mauzah and killed a boy. Two days after it killed a woman at Barbashore, and on the following night added to the number a man and woman at Kamaria. Thence it made its way to Donoria, and the villagers tried to escape, but two old women met their death, and another was trampled on and seriously injured. Its next stage was Manori, destroying a woman and two children, and so to Karbah. Here it snatched a baby from the mother's arms and killed it, and in the evening succeeded in killing a man in the same place. The next night a man was killed at Nigheri, and on that following another at Banu. On the 7th February it met with a check in passing the Ramgurgh Tahsil, where it was fired on, and retreated to Bijori, taking revenge by killing a man and a boy. On the 8th it surprised a party of villagers in the jungle, who had escaped from Nanda, again taking a woman's baby from her arms and killing it. The next slaughter was of a man at Belgaon and another at Belgara. It then visited Sayla, the villagers making their escape, except one boy, who was caught by it, but only rolled about for fun, but the elephant went into the village and pulled down several houses. By the 15th he was at Mohari, and injured a man and woman by rolling them about without killing them. On the 19th it killed one man and wounded another at Naraingunj. By this time a party was got together to resist it, about three weeks having elapsed, and the animal was driven across the river Nerbudda and into the jungle of a hill, but from which the force was inadequate to dislodge it. In three weeks it drove the people out of many villages, killing twenty-one persons, wounding others, and ravaging the country. It is alleged to have devoured five of its victims. The above recital of what took place in a relatively settled country, gives colour to the legends of Hercules and Theseus. In this case nothing is said of the destruction of crops which must have taken place.

An improvement in the apparatus attached to fire-engines has been proposed by Mr. Prosser in the form of a spreading fire-nozzle, the object of which is, by means of a number of moveable as well as fixed fingers so to direct the jet of water that it shall divide it into a more or less fine spray. The water is thus economised, and instead of a large proportion running off after scarcely coming into contact with the burning material, every drop, falling in the form of a conical shower of rain, performs its part towards extinguishing the fire.

COLDING ON THE LAWS OF CURRENTS IN ORDINARY CONDUITS AND IN THE SEA

II.

Forchhammer has filled up that gap by his researches upon the water of the ocean; for we can now, by the help of his results and of the temperatures, ascertain pretty exactly the specific weight of the water of the ocean in the principal seas of the globe. Calculation has proved the correctness of Maury's original notion, viz., that the density of the water of the ocean is least at the equator, and increases with tolerable regularity in proportion as we advance towards the north and towards the south. The water of the Atlantic seems to be of the greatest density at about 60° N. latitude to the south and south-east of Greenland. If we take this density as unity, the specific weight of the water of the sea will on an average be represented by the following numbers:—

Northern Hemisphere		Southern Hemisphere	
Between 60° and 70° latitude in Davis Straits .	0·9980	Unknown	
About 60° latitude in the Atlantic	1·0300	Unknown	
Between 50° and 60° latitude in the Atlantic . .	0·9994	In the Cold Currents of Cape Horn	0·9990
Between 40° and 50° latitude in the Atlantic . .	0·9985	In the Atlantic	0·9984
Between 23° and 40° latitude in the Atlantic . .	0·9972	In the Atlantic	9·9970
Between 0° and 23° latitude in the Atlantic . .	0·9966	In the Atlantic	0·9966

Of these the former, those of the Northern Hemisphere, are most to be depended on, because the observations there have been most numerous.

It will be seen by this table that the density of the water of the ocean increases along with the latitude, and in almost the same proportion both north and south of the equator. But Forchhammer has also determined the saltness of the sea at various depths, and has found that it decreases in very slow proportion with the increase of the depth. It we start from this fact, taking account at the same time of the decrease of temperature in proportion to the depth, we find the result to be that, at 500 fathoms below the surface, the density of the water of the sea over the whole globe may be considered as equal to 1, the difference at any particular point being scarcely discernible. But since the density of the water of the ocean at a depth of 3,000 feet is everywhere equal to 1, and since at the surface it diminishes as we approach the equator, it is evident that the mass of water underneath cannot be in equilibrium; that if the surface of the sea is more elevated between the tropics than under the poles, and if we take the mean densities given above, at the surface, and at the bottom of this liquid mass, we find that the height of the surface of the sea above the level corresponding to the density of 1, ought to be nearly as follows:—

Height	between the	Equator and the Tropics		6·6	feet.
,,	,,	Tropics and 40°	lat. .	4·2	,,
,,	,,	40° and 50°	,,	2·2	,,
,,	,,	50° and 60°	,,	0·9	,,
,,	at	60°	,,	0·0	,,
,,	between	60° and 70°	,,	3·0	,,

But a similar difference of level necessitates the formation of a double surface-current passing from the equator to the two poles, and that cannot take place without entailing a diminution of the height of the water under the tropics, unless, indeed, there be an equivalent afflux into the tropical seas. But if the level of the water between the tropics be lower, the equilibrium of the under strata will be destroyed, and there ought, consequently, to be a submarine current which comes both from the north and the south towards the equator. That there really exists a current in that direction is a result of the circumstance that the temperature of the sea decreases with the depth.

Supposing then that there were no other forces in action, the difference of level mentioned above, ought, as Maury at first admitted, to give rise to a surface-current from the equator to the poles, and an under-current from the poles to the equator. But these currents are enormously modified by the intervention of other forces. The north-east trade-winds react against this equatorial current of the northern hemisphere, exercising upon the surface of the sea an oblique pressure, of which the effect is greater than that of the difference of level. There results from this, reckoning from the 30° latitude, a rising of the water in a direction contrary to the liquid masses which the south-east trade-winds tend to draw from the south Atlantic; at the same time the north-east trade-winds force the waters of the surface, as Franklin supposed, to take a south-western direction towards the Carribean Sea. In this sea, and in the Gulf of Mexico, where the trade-winds exercise no influence, the water continues its course to the north by the Strait of Florida, and thus gives birth to the Gulf Stream. But in order to enable the Gulf Stream to advance from the Gulf of Mexico and the Strait of Florida as far as 30° N. latitude, a difference of level is necessitated, which can be calculated by the help of the general formulæ for the movement of water in currents; by this means we find that the level of the water in the Gulf of Mexico ought to be about 6 feet higher than at St. Augustine. If we then observe that in accordance with the density of the water at St. Augustine, the level of the sea ought to be found to be about 3½ feet above the point marked zero, which corresponds to the mean density of 1, it follows that the level of the Gulf of Mexico is about 9½ feet above that point, and that the trade-winds are the means of adding a height of 3 feet to the water of that gulf.

