THURSDAY, FEBRUARY 9, 1882

PROFESSOR HUXLEY'S ESSAYS

Science and Culture, and other Essays. By Thomas Henry Huxley, LL.D., F.R.S. (London: Macmillan and Co., 1881.)

THIS collection of Prof. Huxley's more recent lectures and essays appears as a companion volume to the previous well-known collections of the same kind. The first thing, therefore, that naturally occurs to us is to compare this series with its predecessors, for when an author has been so long and so prominently before the public as Prof. Huxley, and when the authorship has been of a kind so varied and original, we cannot but entertain fears, even for the strongest man, that signs of exhaustion may become apparent in the works of his middle life. But if any one should entertain such charitable apprehensions on behalf of Prof. Huxley they may immediately be quieted by the book before us; the eye is as clear for seeing and the arm as strong for hitting as they have always been, and on every page we meet with new instances of that same versatility of learning, force of thought, and brilliancy of style which, while producing so wide an influence on the science and philosophy of our time, have justly placed this distinguished leader of both in a class *sui generis* as an expositor.

The first essay, as the title of the collection signifies, is that on Science and Culture.

"From the time that the first suggestion to introduce physical science into ordinary education was timidly whispered, until now, the advocates of scientific education have met with opposition of two kinds. On the one hand they have been pooh-poohed by the men of business who pride themselves on being the representatives of practicability, while on the other hand they have been excommunicated by the classical scholars, in their capacity of Levites in charge of the ark of culture and monopolists of liberal education."

The first of these two classes of opponents is easily disposed of, notwithstanding that "your typical practical man has an unexpected resemblance to one of Milton's angels; his spiritual wounds, such as are inflicted by logical weapons, may be as deep as a well and as wide as a church door, but beyond shedding a few drops of ichor, celestial or otherwise, he is no whit the worse." But the other class of opponents is more formidable, and as the essay is "an Address delivered at the opening of Sir Josiah Mason's Science College at Birmingham," Prof. Huxley observes—

"It is not impossible that we shall hear the express exclusion of 'literary instruction and education' from a College which, nevertheless, professes to give a high and efficient education, sharply criticised. Certainly the time was that the Levites of culture would have sounded their trumpets against its walls as against an educational Jericho."

The address therefore proceeds to justify the action of the founder in having imposed this exclusion.

"For," says Prof. Huxley, "I hold very strongly by two convictions. The first is, that neither the discipline nor the subject-matter of classical education is of such direct value to the student of physical science as to justify the expenditure of valuable time on either; and the second is, that for the purpose of attaining real culture, an exclusively scientific education is at least as effectual as an exclusively literary education."

The remainder of the essay proceeds to make good these two propositions, and in the course of doing so gives an interesting historical sketch of the circumstances which have hitherto led to an undue depreciation of the study of science as an instrument of mental culture. In the Middle Ages, and so long as theological dicta held exclusive sway, men "were told how the world began and how it would end; they learned that all material existence was but a base and insignificant blot upon the fair face of the spiritual world, and that nature was, to all intents and purposes, the playground of the devil." Although this statement of the case is, as it is no doubt intended to be, hyperbolical rather than historical, there can be no question that it "was far from the thoughts of men trained" in the system of mediæval theology to suppose "that the study of nature—further than was requisite for the satisfaction of everyday wants—should have any bearing on human life." But—

"The distinctive character of our own times lies in the vast and constantly increasing part which is played by natural knowledge. Not only is our daily life shaped by it, not only does the prosperity of millions of men depend upon it, but our whole theory of life has long been influenced, consciously or unconsciously, by the general conceptions of the universe which have been forced upon us by physical science."

Therefore it is obvious that we must now hold a different estimate of the importance of physical science in relation to culture, if with Mr. Matthew Arnold we mean by culture "the knowledge of the best that has been thought and said in the world."

"The period of the Renascence is commonly called that of the 'Revival of Letters,' as if the influence then brought to bear upon the mind of Western Europe had been wholly exhausted in the field of literature. I think it is very commonly forgotten that the revival of science, affected by the same agency, although less conspicuous, was not less momentous. . . . . We falsely pretend to be inheritors of their culture [*i.e.* that of the Greeks], unless we are penetrated, as the best minds among them were, with an unhesitating faith that the free employment of reason, in accordance with scientific method, is the sole method of reaching truth."