After this immense current—which, in the Strait of Bemini, may be compared to a river delivering at the rate of 1,600,000,000 cubic feet per second—has passed St. Augustine, it pursues its course to the north-east, as has been said above. In order to accomplish this long passage, it has at its disposal, at the most, an incline of 3½ feet; but it is easy to see that the force which results from this is altogether insufficient to accomplish the work which this movement demands, and it evidently follows that the Gulf Stream ought, during all this course, to be subjected to the action of another force, to which hitherto our attention has not been drawn. But what is this force of which we have thus taken no notice? Singularly, it is an old acquaintance, whose function we have not sufficiently understood, although Kepler was the first to announce its importance. In fact, the force which impels the Gulf Stream towards the north is simply that which results from the rotation of the Earth; and it acts not only upon the Gulf Stream, but is, as we shall see, the chief cause of all currents, both atmospheric and marine. That the daily rotation of the earth should exercise an influence upon all currents which go from the equator to the poles and *vice versâ*, and that the direction of the trade winds are due to the same cause, are facts well known. But though it is agreed that this rotation acts upon the currents of the ocean, opinion has hitherto been very much divided as to the importance of the action; some maintaining that the rotation of the earth is the chief cause why the Gulf Stream and the polar currents follow respectively the directions north-east and south-west, while others hold that it cannot cause any change to speak of in the courses taken by the ocean currents, courses which they would continue to follow all the same were there no rotation of the earth. But although there is so much dispute as to this point, every one agrees in acknowledging that we know but little about the matter, and in any case nothing certain of the laws which regulate the movements of the ocean and atmosphere; for we are at present ignorant whether the atoms of water or air move without resistance, or whether they meet and are subject to the action of certain forces, and we know still less about the origin of these forces, their magnitude, &c. This ignorance on the subject of the influence which the rotation of the earth exercises upon the currents is evidently due to the imperfect knowledge which we have of the laws which regulate the movement of fluids in currents; for if we had been able to establish that such a force ought to be in play, we would, without doubt, soon have determined the true expression. The thing is, in fact, very simple; if we suppose that a section of element current flows from the equator in the direction of the meridian in a definite channel, that line will turn with the earth with a speed from west to east $= \frac{2\pi R}{86400} \cos\theta$, θ representing the latitude, and R the radius of the earth. After a time dt, during which the current in question will arise at latitude $\theta + d\theta$, it will act upon the sides of the canal as if it were subjected to a force which, in the time dt, had communicated to it an increase of speed $\frac{2\pi R}{86400}$ sin. $\theta \, d\theta$ from west to east, the line of current being supposed perfectly free. The force which results from the rotation of the earth could then be represented by

$$\psi = \frac{2\pi R}{86400} \sin.\theta \left(\frac{d\theta}{dt}\right) = \frac{2\pi}{86400} \sin.\theta\, v$$

v being the speed in the supposed channel. But the movement not being free, since the material section which we are considering is forced to move in a channel from south to north, it will exercise per unit of mass against the sides of the canal, a pressure ψ directed from west to east. If the section, as we have supposed, forms part of a current compelled to move circularly in a channel, it is evident that the surface of the water will rise from left to right; and if we designate the height by what it rises by h, for a breadth of channel $= l$, we shall have $-g\frac{h}{l} = \frac{\sin.\theta\, v}{13750}$.

The trajectory being the same, it is clear that the surface of the current ought to present the same slope, whether it moves in a channel or flows freely in the middle of the sea. But it is no less evident that whatever be the situation of this trajectory on the surface of the globe, the section which in the time t is found at latitude θ, and after the infinitely small time dt, arrives at latitude $\theta + d\theta$, ought, under the influence of the rotation of the earth, to move in the same manner as if, the earth being immovable, it had been driven from west to east with a force

$$\psi = \frac{2\pi R}{86400} \sin.\theta \frac{d\theta}{dt} = \frac{\sin.\theta.\ \sin.w\, v}{13750}$$

where v still represents the speed of the section under consideration, and w the angle which the direction of the trajectory described makes with the eastern part of the circle of latitude. But we can, in consequence, put aside the rotation of the earth, and consider the latter as immovable if to the other forces which act upon the water, we add the force ψ acting from west to east. If we decompose this into two other rectangular forces, one of them following the direction of the current, which, let us suppose, has throughout its course a fall $\frac{du}{d\lambda}$, we find that its surface ought to present from left to right, and perpendicularly to the direction of the current, an elevation $\frac{h}{l}$, whose value is given by the equation

$$(1) \ldots\ldots g\frac{h}{l} = \frac{\sin.\theta \sin.^2 w.\ v}{13750}$$

and that the liquid mass is impelled forward by a force

$$\left[\frac{\sin.\theta \sin.w \cos.w.\ v}{13750} + \frac{du}{d\lambda} g\right]$$

which, in accordance with my theory, leads to the following equation of the movement of the current:—

$$(2)\quad u = \frac{V^2 - V_0^2}{2g} + \frac{0{\cdot}016}{3}\,\frac{V^2 + V.V_0 + V_0^2}{2g}\,\frac{\lambda}{H} + \frac{\sin.\theta \sin.w \cos.w}{13750}\cdot\frac{V + V_0}{2g}\lambda$$

where u is the fall of the current in the length λ, H its depth, V_0 its initial speed, and V its final speed after having run the course λ. In short, if, according to the theory, we place for the delivery of the current per second

$$(1) \ldots\ldots 2 = 0{\cdot}82\ V.\ H.\ \lambda$$

we shall have the fundamental formulas which give the laws of the course of ocean currents over the whole surface of the globe; the angle θ, which is positive in the northern hemisphere and negative in the southern, having its values comprehended between 0° and 90°, while the angle w, following the direction of movement, may be found in the 1st, 2nd, 3rd, or 4th quadrant.

It follows from these three formulas that all the currents of the northern hemisphere, whatever be their direction, have a surface which goes on rising from left to right, and whose progress, the force resulting from the rotation of the earth, accelerates or retards according as they move in the 1st or 3rd, or in the 2nd or 4th quadrant: hence it follows that a movement in one of these latter quadrants is possible only when the current possesses a sufficient fall, or an equivalent force, due, for example, to the action of the wind. the specific weight of the water of the sea, &c. When the current follows the meridian, the inclination of its surface, perpendicularly to its direction, is at the maximum; but besides this, the rotation exercises no influence upon its course. When the current flows at right angles to the meridian, the fall $\frac{h}{l} = 0$, and the rotation has, in short, no effect upon its course.

If, then, we consider the Gulf Stream from its exit from the Gulf of Mexico, we see that, in its passage from Bemini to St. Augustine by the Strait of Florida, where it runs directly north, the current is kept up by a difference of level which, as has been stated above, may, for that extent, be estimated at six feet. Throughout this course the current presents from west to east an elevation whose total value is about 1·3 feet.

From St. Augustine to the Bay of New York the Gulf Stream runs towards the north-east; in all this course it is impelled by the rotation of the earth with a force corresponding to a fall of from nine to ten feet, and rises from left to right about 1·2 feet.

From the Bay of New York the Gulf Stream runs eastward towards the shores of Europe, and, throughout the passage, obeys the impulse of the force of rotation, which raises it from left to right by a total elevation of about one foot. Having reached the neighbourhood of Europe, the current divides into two nearly equal branches, one of which, under the influence of the diminished force of the action of the earth's rotation, runs in a south-easterly direction towards the coast of Africa, with an elevation from left to right. The other branch, meanwhile, is forced to skirt the coasts of Great Britain, taking a more northerly direction on account of the resistance it meets with from the land, the action of the force of rotation causing it to advance in its northerly course with an elevation from left to right facing the land of one and-a-half feet. If we try to estimate the influence which the earth's rotation exercises upon the Gulf Stream from St. Augustine to the 60th degree of N. latitude, we find that the force is nearly the same as that which would act upon the current, if, between these two points, a distance of about 950 miles, the Atlantic showed a difference of level of twenty-five feet. When the Gulf Stream has passed the northern extremity of Scotland, the resistance which obliged it to take a more northerly direction disappears, and, from this time, the principal current inclines more to the east towards the coast of Norway, which it then skirts to the north-east, sloping towards the land on account of the earth's rotation. Another branch of the Gulf Stream is arrested by Iceland in its course to the north, and turned to the north-west, striving against the earth's rotation, which elevates it towards the south and south-west coast of the island just mentioned, it ought consequently to present a slope towards the north-west as far as the polar current.

(*To be continued.*)

SCIENCE IN GERMANY*

IN his address at the opening of the present University Session at Berlin, the out-going Rector quoted some interesting figures showing the effect of the recent war on the activity of the University. In October 1870 there matriculated in all the faculties 1,236 students, while the number of entries for the winter session of 1869 was 2,421. Of the 1,236 students who entered their names in October, only 904 continued their attendance throughout the winter. The actual number of medical students last winter was 173, while in the previous winter session they amounted to 550. The falling off in numbers extended about equally to all the four faculties; but it appears that none of the theological students who entered at the beginning of the session were required to break off their studies. The courses of lectures, public and private, that were announced amounted to 366, and of these 271 actually came off. Forty students took their degrees—8 in jurisprudence, 19 in medicine, and 13 in philosophy. The number of deaths, so far as was ascertained, amounted to 32. The University seems now to have returned to its full activity, to judge from the crowded state of many of the class-rooms. A few of the students are to be seen wearing the ribbon of the Iron Cross.

Two ladies from America have applied to the Berlin University authorities for permission to attend the medical classes. One lady, a Russian, is studying chemistry in Prof. Hofmann's laboratory. An American lady has been studying medicine at Breslau, and has sent to an American newspaper a glowing account of her friendly reception at the Silesian University. Another pioneer of the same sex is studying engineering at the Polytechnic School of Aix-la-Chapelle; and two ladies recently joined the University of Prague, where they are studying under the professor of history. During the past summer a solitary American lady, M.D., attended the clinics at the Vienna General Hospital, and appeared to suffer, to the full extent, the inconveniences of being in so considerable a minority.

The autumn season on the Continent, as in England, is marked by the occurrence of various scientific gatherings. At several of these, Prof. Virchow has been receiving invitations, which the Berlin newspapers have chronicled from time to time. At the Assembly of German Naturalists and Physicians, held at Rostock, his speech was the great event of the meeting. During the Bologna Conference of Archæologists, he was entertained at a banquet by the Italian dignitaries and men of science; and at a scientific assembly held in Rome, the audience rose to their feet to welcome the celebrated Berlin professor, who made them a speech in French. In his address to the Rostock Conference, Virchow made some remarks upon the nature of annual scientific gatherings, of which he himself is an assiduous frequenter. "It was a matter of encouragement to me," he said, "when I read in the proceedings of the recent meeting of the British Association, in the opening address of its renowned President, Sir William Thomson, that Brewster, in his letter by which he called the Association into existence, expressly stated that he was led to this step from considering the great and beneficent results that the German Naturalists' Association (*Naturforscherversammlung*) had achieved during its nine years' previous activity. We were the first to advance among all nations; the English followed, and the number of these associations has gradually increased. They have, by degrees, extended into every possible province of human activity, and we have thereby become accustomed, by the co-operation of the many, to define more clearly the common objects at which the whole has to aim." And again, speaking of the results of these meetings, he says: "Not only the pleasures of fellowship, which are inseparable from a great congress of individuals; not only the amenities of personal acquaintance, which cannot be too highly valued; the forming of friendly ties, where perhaps, under other circumstances, harsh and even bitter opposition would have sprung up; the reconciling of many controversial antagonisms through personal intercourse—all this is the smaller result. There is yet a greater—the communication of knowledge, the explanation of methods, the clearing up of the directions in which research should be undertaken—and these are things which can be nowise better told than by word of mouth." The main subject of Professor Virchow's address was the part that science would have to play in the new national life of Germany. Their work, he held, was to introduce into the popular life of the nation the great and all-pervading idea of evolution. Space will not permit even to give an abstract of his views.

Among the books that have issued from the German press within the last month or two are—the new edition of Virchow's "Cellular Pathology," much improved and enlarged; Professor Traube's "Contributions to Physiology and Pathology," in two bulky volumes, one containing experimental and the other clinical researches; a new instalment (the fifth) of Stricker's "Handbuch;" a treatise on Leuchæmia, by Professor Mosler of Greifswald; and an elaborate work with plates, by Barkow of Breslau, on "Dilatations and Tortuosities of the Blood-vessels," with special reference to aneurism of the aorta in its various sites.

* From a Correspondent of the *British Medical Journal*.