The address continues:—

"But I should be very sorry that anything I said should be taken to imply a desire on my part to depreciate the value of classical education, as it might be and as it sometimes is. The native capacities of mankind vary no less than their opportunities, and while culture is one, the road by which one man may best reach it is widely different from that which is most advantageous to another. . . . But for those who mean to make science their serious occupation, or who intend to follow the profession of medicine, or who have to enter early upon the business of life, for all these, classical education is in my opinion a mistake; and it is for this reason that I am glad to see 'mere literary education and instruction' shut out from the curriculum of Sir Josiah Mason's College, seeing that its inclusion would probably lead to the introduction of the ordinary smattering of Latin and Greek."

The second essay, which is "the Inaugural Address of the Lord Rector of the University of Aberdeen," is

entitled "Universities, Actual and Ideal." Here the leading theme is that an "ideal university" should be open to men of all classes, and be able efficiently to teach all branches of knowledge. "I should like to see Professors of the Fine Arts in every University; and instruction in some part of their work make a part of the Arts curriculum." "If there are Doctors of Music, why should there be no Masters of Painting, of Sculpture, of Architecture?" This is one kind of knowledge; another is "knowledge relating to the scope and limits of the mental faculties of man; a form of knowledge which, in its positive aspect, answers pretty much to Logic, and part of Psychology, while, on its negative and critical side it corresponds with Metaphysics." Yet another class "comprehends all that knowledge which relates to man's welfare, so far as it is determined by his own acts, or what we call his conduct. It answers to Moral and Religious Philosophy." Lastly, there is "knowledge of the phenomena of the universe," or science, mathematical, physical, biological, and social. Concerning the relative importance of these departments of knowledge, substantially the same opinion is expressed as in the previous address: "I am ashamed to repeat here what I have said elsewhere, in season and out of season, respecting the value of science as knowledge and 'discipline,'" &c. Concerning the teaching of science, it is shown that the "ideal University" "ought not to be satisfied with mere book-knowledge. . . . If I may paraphrase Hobbes' well-known aphorism, I would say that 'books are the money of literature, but only the counters of science.'" The address next goes on to the question of Medical Education, advocating the abolition of Botany, Zoology, and Comparative Anatomy from the curriculum. Speaking of the study of Physiology, the Lord Rector says—

"Moreover, I would urge that a thorough study of Human Physiology is in itself an education broader and more comprehensive than much that passes under that name. There is no side of the intellect which it does not call into play, no region of human knowledge into which either its roots or its branches do not extend; like the Atlantic between the Old and the New Worlds, its waves mark the shores of the two worlds of matter and of mind; its tributary streams flow from both; through its waters, as yet unfurrowed by the keel of any Columbus, lies the road, if any such there be, from the one to the other; far away from that North-West Passage of mere speculation, in which so many brave souls have been hopelessly frozen up."

In an ideal University it should be recognised that Science has the same right as Theology, Law, or Medicine to a

"Faculty of its own in which men shall be trained to be professional men of science . . . The establishment of such a Faculty would have the additional advantage of providing, in some measure, for one of the greatest wants of our time and country; I mean proper support and endowment of original research. . . . If a student of my own subject shows power and originality, I dare not advise him to adopt a scientific career . . . and I believe the case is as bad, or perhaps worse, with other branches of science. In this respect Britain, whose immense wealth and prosperity hangs on the thread of applied science, is far behind France, and infinitely behind Germany."

On the subject of Examinations Prof. Huxley says:—

"Examination, like fire, is a good servant, but a bad master; and there seems to me to be some danger of its becoming our master. I by no means stand alone in this opinion. Experienced friends of mine do not hesitate to say that students whose career they watch, appear to them to become deteriorated by the constant effort to pass this or that examination, just as we hear of men's brains becoming affected by the daily necessity of catching a train. They work to pass, not to know; and outraged science takes her revenge. They do pass, and they don't know. . . . Under the best of circumstances, I believe that examination will remain but an imperfect test of knowledge, and a still more imperfect test of capacity, while it tells next to nothing about a man's power as an investigator."

While dealing with the desirability of undergraduates having had sufficient instruction at school to profit by the higher education which ought to be provided by a university, Prof. Huxley says:—

"A high authority, himself head of an English college, has solemnly affirmed that: 'Elementary teaching of youths under twenty is now the only function performed by the University'; and that colleges are 'boarding schools in which the elements of the learned languages are taught to youth.' This is not the first time I have quoted these remarkable assertions. I should like to engrave them in public view, for they have not been refuted."

Here we are less surprised at the certainly "remarkable assertions" of the Rector of Lincoln, than by their unqualified endorsement of the Rector of Aberdeen; for if "they have not been refuted" we should suppose that the only reason must be because they are too obviously extravagant to demand refutation. That our English universities have thrown upon them a great deal more work in the way of comparatively elementary education than is either desirable or creditable, and that in consequence a vast amount of money and of teaching power is misappropriately applied, no one can dispute; but to "solemnly affirm" that the *only* function of these universities is that of boarding schools, is unwisely to overstate the evil.