SCIENTIFIC SERIALS

THE fourth number of the *Zeitschrift für Ethnologie* for the present year begins with Dr. A. Erman's concluding part of his "Ethnological Observations on the coasts of Behring's Sea." He draws attention to the bold and often successful surgical treatment which was found to have been practised by the Aleutians when they were first visited by Europeans. The influence exerted by the Russians on these primitive people has tended to make them conceal, or even gradually relinquish the practice of many of their old national habits, and, amongst other usages, they have almost wholly given up their heroic surgical operations. Dr. Erman met, however, with one skilled Aleutian operator, from whom he learned many particulars in regard to the native practice of his art. It would appear that their variously-sized lancets are formed of finely-polished and sharply-edged flakes of obsidian. With these instruments bleeding in the leg as well as the arm is performed, and incisions made in various parts of the body, including the thoracic walls, for the purpose of removing blood or pus, in cases of their effusion into the cavity of the pleura, or in pulmonary disease. But although we are told that this practice is not found to be attended with any dangerous results, we are not informed how the injurious effect of any possible admission of air into the chest is guarded against. The Aleutians exhibit great dexterity in removing various parts of the bodies of whales, and of sea-lions and other seals which they have killed, as, for instance, the mucous membrane of the neck, without in any way injuring the contiguous parts. And they show wonderful skill in fabricating from such membranes thoroughly water-proof and highly elastic coverings for the feet and legs, as well as those invaluable rowing dresses known as "Kamlejkes," which, when drawn over the head and upper part of the body and fastened down to the rowing seat, enable the Aleutian in his one-holed *baidurka* to bid defiance to the fiercest storm and roughest sea. Unlike their neighbours, the Kamtschadales, who, in their aversion to come in contact with a corpse, throw their dead to their dogs to be devoured and removed from sight, the Aleutians devote much time and care to the preservation of the body after death. This they do so effectually that they can keep the corpse in their dwellings for more than a fortnight without causing injury or annoyance to the living, while long after death the features and external appearance of the deceased remain unchanged. Dr. Erman supplies us with many valuable additions to our knowledge of the social habits, taste for ornamentation, traditional lore, language, &c., of the Aleutians. In counting the Aleutian employs 20 as his highest numeral, making all larger quantities dependent upon that number; thus, 40, 60, &c., are respectively 2, 3, &c., twenties. —In the second paper of the *Zeitschrift*, Dr. Robert Hartmann continues his careful summary of the remains of Swiss Lacustrine dwellings, passing in review the principal mammals represented in the deposits, and entering fully into the often-discussed question whether the diluvial Cave bear (*Ursus spelæus*), is identical in species with our common bear (*U. arctos*) or whether and to what extent it differs from it. Dr. Hartmann seems disposed in this inquiry to regard the question of identity as possessing strong claims to probability, although there may not be sufficient ground at present to answer it affirmatively.—"The Nirvana and Buddhistic Morality" forms the title of a very comprehensive paper by A. Bastian, which treats very fully of the principles on which the faith of Buddha is based, the ideas underlying the various forms which it has assumed, and the special phases of human thoughts and feelings to which it more particularly addresses itself.—In a paper by G. Rohlfs, entitled "Henry Noël, of Bagermi," the writer gives an account of the kingdom of Bagermi, which is situated on the N.E. of Lake Tsad, in Central Africa. The Bagermi people are a pure Ethiopian race, who, in point of moral and intellectual capacity, may be said to form the link between the most highly-developed negro kingdoms, and the numerous small negro states, lying to the S. of them, of which we do not even know the names. The King and Court of Bagermi, after a temporary adhesion to Islamism, have relapsed into their old Fetish worship, in which trees appear to form the principal objects of adoration. The practice of taking sisters and daughters in marriage prevails in the reigning family; but, while the rich indulge extensively in polygamy, poor men take only one wife.—Dr. Behrnauer, of Dresden, gives a *résumé* of an official paper by the Assistant-Resident, Herr J. Riedel, of Batavia, on the geographical, topographical, and geological character of the districts of Holontalo, Limœto, Bone, Boalemo, and Kattingola or Andagile in the Celebean Isthmus of the Eastern Archipelago. To this is appended much useful information in regard to the statistical, historical, and social condition of these countries, from which, however, we are not led to form a favourable opinion of the character, either of the Aborigines or of the Chinese and other foreign settlers. There are different grades of nobility, and till lately slavery and the slave-trade were allowed. Opium is undermining the health and vigour of the upper classes, and the poor are sunk in misery in the midst of an abundant vegetation, and with numerous sources of wealth around them; the mountains and river beds being rich in minerals. On the banks of the river Lenœo lumps of gold have from time to time been found as large as a hen's egg.—The last paper in this number of the *Zeitschrift* that we can notice is one by Herr Neumayer on the intellectual and moral qualities of the native Australians.

THE *American Journal of Science and Arts* for October. The first paper in this number is "On the Connecticut River Valley Glacier, and other examples of Glacier Movement along the Valleys of New England," by James D. Dana. In former papers by the author he has pointed out the existence of a Connecticut valley glacier in the glacial era, understanding by this expression that the under part of the great continental glacier, lying in the Connecticut valley, moved in the same direction. In the present paper the evidence with regard to this movement is gone into more fully, and further evidence is given to show that other large valleys of Central and Western New England had, in the same sense, their valley glaciers, that is the valleys determined the direction of the ice that lay within them.—Mr. R. Pumpelly follows with a second contribution "On the Paragenesis and Derivation of Copper and its Associates on Lake Superior." He gives a number of observations as to the minerals occurring with copper in various mines. In many of the cases in which calcite crystals are found enclosing copper, it is difficult to distinguish as to the relative ages of the two. The author has, however, conclusive proof that each of the following cases occur:—(1) that the copper was present before the calcite began to form and became enclosed in the growing crystal; (2) the crystal of calcite was partly formed, then became incrusted with copper, and was finished by a new growth of calcite over the metallic film; and (3) the copper has entered the calcite crystal since its growth was finished.—A valuable paper follows, "On photographing Histological Preparations by Sunlight," by J. J. Woodward. The arrangement which is found most suitable is to place the microscope at the window of the dark room, the body being horizontal, the achromatic condenser is then illuminated by a solar pencil, which is reflected from a heliostat on to a movable mirror. Between this mirror and the achromatic condenser there is placed a 2-inch lens of ten inches focal length, at such a distance that the solar rays are brought to a focus, and begin again to diverge before they reach the achromatic condenser. When a photograph is to be taken, a cell containing ammonia-sulphate of copper is placed between the lens and condenser, working with a power of 500 diameters; the time of exposure was but a fraction of a second. By allowing the solar rays to come to a focus before reaching the achromatic condenser, the heat rays may be separated from the light rays by so adjusting the condenser as to bring the light rays to a focus, while the heat-rays, after passing the second lens, became parallel, or even divergent according to the position of the achromatic condenser. The author finds that a right-angled prism may be used instead of the heliostat, and in working with low powers a piece of plain unsilvered plate-glass is sufficient instead of the mirror.—The concluding original paper in this number is "On the Discovery of a New Planet," by Dr. Peters, which will probably receive the number 116 of the asteroid group. The elements of the 114th asteroid have been computed, and are given, which show that this planet is not so small as was supposed. It is found to be now in the remotepart of its orbit, near its aphelion.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 16.—General Sir Edward Sabine, K.C.B., president, in the chair.

"Contributions to the History of the Opium Alkaloids.—Part III." By C. R. A. Wright, D.Sc.

"On a Periodic Change of the Elements of the Force of Terrestrial Magnetism discovered by Prof. Hornstein."

"Corrections and Additions to the Memoir on the Theory of Reciprocal Surfaces, Phil. Trans. vol. clix. (1869)." By Prof. Cayley, F.R.S.

"Corrections to the Computed Lengths of Waves of Light published in the Philosophical Transactions of the year 1868." By George B. Airy, C.B., Astronomer Royal. The author, after adverting to the process by which in a former paper he had attempted the computation of the lengths of waves of light, for the entire series measured in the solar spectrum by Kirchhoff, from a limited number of measured wave-lengths, and to the discordances between the results of these computations and the actual measure of numerous wave-lengths to which he subsequently had access, calls attention to his remark that means existed for giving accuracy to the whole. The object of the present paper is so to use these means as to produce a table of corrections applicable through the entire range of Kirchhoff's lines, and actually to apply the corrections to those computed wave-lengths which relate to spectral lines produced by the atmosphere and by many metals. Adopting as foundation the comparisons with Angström's and Ditscheiner's measures given in the former paper, and laying these down graphically, the author remarks that in some parts of the spectrum the agreement of the two experimenters is very close, that in some parts they are irreconcilable, and that in one part (where they agree) there is a peculiarity which leads to the supposition that some important change was made in Kirchhoff's adjustments. He then explains the considerations on which he has drawn a correction-curve, whose ordinates are to give the corrections applicable to his former computed numbers. A general table of corrections is then given, and this is followed by tables of the lengths of the light-waves for the air and metals as corrected by the quantities deduced from that general table. The author remarks that he has not yet succeeded in discovering any relation among the wave-lengths for the various lines given by any one metal, &c., which can suggest any mechanical explanation of their origin.

Zoological Society, November 21.—Prof. Flower, F.R.S., V.P., in the chair. Mr. Sclater exhibited and made remarks on a fine skin of *Ateles variegatus* Wagner (*A. bartletti* Gray) which had been received in a collection from Oyapok, on the eastern limits of Cayenne, being a new locality for this species.—A communication was read from Prof. Owen, F.R.S., containing the third of a series of memoirs on the osteology of the Marsupials. In this memoir Prof. Owen entered at full length into the modifications observable in the cranium of the three known species of Wombats (*Phascolomys*).—Dr. Günther, F.R S., read a report on several important collection of Fishes which had been recently obtained for the British Museum collection. Amongst them were many new forms from the Pacific, obtained through the agency of the Museum Godefroianum of Hamburgh; several novelties from Celebes, collected by Dr. B. Meyer; and some interesting fishes from Tasmania, transmitted by Mr. Morton Allport. Dr. Günther called special attention to the occurrence of many well-known European forms of fishes in the Australian seas, and in explanation of this fact, suggested that these might also occur as deep-sea fishes in the intermediate seas of the tropics.—A paper by Mr. A. Anderson was read, containing notes on the Raptorial Birds of North Western India.—A communication was read from Messrs. G. Stewardson Brady and David Robertson, giving descriptions of two new species of British *Holothuroidea*.—Mr. P. L. Sclater exhibited and described, under the name *Turtur aldebranus*, a specimen of a new species of Dove of the genus *Turtur*, from the coral reef of Aldabra, north of Madagascar. This specimen had been lately living in the Society's Gardens, having been presented by Mr. E. Newton, —A paper by Mr. John Brazier, of Sydney, N.S.W., was read, giving descriptions of seven new species of the genus *Helix*, and of two Fluviatile Mollusks from Tasmania. A second paper, by Mr. Brazier, contained notes on the specific names of certain Land Shells from the South Sea Islands.—A communication was read from Count Thomas Salvadori, containing a note on *Ceriornis caboti*.—A communication was read from Mr. W. T. Blanford giving a description of a new Himalayan Finch, proposed to be called *Procarduelis pubescens*, from Sikim.

Anthropological Institute, November 20.—Sir John Lubbock, Bart., M.P., president, in the chair.—Captain R. T. Burton, late H.M.'s Consul, Damascus, read a paper on "Anthropological Collections from the Holy Land." Captain Burton having unexpectedly returned to England, under the peculiar circumstances now publicly known, travelled to Palmyra from Damascus between April 5 and April 20, 1870, and has brought home specimens of the Palmyrene mummies, the first which have seen the light in England, statuettes, beads, coins, and other articles calculated to throw light upon a subject hitherto left in the gloom of antiquity. On some of the figures described were emblems illustrative of the Phallic and other mysteries, and according with similar reliques found at Nineveh.—Dr. Carter Blake read a long note on the human remains discovered by Captain Burton at Palmyra. These indicated an entirely different race from that which inhabited modern Syria, and the skulls afforded many points of resemblance to the ancient Phoenicians which have been described by other anthropologists. The men were of large stature, in one case reaching probably about 6 feet 4 inches. There were among these remains not one which could be confidently referred to the Hebrew race, a fact on which the author laid stress, without offering any comment. Minute descriptions and measurements of all the specimens were given. Captain Burton will read further papers before the Anthropological Institute, and describe, with topographical notes, the various objects of silex and others which he collected during his 22 months of service in Syria and Palestine.

Entomological Society, November 20.—Mr. A. R. Wallace, president, in the chair. The following gentlemen were elected: Mr. C. V. Riley, State Entomologist for Missouri, as foreign member; Lieutenant B. Lowsley, R.E., and Mr. F. Raine, as ordinary members; and Mr. W. H. Miskin as a subscriber.—With reference to Prof. Westwood's exhibition of *Formica herculanea* (at the last meeting), found in the crop of a great black woodpecker said to have been shot near Oxford, Mr. Dunning remarked that, according to information received, several examples of this bird (presumably of foreign origin) were exposed for sale in the London markets at the precise time of its supposed occurrence near Oxford. Prof. Westwood had information from Messrs. Robertson and Jackson that it occurred in Devon; the former gentleman affirming that he had repeatedly seen it at Clovelly. Mr. F. Smith was informed that thirty examples had been recorded as British, and that one in particular had been shot by the grandfather of the present Lord Derby. Mr. Jenner Weir reiterated his belief in the species not being British, and Mr. Bond said that every recorded instance had been traced and found to be erroneous, save Lord Derby's example, concerning which doubt existed. Mr. E. Sheppard could not reconcile the occurrence of a gigantic ant, not hitherto known as British, in the crop of a bird, the origin of which was open to doubt, with the idea of the former being an addition to the British Fauna. Mr. McLachlan suggested that Prof. Westwood should visit the locality in which the bird was said to have been shot, and search for the ant. The discussion ended by Prof. Westwood promising to furnish further evidence.—Mr. Bond exhibited small pale examples of *Lasiocampa trifolii*, which appeared to form a distinct race; also females of *Clisiocampa castrensis*, with the wings on one side assuming male characters, without any evidence of gynandromorphism.—Mr. Stainton exhibited a variety of *Agrotis comes* (*Triphæna orbona* of collections), captured near Exeter by Mr. Dorville.—Mr. Smith exhibited the cocoons of the American *Tiphia tarda*; these were double, consisting of a flimsy outer casing, and a hard inner cocoon. He expressed his belief that the larvæ of the *Tiphia* devoured those of *Aphodius*. Mr. McLachlan brought before the notice of the meeting an instance of mimetic resemblance between two common North American *Libellulidæ*. The insects in question were *Libellula pulchella* Drury, and *Plathemis trimaculata* De Geer. In the former the sexes were nearly similar in appearance; in the latter very dissimilar, and the female almost precisely resembled that of *Libellula pulchella*. During the discussion which followed, the question was raised as to the liability or non-liability of dragon-flies to the attacks of birds. Mr. F. Smith had seen swallows devouring *Agrions*, and Mr. Briggs had observed a contest between a sparrow and a large dragon-fly in the streets of London, in which the former was obliged to retreat. It was recommended that American entomologists should observe the habits of these two species, and suggest a reason for the close mimicry existing between them.—Mr. Müller related that he had found the larvæ of a *Thrips* to be destructive to peas, by eating the outside of the green pods.—Mr. McLachlan read notes on the confusion existing in the nomenclature of the common European *Myrmeleonidæ*, in consequence of Linnæus having confounded them in his descriptions.—The publication of a further portion of the proposed general Catalogue of British Insects (*Hymenoptera Aculeata*, by Mr. F. Smith) was announced.