The third essay is on "Technical Education." Delivered before the "Working Men's Club and Institute," it appropriately inculcates—

"The truth that while under-instruction is a bad thing, over-instruction may possibly be a worse. Success in any kind of practical life is not dependent solely, or even chiefly, upon knowledge. Even in the learned professions, knowledge, alone, is of less consequence than people are apt to imagine. And, if much expenditure of bodily energy is involved in the day's work, mere knowledge is of still less importance when weighed against the probable cost of its acquirement."

The ideal of "Technical education for handicraftsmen" held out by Prof. Huxley is that of avoiding excess either of general or of technical instruction for "the great mass of mankind who have neither the liking nor the aptitude for either literary, or scientific, or artistic pursuits," while making provision "to catch exceptional people—the small percentage of the population which is born with that most excellent quality, a desire for excellence, or with special aptitudes of one sort or other. . . . I weigh my words when I say that if the nation could purchase a potential Watt, or Davy, or Faraday, at the cost of a hundred thousand pounds down, he would be dirt-cheap at the money."

Substantially the same views are expressed in the next

essay, which is on "Elementary Instruction in Physiology." Thus—

"The saying that a little knowledge is a dangerous thing is, to my mind, a very dangerous adage. If knowledge is real and genuine I do not believe that it is other than a very valuable possession, however infinitesimal its quantity may be. Indeed, if a little knowledge is dangerous, where is the man who has so much as to be out of danger?"

If the life-long labours of the greatest physiologist of his age—William Harvey—had revealed to him a tenth part of the knowledge which may now be made sound and real to our boys and girls "he would have loomed upon the seventeenth century as a sort of intellectual portent."

The address on "Joseph Priestley" is an exceedingly interesting biographical and historical sketch, and is followed by the essay on "The Method of Zadig," which, from having been so recently published in the *Nineteenth Century*, will be fresh in the memory of most readers.

The lecture on "The Border Territory between the Animal and the Vegetable Kingdoms" was delivered at the Royal Institution in January, 1876, and is a masterly piece of biological exposition, which "tends to the conclusion that the difference between animal and plant is one of degree rather than of kind; and that the problem whether, in a given case, an organism is an animal or a plant, may be essentially insoluble."

The essay "On certain Errors respecting the Structure of the Heart attributed to Aristotle," having been originally published in NATURE (vol. xxi. p. 1) need not detain us now; we shall therefore pass on to the next in the series, and the one which has excited more interest and discussion than any of the others. This is the Evening Lecture before the British Association in 1874, "On the Hypothesis that Animals are Conscious Automata;" and both as regards the interest of its subject-matter and the logical precision with which the argument is stated, we think that it deserves to be considered the most important essay in the series.

It is now universally known what the argument is, and how with irrefragable sequence it leads us to the conclusion that—

"Consciousness would appear to be related to the mechanism of the body simply as a collateral product of its working, and to be as completely without any power of modifying that working as the steam-whistle which accompanies the work of a locomotive engine is without influence upon its machinery."

There can be no doubt that the logic by which this conclusion is reached is everywhere intact; but there is one important criticism to which the "hypothesis" in question is open, and which, as it has not we believe been hitherto clearly advanced, we may briefly state.

The hypothesis rests on the fact that there is a constant parallelism between cerebral processes and mental processes, and as this fact cannot be attributed to accident and is not attributed by the hypothesis of automatism to any pre-established harmony, there remains only the supposition that the true processes are in some way intimately associated. Some intimate association between neurosis and psychosis being thus accepted as a fact by the hypothesis of automatism, the whole question which this hypothesis raises may be briefly put thus:—If the stream of mental activity were withdrawn, could the stream of cerebral activity with which it is now associated continue in exactly the same way, or could it not? In other words, is the constant relation which now subsists between the two processes necessary or unnecessary to the occurrence of the latter? The hypothesis of automatism virtually answers that the relation is unnecessary, and this on the ground of its being inconceivable that it should be necessary. But now let us ask, Is it any more conceivable that this relation should be unnecessary? Certainly not, because the inconceivability resides in the fact of there being *some* relation, and is not affected whether we choose to regard the *character* of this relation as necessary or unnecessary. We may try in thought to refine this relation, and to re-refine it again and again, until we conceive of mental processes as mere indices of corresponding neural processes; but so long as we accept the belief that there is *any one point of contact* between these two sets of processes, so long are we in the presence of just the same difficulty as when we started. Having driven the soul into some minute pineal gland of unnecessary relation, we find after all that we have gained nothing on the side of conceivability; we find it is no more easy to understand the soul as located in this little gland of unnecessary relation, than to understand it as distributed over the whole brain-work of intimate and necessary relation. The hypothesis of automatism would thus appear to contain the elements of its own destruction. For while accepting a fact which renders either the affirmation or the negation of the hypothesis alike inconceivable—viz. the fact of there being *a* connection between neurosis and psychosis—it nevertheless proceeds to choose one of these alternatives in preference to the other; and this on the sole ground of inconceivability.