Linnean Society, November 16.—Mr. G. Bentham, president, in the chair.—"On the Floral Structure of *Impatiens fulva*," by A. W. Bennett, F.L.S The author described the closed "cleistogenous" flowers of this plant, which are far more numerous than the well-known conspicuous flowers, and which produce nearly all the seed-vessels, being abundantly self-fertilised. He suggested that the "cap" formed by the calyx and corolla in these closed flowers is thrown off by the elasticity of the stamens, which are entirely different in structure from those in the conspicuous flowers, the anthers never dehiscing, but the pollen putting out its pollen-tubes while still in the anther, and piercing the wall in order to come into contact with the stigma. In the conspicuous flowers there is a peculiar arrangement in the form of a membrane attached to the stamen-tube, which prevents the access of pollen to the stigma, and as they do not appear to be visited by insects they seldom produce seed-vessels.—"Floræ Hongkongensis Supplementum," by H. F. Hance, Ph.D. In this paper a large number of new species are described, increasing the number included in Bentham's "Flora Hongkongensis" by about one-seventh.

GLASGOW

Geological Society, November 2.—Mr, John Young, vice-president, in the chair. Mr. James Thomson, F.G.S., laid before the meeting some portions of curiously-spotted clay which he had obtained during the recent excavations to the east of the old College of Glasgow. He stated that the occurrence of white spherical spots in the Old Red sandstone, particularly in the neighbourhood of Dumbarton, had often been remarked by the members, and various opinions had been expressed as to the probable cause of the discolouration. Having observed similar spherical markings in a bed of dull red clay which was being excavated near the old College, he secured several portions of it, which, after drying, split freely and exposed both discoloured spots and lenticular patches similar to those found in the Old Red sandstone referred to. On examination, he observed in the centre of each discoloured spot faint indications of some foreign body, which, on closer scrutiny, proved to be decayed vegetable matter; and on further breaking up the clay, he found the matrix around this vegetable matter always more or less discoloured, while the fibrous or woody matter itself was nearly black. He suggested that the phenomenon was due to the chemical affinity of the oxide of iron in the clay for the constituents of the vegetable matter, and that the discoloured spots in the red sandstone might be due to a similar cause, though no trace remained of the organism by which they were occasioned.

Dublin

Royal Geological Society, November 8.—Edward Hull, M.A., F.R.S., Director of the Geological Survey of Ireland, in the chair. G. H. Kinahan, M.R.I.A., read a paper on the Coal Measures of Ireland. This paper was in reply to some statements made by Mr. Hull at a former meeting of the Society in regard to the work of the late Mr. J. B. Jukes and his colleagues. Mr. Hull had stated that, while true Coal Measures existed in Connaught, there were none in either Leinster or Munster. The author argued that this assertion was quite erroneous, and that the Coal Measures of these three provinces were identical. Mr. Hull, in reply, seemed to argue that the lower Measures in Munster and Leinster were very similar to the so-called Yoredale rock and millstone grits of England, but acknowledged the general correctness of the maps published under Mr. Jukes' direction. Rev. Dr. Haughton moved that Mr. Kinahan's paper be published, and expressed his belief that all such subjects were much better discussed on published data.—Rev. Dr. Haughton F.R.S., read a note from Mr. Richardson, secretary to G. R. Graves, M.P., of Liverpool, informing him that the *Neptune*, Captain Edwards, had just put in from Quebec, and that the Captain reported that on the 12th October, at sea, in lat. 46° N., long. 35° W., at about 4 P.M., blowing strong from W., he observed a dense cloud of fog arise on the western horizon, which gradually came up with and surrounded the vessel, and so continued until midnight. From first coming up with the ship until clearing off, there prevailed a very strong smell of burning wood, both the Captain and crew felt their eyes much irritated by the smoke, and the decks were strewn with fine dust. At the time the ship was more than 2,000 miles from Chicago.—Prof. Macalister exhibited for the President, Lord Enniskillen, the skull of *Ursus ferox* found in the County of Monaghan.

Royal Irish Academy, November 13.—The President, Rev. Dr. Jellett, in the chair.—Dr. Whitley Stokes read a paper "On the Féiire of Oengus." This ancient Irish MS., of which Dr. Stokes presented a translation to the Academy, although it, he said, was of but little literary merit, possessed from the purity of its vocabulary considerable value to the student of comparative philology, revealing very fully the position which the Celtic occupied in the great Aryan family of languages. Dr. Stokes illustrated his views by the comparison of many words with their cognate forms in Greek, Latin, Sanscrit, &c. He also explained the structure of the metre in the poem, and mentioned the several copies of the MS. in existence.—Prof. R. Ball read a paper, written by his brother, Valentine Ball, B.A., of the Geological Survey of India, "On the Andaman Islands," in which he gave a short account of a visit to the "Home" at Mount Augusta, which he made in company with Mr. Humfrey, who is the superintendent of the Home, and Dr. Curran. — Prof. Ball read a paper "On a Geometrical Study of the Kinematics, Equilibrium, and small Oscillations of a Rigid Body."—G. H. Kinahan read a paper "On the Granitic and other Ingenite Rocks of the Mountainous track of Country west of Loughs Mask and Corrib." The term Ingenite he adopted from David Forbes.—