Of course in advancing this criticism we are not ourselves arguing for any theory. We are merely observing that as in the theory of automatism there is, *ex hypothesi*, *some* connection between neurosis and psychosis which is of a nature not merely unknown but inconceivable, the theory can have no right to affirm, or even to infer, that this connection is unnecessary; and common sense will, therefore, have as much reason as ever to disbelieve that if consciousness had never appeared upon the scene of life, railway trains would now have been running filled with mindless passengers, and telephones would have been invented by brains that could not think, to speak to ears that could not hear. Thus, until it is shown who or what it is that blows the whistle of consciousness in the simile of the steam-engine, we must conclude that the hypothesis of conscious automatism is nothing more than an emphatic re-statement of the truth, that the relation between body and mind is a relation which has so far proved inconceivable.[1]

Essay X. is on "Sensation and the Unity of Structure of Sensiferous Organs." It presents a *résumé* of some of the older theories of sensation, and a clear statement of the modern generalisation that "whatever be the apparent diversities among the sensiferous apparatus, they share certain common characters," &c.

[1] It is no answer to say that the *brain* blows this whistle, for even if a causal relation is assumed, it is no more *conceivable* that this should extend from neurosis to psychosis than that it should extend from psychosis to neurosis.

"Evolution in Biology" is an entertaining history of the contest between the theories of Epigenesis and Metamorphosis, passing on to a brief account of the facts relating to the "Evolution of the Individual" as brought to light by modern embryology, and of the "Evolution of the Sum of Living Beings," as previously taught by the older theorists, and as now taught by a conjunction of the sciences.

On the two addresses that remain it is needless to comment, as one of them—viz. that which was delivered before the International Medical Congress in August last—must be well within the recollection of our readers, and the other "On the Coming of Age of the 'Origin of Species,'" has already been printed in these columns (1880). We may, however, fitly conclude our necessarily inadequate review of so much admirable writing by again printing the beautiful peroration of this address.

"I venture to repeat what I have said before, that, so far as the animal world is concerned, evolution is no longer a speculation, but a statement of historical fact. It takes its place alongside of those accepted truths which must be reckoned with by philosophers of all Schools. Thus when, on the first day of October next, the 'Origin of Species' comes of age, the promise of its youth will be amply fulfilled; and we shall be prepared to congratulate the venerated author of the book, not only that the greatness of his achievement and its enduring influence upon the progress of knowledge have won him a place beside our Harvey; but, still more, that, like Harvey, he has lived long enough to outlast detraction and opposition, and to see the stone that the builders rejected become the head-stone of the corner."

GEORGE J. ROMANES

OUR BOOK SHELF

Proceedings of the London Mathematical Society, vol. xii. (November 11, 1880-November 10, 1881).

THE papers in this volume, as usual, are mostly purely analytical in their character. Prof. Cayley's contributions are very short: the binomial equation $x^p - 1 = 0$; quinquisection; on the flexure and equilibrium of a skew surface; on the geodesic curvature of a curve on a surface, and on the Gaussian theory of surfaces. Sir J. Cockle continues his remarks on binomial biordinals. Mr. Glaisher's papers are also few and short, viz. on some definite integrals expressible in terms of the first complete definite integral, and of gamma-functions; note on certain symbolic operators and their application to the solution of certain partial differential equations. Messrs. Crofton and J. J. Walker have some points of contact, the former writing on operative symbols in the differential calculus, the latter continuing his theorems in the calculus of operations. Mr. Walker also contributes a quaternion proof of a problem discussed by Mr. S. Roberts, viz. certain tetrahedra specially related to four spheres meeting in a point. Mr. Roberts also gives a historical note on Dr. Graves's theorem on confocal conics." Mr. W. R. W. Roberts has a paper on the periods of the first class of hyper-elliptic integrals, and a note on the coordinates of a tangent line to the curve of intersection of two quadrics. Mr. T. Craig has a note on Abel's theorem. Papers bearing on geometry are contributed by Prof. Genese, on a system of co-ordinates; by Mr. H. Hart, on the general equation of the second degree in tetrahedral co-ordinates; by Mr. H. M. Jeffery, on bicircular quartics, with a triple and a double focus, and three single foci, all of them collinear; and on spherical quartics, with a quadruple cyclic arc and a triple focus; by Prof. Mannheim, sur les surfaces parallèles; by Mr. R. A. Roberts, on the tangents drawn from a point to a nodal cubic; and note on a system of cartesian ovals, passing through four points on a circle. Signor Brioschi writes sur une propriété du paramètre de la transformée canonique des formes cubiques temaires; and Mr. Carpmael renews an old discussion in his some solutions of Kirkman's 15-school-girl problem. The subject of kinematics on a sphere is ably treated by Mr. E. B. Elliott. Mr. Routh contributes some applications of conjugate functions, and Mr. W. D. Niven writes on the electrical capacity of a conductor bounded by two spherical surfaces cutting at any angle. The presidential address is by Mr. C. W. Merrifield, and is entitled "Considerations respecting the Translation of Series of Observations into Continuous Formulæ." We have sketched out a bill of fare appealing to many diverse tastes, and we can assure our readers that the dishes are all of admirable quality.

Jornal de Sciencias Mathematicas e Astronomicas. Publicado pelo Dr. Francisco Gomes Teixeira. (Coimbra, 1881.)

WE have received the first two volumes of this work and the five opening numbers of the third volume. It is a matter of considerable interest to see what a place scientific writings and mathematical works are taking in the Peninsula. The journal before us is apparently not at all ambitious in its aims, but seeks to bring before the students such articles as might perhaps find a place in our own *Messenger of Mathematics*. A fault we have to find with the single numbers is that they have no index of contents, and further, they are unstitched. We wish Prof. Gomes Teixeira every success in his venture.

Philosophische Studien herausgegeben. Von Wilhelm Wundt. Bd. 1 Heft 1. (Leipzig: W. Engelmann, 1881.)

IN the *Philosophische Studien* we have the first instalment of a new periodical conducted by Wilhelm Wundt, which bids fair to attract a wide circle of readers not deterred by close, hard reasoning. It contains four articles:—(1) *On psychological methods*, by the editor; in three sections treating of the psychophysical methods, methods of analysis of the sense-perception, and of psychological measurement of time; (2) *On the length of time in the apperception of simple and compound ideas* (*colours* and *numbers*), by Dr. Max Friedrich; an essay which no doubt owes a great deal also to the editor, and containing the results of some remarkable experiments on the above phenomena; (3) *Investigations on the sense of time*, by Julius Kollert, in continuation of Vierordt's experiments on the same subject; (4) *On mathematical induction*, by the editor, under the heads of "analytical and synthetic methods in mathematics," "the question of the origin of mathematical principles," "experimental beginnings of mathematics," "permanent forms of mathematical induction," "mathematical abstraction," and "exact analogy." The spirit and methods of the editor permeate the whole of this first number, and guarantee the value of the periodical.

Biologische Probleme, zugleich als Versuch einer rationellen Ethik. Von W. H. Rolph. (Leipzig: W. Engelmann, 1881).

ORIGINALLY intended as a criticism on the customary methods of ethics, especially Herbert Spencer's "Data of Ethics," the present work has assumed a wider scope, and embraces the treatment of a number of biological problems, which the author has endeavoured to connect with a view to solution on a common basis. Its aim may be best exhibited in the following enumeration of the subjects discussed:—viz. the doctrine of evolution, subjective systems (Mallock, Spencer, Miss Bevington); H. Spencer's Hedonism; theory of nourishment (hunger the first motive to action, p. 53); theory of development

(abundance of suitable nourishment the primary condition); theory of propagation; animal ethics; and lastly, human ethics.

Abriss der Zoologie für Studirende, Ärzte und Lehrer. Von Dr. A. Brass. (Leipzig: W. Engelmann, 1882.)

IN this octavo volume of over 360 pages we have a sketch of the modern aspect of zoology fairly well executed, and with woodcut illustrations after Frey, Hæckel, Kölliker, and Gegenbaur. The first section treats of zoology in general, discusses the subject of the differences between the animal and vegetable kingdoms, and considers the animal in general. The second section is devoted to the morphology and developmental history of animals. The third is the systematic portion. The classification adopted is for the most part a copy of Claus's. The volume forms a handy compendium of zoological science, and, like all the works from the establishment of the well-known Leipzig publisher, is well printed on good paper.