Paris

Academy of Sciences, November 13.—M. Dumas noticed the loss which the Academy had sustained in the death of its foreign associate, Sir Roderick Murchison, of whom he spoke in high terms.—M. F. du Moncel read a note on the most economical arrangement of voltaic piles with respect to their polar electrodes, in continuation of a former note.—M. Faye presented a note on the spectroscopic measurement of the rotation of the sun by means of Dr. Zöllner's reversion spectroscope, in which he stated that Dr. Vogel of Bothkamp, near Kiel, had succeeded in effecting this measurement, and ascertained a velocity of rotation of 2,497 metres per second.—M. Faye also communicated a memoir on the law of rotation of the sun, in reply to a reclamation by Father Secchi, and a memoir by Dr. Zöllner; in this he indicated the reasons which led him to the belief that the sun is a gaseous body.—M. Le Verrier announced that but few meteors had been observed in France on the night of the 12-13th November.—M. Phillips read a paper on the governing spiral of chronometers.—M. H. Resal presented a note on the movement of a material system referred to three rectangular axes capable of moving around their origin.—General Morin communicated a memoir by M. Tresca on the results of experiments of flexion made upon steel and iron rails beyond the limit of elasticity.—A note by M. W. de Fonvielle was read relating to an observation made by M. Janssen on the stoppage of the rotation of the car of a balloon.—MM. Becquerel presented a memoir on the temperature of soils covered with low vegetation or denuded. The observations were made at various depths below the surface, from five to sixty centimetres, and showed that the mean temperature during the months of August, September, and October is lower under a denuded surface than under one covered with herbage.—M. C. Sainte-Claire Deville noticed the observation of faint aurora borealis in France on the evening of the 9th November.—A memoir, entitled "Thermic Investigation on Crystalline Dissociation," by MM. P. A. Favre and C. A. Valson, was read. The authors remarked upon the variety of phenomena involved in the solution of a crystalline salt in water, which they proposed to study from the thermo-chemical point of view, and tabulated and discussed the results of the solution of a long series of crystalline salts, chiefly sulphates.—M. E. P. Bérard presented a note on the *salant*, or saline crust, which is formed on the shores of the Mediterranean upon certain unproductive soils. Common salt is the chief ingredient in this crust.—M. Berthelot communicated a continuation of his memoir on the formation of precipitates, in which he discussed the thermal phenomena associated with the separation of the acid of salts from the base.—M. Maumené presented a note calling attention to the fact that he had some years ago indicated the possibility of the slow transformation of cane sugar into glucose.—M. J. Decaisne communicated some observations on the Pomaceæ, the chief object of which was to indicate the characters by which this important group of plants may be divided into good natural genera.—M. Bossin and M. Baudet communicated suggestions for the destruction of *Phylloxera vastatrix*.—M. Claude Bernard presented a note by M. Ranvier, on the Histology and Physiology of the Peripheral Nerves.—M. Milne-Edwards presented a note on *Oncidium celticum*, by M. L. Vallant, in which the author described the anatomy of that curious gasteropod, and expressed the opinion that although rightly placed among the Pulmonata, it presents certain affinities with the Opisthobranchiate mollusca.—M. de Quatrefages communicated a note by M. E. Perrier on *Eudrilus*, a new genus of Lumbricina from the West Indies.—M. Mène presented some investigations on the fat of domestic animals.

November 20.—A paper was read by M. de Saint-Venant on the mechanics of ductile bodies.—M. H. Resal presented a memoir on the movement of a point subjected to the action of a periodical cause, which experiences a constant resistance directed in the inverse direction of the velocity; M. C. Rozé a note on the asymmetry of the terminal curves of the spiral spring of chronometers; and M. de Saint-Venant a memoir by M. J. Boussinesq on the theory of the undulations and movements which are propagated along a rectangular horizontal canal when there is communicated to the liquid contained in this canal like velocities from the surface to the bottom.—M. Yvon Villarceau communicated extracts from a letter from Mr. Gould relating to the establishment of an Observatory at Cordoba in the Argentine Republic.—M. Le Verrier communicated a note giving the results of observations of meteors made in France on the 12th, 13th, and 14th November. Those observed on the 12th and 13th issued from a point in the neighbourhood of the constellation Auriga; the "Leonides" or meteors issuing from Leo were most numerous on the night of the 14th. M. Faye made some remarks on this communication, and to these M. Le Verrier replied.—M. Chapelas also presented a note on the meteors of November 1871.—M. Le Verrier presented a note by M. de Gasparis on the formulæ for calculating the orbits of double stars.—M. P. A. Favre read a continuation of his thermic investigations upon electrolysis, in which he discussed the thermic phenomena observed during the electrolysis of sulphate of copper, sulphate of zinc, nitrate of copper, and mixtures of neutral sulphates of zinc and copper with sulphate of hydrogen.—M. Elie de Beaumont made some remarks upon the Mont Cenis tunnel, and read a letter from Father Secchi on the pendulum experiments which it is proposed to make in the tunnel.—M. J. Bourget presented a paper on the velocity of sound in sonorous tubes.—M. Jamin communicated a note by M. E. Gripon on the transverse vibrations of wires and thin plates, and also a note by M. Alvergniat on a new phenomenon of phosphorescence produced by frictional electricity. According to the latter a small quantity of chloride or bromide of silicium hermetically sealed in a vacuum tube gives a bright luminosity when the tube is rubbed with a piece of silk. The chloride gives a rose colour, the bromide a greenish yellow.—M. Le Verrier presented a note on the history of the observations on the action of ecliptic conjunctions upon the elements of terrestrial magnetism, by M. Moïse Lion.—M. Le Verrier also presented a note by M. Tarry, giving an account of an aurora borealis observed at Brest on the 9th November, in which the author noticed particularly the perturbations manifested by the apparatus employed in telegraphy.—M. Le Verrier also remarked that auroras had been observed in Piedmont on the nights of the 2nd, 9th, 10th, and 15th November, and referred to the coincidence between the occurrence of these phenomena and the November flight of meteors, which M. C. Sainte-Claire Deville supposed to exist.—M. Berthelot read the conclusion of his paper on the formation of precipitates. In this he discussed the changes which take place in the state of aggregation of precipitates, illustrating his views by the facts observed in the cases of the carbonates of strontia, baryta, lead, and silver, and of the oxalates.—M. Wurtz presented a note by M. E. Ritter on the transformation of albuminoid matters into urea by permanganate of potash. This note contained an experimental confirmation of M. Béchamp's statement.—M. de Quatrefages communicated an extract from a letter by M. E. S. Delidon, on the butts of Saint-Michel-en-l'Herm, and on the means by which their elevation above the sea, and other local elevations, may have been effected. He considers that local elevations may be due to infiltration of fresh and salt water.—Mr. E. Blanchard presented a note by M. S. Jourdain on the anatomy of the sunfish (*Orthagoriscus mola*)—An extract of a letter from M. A. Poëy to M. Elie de Beaumont, on the influence of violet light upon the growth of the vine, pigs, and cattle, was read.—M. de Quatrefages presented a note by M. F. Garrigou on lacustrine habitations in the Pyrenean region of the South of France. In this note the author describes the results obtained by him in the investigation of the deposits of ancient lakes at the foot of the Pyrenees.