The Two Hemispheres: A Popular Account of the Countries and Peoples of the World. By G. G. Chisholm, M.A. Illustrations. (London: Blackie and Son, 1882.)

THIS work contains in one volume much useful geographical information, methodically arranged. It is, indeed, a systematic and succinct account of the various continents, countries, and oceans, somewhat after the style of a gazetteer, for which it may be used by means of the copious index. The information seems to us in the main accurate, though many of the illustrations appear well worn. Mr. Chisholm, however, gives the old erroneous measurements of Mounts St. Elias and Fairweather, in Alaska, evidently unaware of the survey made by Dall six years ago, and which showed them to be 4000 feet higher than given here.

LETTERS TO THE EDITOR

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

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

Sun-spots

THE spot seen on the sun by Mr. W. A. Holland (NATURE, vol. xxv. p. 316) would appear to have been simply a large sun-spot which made its appearance at the sun's east limb on November 15, and went off the disk on November 27. It is shown on photographs taken at Greenwich on November 16, 17, 18, 19, 20, 21, 23, 26, and 27. On November 21, 11h. a.m. it was north-east of the centre, Pos-angle 50° 27′, Dist. 0·188 of sun's radius, and on November 23 0h. it was north-west of the centre Pos-angle 313° 39′ dist. 0·412. The estimate of its size by Mr. Holland is very much exaggerated, the dimensions of the whole spot (nucleus and penumbra), as measured on the photographs, being one-twentieth of the sun's diameter in length, and one-twenty-fifth in breadth. The area, corrected for foreshortening and expressed in millionths of the sun's visible hemisphere, was 832 for the whole spot, and 152 for the nucleus on November 21, and 970 for the whole spot, and 171 for the nucleus on November 23. The spot had begun to break up between November 21 and 23, and the area for November 21 is really the largest as applying to a single undivided spot. This spot is one of the largest yet recorded at Greenwich. Two other large spots of about the same size were photographed in 1881, on March 22 and June 1, their areas being respectively 919 for the whole spot, and 195 for the nucleus; and 931 for the whole spot, and 158 for the nucleus. The next largest spot in previous years was that of 1877 November, with an area of 801 for the whole spot, and 109 for the nucleus.

While on the subject of sun-spots, I may mention with reference to Mr. J. B. N. Hennessey's letters on an Outburst of Sun Spots (NATURE, vol. xxiv. p. 508, and vol. xxv. p. 241) that a photograph taken at Greenwich, 1881, July, 24d 23h. 11m. 10s., G.M.T., only 11m. before the new group was noticed on the ground-glass at Dehra Doon, shows no indication whatever of the group in question, and that no trace of it appears on a photograph taken next morning, July 25, 22h. 17m. 55s. G.M.T. Thus the new group, if real, must have formed suddenly in less than eleven minutes at a part of the sun's surface where there was not the slightest previous disturbance of the photosphere, and must have completely disappeared within the space of 23h. It might have been expected that the granules of the photosphere, which are well defined in the Greenwich photographs referred to, would have given some indication of such an outburst.

W. H. M. CHRISTIE

Royal Observatory, Greenwich, February 6

THE importance attached to the solar observations of Mr. W. A. Holland by so great an authority as Sir W. Thomson, would alone suffice to warrant me in forwarding for your publication exact drawings of the spots observed on November 22 and 23 of last year, and the wording of the letters of Mr. Holland makes it still more urgent to determine the precise extent of the spots in question.

The small optical power used on November 22 and 23, on board the *Sarah Bell*, places the result almost on a level with direct eye observations, and the description strongly recalls to mind the accounts given of solar spots previous to the discovery of the telescope. Thus on November 22 we have two eye-estimates of the size of the spot. "I, myself," writes Mr. H., "estimated the spot on the sun to be ⅛ diam., but conferring with the captain, he estimated it to be ¼ diam.; it was purely an estimate of the eye."

The pictures of the sun, which I inclose, were taken at Stonyhurst Observatory on November 20 and 22, and they give an exact outline of the spot seen on board the *Sarah Bell*, clearly showing what meaning we may reasonably attach to those ancient carefully denoted sun-spots, which were said to have a diameter equal to ¼, ⅛, or even ½ of the solar disk. The length of the spot observed on November 22 agrees very fairly with Mr. H.'s approximate estimate, if we include the whole group, but this gives a very incorrect notion of the spot-area, and of the disturbing forces then apparently at work in the sun.

From accurate measurements of the original drawings, which give the relative dimensions of the spots on the solar disk, I find the diameter of the sun to be 267 mm., the length of the group 54 mm., and its breadth 22 mm., whilst the length of the large spot, including its whole penumbra, is only 15 mm. The group is a scattered one, and the whole spot area in the picture can scarcely exceed 225 sq. mm., and therefore, being situated almost at the centre of the disk, will not cover more than one thousandth part of the visible hemispheres, although the whole group is spread over a space nearly five times as large. We thus get a more correct notion of the disturbance on the solar surface than by measuring merely the diameter of the group, or by expressing the spot area in millions of square miles.

The drawing of November 22 contains another spot in the *n.p.* quadrant, which is not mentioned by Mr. Holland, but which a few days previously, when nearer the centre of the disk, was as conspicuous an object as the spot under discussion, and was easily seen by the naked eye on November 18, shortly after sunrise. The group which followed was then near the limb, and was a fine object in a small binocular, but not visible to the naked eye.

The fact of two separate spots, each seen easily without a telescope, being on different portions of the solar disk at the same time is, I think, rather extraordinary, but the area covered by spots has never approached of late to what was sketched by Tacchini in 1871, or even what was photographed by Rutherfurd in 1870. I might perhaps also mention that the spot which crossed the disk in May and June was as large as that of November.

S. J. PERRY

Stonyhurst Observatory, Whalley, February 5

[The drawings sent by Mr. Perry seem to us to quite bear out his statements.—ED.]

Rime Cloud observed in a Balloon

A SINGULAR phenomenon was observed in Paris in the month of January. An obscure cloud remained in a state of suspen-

sion over Paris and a large tract of the country from the 4th up to the 26th, without any intermission. Neither sun, nor stars, nor moon were visible for an instant during that lengthened period.

The prevailing opinion among meteorologists was that the nebulosity was formed by a mass of snow suspended in the atmosphere.

Although the notion was generally accepted, I opposed it, in my contributions to *L'Electricité*, remarking that if such were the case, snow or at least water should have fallen in Paris and vicinity where the dryness was complete from the apparition of this remarkable nebulosity. But being unable to settle the controversy without actual observation, I ascended in a balloon from La Villette Gas Works on January 25 at 2h. 35. p.m. I found my anticipations were quite correct, as not a single flake of snow was seen by me or by M. Anatole Brissonet, a young gentleman who was assisting me by manœuvring the balloon. But I was quite deceived in the thickness of the cloud, which did not exceed 300 metres, although it rendered the sun perfectly invisible, and I had written it ought to be numbered by thousands.

The earth was lost sight of gradually, and was perfectly invisible at 270 metres, but the sun was shining in all its glory at 580 metres, with blue sky. The cloud was not so blinding as usual when it is composed of condensed vapour, as the thermometer and barometer could be read with perfect accuracy in the centre of it, and the lower part of the balloon was entirely visible at a distance of about 4 or 5 metres, but the equator was lost in whitish smoke perfectly impenetrable to sight. This nebulous matter appeared perfectly homogeneous, and I could see no trace of any crystalline matter, but an unexpected observation proved that it was formed of minute solidified atoms of water in a real microscopic state of division.

When we emerged from the cloud gently and slowly, I stop the throwing out of any ballast in order to remain in close vicinity of its surface. M. Brissonet and I observed carefully what was occurring around us. The heating effect of the sun was in some respect destroyed by the radiation towards the cloud, which was at a temperature of 5° C. So we were floating at a level almost perfectly equal, in an air at a temperature from −2° to −3°. The air at the surface of the clouds was perfectly calm, but at a few metres upwards it was moving north-north-easterly at a rate of eight miles an hour. The consequence was that we we were towed by the globe, and feeling keenly a cold current sweeping over our faces. We had uncoiled our guide rope, the length of which was 60 metres, and the end of which was consequently immersed in the cloud and dragged into it. To our intense surprise, and I may say delight, we perceived that this part was quite loaded with hoar frost, which had precipitated regularly by series of hairs a few millimetres long. These accumulations during a sweep which lasted for an hour, and a distance of about eight miles, are consistent with the fact previously stated, that no deposit was visible during our ascent, which had been very slow indeed. My calculations show that our vertical velocity was not exceeding 30 metres per minute, which is only one-eighth of our horizontal velocity, continued during six times longer. In our descent, which was rather quicker, but not to a great degree, the sweeping may have accumulated the frost rime on the bottom of the car, which it could not have been easy to observe, and consequently I cannot state what occurred, but not a single crystal was deposited on our ropes during that period.