BOOKS RECEIVED

English.—Beeton's Medical Dictionary (Ward, Lock, and Tyler).

Foreign.—Anales del Museo publico de Buenos Aires; Entrega octava: por German Burmeister (Paris, Savy). (Through Williams and Norgate.)—Beiträge zur Parthenogenesis der Arthropoden: von Siebold.—Lehrbuch der chemischen u. physikalischen Geologie: G. Bischof.—Untersuchung des Weges eines Lichtstrahls durch eine beliebige Anzahl von brechenden sphärischen Oberflächen: P. A. Hansen—Die Arachniden Australiens nach der Natur beschrieben und abgebildet: Dr. L. Koch.

PAMPHLETS RECEIVED

English—On the Formation of the Cirques of Brittany: Rev. T. G. Bonney.—Law of Husband and Wife: Philofamilias.—The Obstacles to Science Teaching in Schools: Rev. W. Tuckwell—Educational Hospital Reform: T. J. Boyd.—Report of Science and Art Department of the Committee of Council on Education, South Kensington—Directory, with Regulations for Establishing and Conducting Science Schools.—Flints, Fancies, and Facts; a Review: W. Robinson.—Cases of Diarrhœa: Dr. Chapman.—Apprenticeship to the Sea Service; a Circular of the Board of Trade.—Proceedings of the Bristol Naturalists' Society, Vol. iv., part 1.—Glaciation of the North-west of England: C. E. De Rance.—Cholera and Disinfection; Asiatic Cholera in Bristol in 1866: Dr. Budd.—Primary Schools and the Difficulty of Spelling: E. Jones—On the Effect of Small Variations of Temperature on Steel Magnets: Gordon and Newall.—Prize Medals of the Royal Geographical Society.—General Representation on a Complete Readjustment and Modification of Mr. Hare's Scheme: A. E. Dobbs.—Reply to John Hampden's Charges against Mr. Wallace.—The Variations at Different Seasons of a *Hieracium*: Prof. Balfour.—Quarterly Journal of Education, October—Fifteenth Annual Report of the Medical Officer of Health of St. James's.—On the Pre-glacial Geography of Northern Cheshire: C. E. De Rance.—Man contemplated Physically, Morally, Intellectually, and Spiritually: J. W. Jackson.—Introductory Lecture on Experimental Physics: J. Clerk Maxwell.—On Ocean Currents: J. K. Laughton.

American and Colonial.—On the Constitution of the Solid Crust of the Earth: Archdeacon Pratt.—On the Direction and Force of the Wind: F. C. Loomis.—Influence of Temperature: F. C. Loomis.—Thoughts on the Higher Education of Women: Principal Dawson.—Papers and Proceedings of the Royal Society of Tasmania, 1871.—Monthly Notices of the Royal Society of Tasmania, 1871.—Reports of the Mining Surveyors and Registrars, Victoria, June 30, 1871.—Victoria; Patents and Patentees, Vol. iv.: W. H. Archer.—Victoria; Seventh Report of the Board of Visitors to the Observatory.—Lessons on Population, suggested by Grecian and Roman History: Dr. N. Allen.—An Address delivered at the Annual Exhibition of the Farmers' Club, Princeton: Dr. N. Allen.—On the Intermarriage of Relations: Dr. N. Allen.—Remarks on the Relations of Anomia: E. S. Morse.—Correspondence on the subject of Atmospheric Electricity: Seth Boyden.—Spectroscopic Notes: Prof. C. A. Young.

Foreign.—Medizinische Jahrbücher, 1870: S. Stricker.—On the Diurnal Variation of the Inclination of the Magnet at Batavia: P. A. Bergmann.—On the Lunar Atmospheric Tide at Batavia: P. A. Bergmann.—Bulletin de la Société d'Anthropologie de France, Tome v.—Studi sopra un lignaggio anemofilo delle composte ossia sopra il gruppo delle Artemisiacee: Delpino.—Zeitschrift des oesterreichischen Gesellschaft für Meteorologie, Band vi., Nos. 14–22.

DIARY

THURSDAY, November 30.

Royal Society, at 4.—Anniversary Meeting.

Society of Antiquaries, at 8.30.—Notes on an Example of Alamannic Phalaræ: W. M. Wylie, F.S.A.—On an Early French Deed (A.D. 1397) Relating to the Knights of Saint John of Jerusalem: C. K. Watson, M.A.

FRIDAY, December 1.

Geologists' Association, at 8.—On the Glacial Drifts of North London: H. Walker.

Archæological Institute, at 4.

SUNDAY, December 3.

Sunday Lecture Society, at 4.—The Coast Line and its Teachings: Dr. T. Spencer Cobbold, F.R.S.

MONDAY, December 4.

Entomological Society, at 7.

Anthropological Institute, at 8.—Anthropological Collections from the Holy Land. No. II.: Captain Richard F. Burton, F.R.G.S.—On a Collection of Flint Implements from the Cape of Good Hope: Prof. Busk, F.R.S., and Rev. Mr. Dale.

Victoria Institute, at 8.—The Serpent Myths of Ancient Egypt: W. R. Cooper.

London Institution, at 4.—The Physiology of Bodily Motion and Consciousness (VI.); Prof. Huxley, F.R.S.

Royal Institution at 2.—General Monthly Meeting.

TUESDAY, December 5.

Zoological Society, at 9.—On the Freshwater Siluroids of India and Burmah: Surgeon Francis Day, F.Z.S.—On a Small Collection of Butterflies from Angola: A. G. Butler.—Description of a New Genus of Lepidoptera, allied to *Apatura*: A. G. Butler.

Society of Biblical Archæology, at 8.30.

WEDNESDAY, December 6.

Geological Society, at 8.

Society of Arts, at 8.—On Sewage as a Fertiliser of Land, and Land as a Purifier of Sewage; J. Bailey Denton.

Microscopical Society, at 8.—On Microscopic Uredines: M. C. Cooke, M.A.

THURSDAY, December 7.

Royal Society, at 8.30.

Society of Antiquaries, at 8.30.

Chemical Society, at 8.

Linnean Society, at 8.—Botany of the Grant and Speke Expedition: Lieut.-Col. Grant, C.B., C.S.I.—On a hybrid *Vaccinium* between the Bilberry and Crowberry: R. Garner, F.L.S.—On the Formation of British Pearls, and their possible improvement: R. Garner, F.L.S.

CONTENTS

Eratum.—P. 63, col. 1, lines 19, 18, 16 from bottom, for "linean" read "linear."