I have been unable to procure Scoresby's Sketches of the Polar Regions, but only a review by Arago, who says (ix. p. 357, 10, *et seq.*): The "*frost-rime* ou fumée-gelée est un phénomène particulier des ces regions de la terre ou le froid est de longue durée, dont une vapeur dense[1] qui est dans un état complet de congelation. . . . Les parties extrémement deliées dont le *frost-rime* se compose s'attachent à tous les corps vers lesquels le vent les pousse, et y forment quelque fois une croûte de plus de 3 centimètres d'epaisseur, herisse de longues files prismatiques, ou pyramidales la pointe dirigée du côté du vent."

It seems to me that the constitution of cirrus clouds seems to be explained by these properties of *frost-rime* clouds. These minute crystals, which can remain for an indefinite period suspended in the air, are, properly speaking, the *materies nivei*, but not *nives ipsa*. It is by motion, either vertical or horizontal, that they are changed either into hoar-frost or snow, according to circumstances.

W. DE FONVIELLE

[1] I suppose that Scoresby is speaking of optical density.

Researches on Animals containing Chlorophyll

MR. PATRICK GEDDES appears to have been anticipated in most of the points set forth in his paper on Further Researches on Animals containing Chlorophyll, published in NATURE of January 26 last, by Dr. Brandt, of Berlin, who, in a paper read before the Physiological Society of Berlin on November 11 last, and published in the *Proceedings* of the Society on the "Symbiosis of Lower Animals with Algæ," describes the cultivation, after removal from the bodies of the various animals affected by them, of the well-known yellow and green chlorophyll-containing bodies, their development of starch grains, and their successful artificial implantation into the bodies of fresh hosts previously free from them; this latter being an important fact apparently not known to Mr. Geddes. Dr. Brandt further names the species of algæ in question under two genera, Zoochlorella and Zooxanthella, and gives to the peculiar physiological relations of mutual advantage between the plants and animals the term "symbiosis." Mr. Geddes appears not to have seen this paper of Dr. Brandt, since he merely refers to some of his earlier papers on the same subject, but it is important. Dr. Brandt's claims in the matter should not pass without notice in NATURE. I have not seen Dr. Brandt's original paper, but only an abstract published in the *Naturforscher* of January 14 last, from which I take the information given above.

H. N. MOSELEY

The Movements of Jupiter's Atmosphere

IN NATURE, vol. xxv. p. 213, Mr. Darwin describes the bands on Jupiter as "due to the trades and anti-trades" set in motion by the action of solar radiation on the solid body of the planet as are the trade-winds of the earth. Many other eminent astronomers still appear to accept this time-honoured explanation of the phenomena.

Have they reflected on the revelations supplied by the low specific gravity of Jupiter? There is no form of matter with which we are acquainted that could exist at a mean density of about one-fourth of that of the earth, while subject to the enormous pressure due to the mass of Jupiter, unless it were sufficiently hot to render the formation of a solid crust on its surface quite impossible. In order to attribute terrestrial solidity to either Jupiter, Saturn, Uranus, or Neptune we must invent a new kind of matter as infusible as platinum, and far lighter than hydrogen, or endow it with absolute incompressibility.

These planets, if composed of any of the chemical elements or compounds known to us, can only retain their low density under the enormous pressure of their masses by the agency of proportionately counteracting heat-repulsion. At and about their centres this may be so far overcome by the superincumbent pressure as to produce solid nuclei, but these must be very small in proportion to the mass of the planet.

Assuming the existence of such a central nucleus of Jupiter surrounded by a great fluid envelope, how will it be affected by the gravitating reaction of the satellite, supposing the compression to give it a specific gravity exceeding the mean specific gravity of its envelope?

It will obviously perform an eccentric rotation, or reeling, within the envelope. This motion must be very irregular and complex, owing to the different periods and the varying relative positions of the satellites; but the varying resultant of their gravitation forces will have one element of constancy, viz. a close coincidence with the plane of the planet's equator.

The effect of such internal reeling upon the surrounding gaseous mass explains far more efficiently than any possibility of solar radiation, the disturbances indicated by the ever-changing belts and spots of this planet; and also the greater rotatory velocity of the equatorial spots, described by Mr. Denning in the above-named number of NATURE, p. 225.

The correspondence of these with the varieties of rotation of the different parts of the solar surface observed by Carrington, is well worthy of note, and admit of similar explanation; planetary reaction in the case of the sun taking the place of the satellite reaction on Jupiter. In my essay on "The Fuel of the Sun" I have worked out other consequences of this reeling of the solar nucleus and their analogues in the greater planets.

Stonebridge Park, January 26 W. MATTIEU WILLIAMS

"The Lepidoptera of Ceylon"

MR. F. MOORE in no way betters the case against him by his letter printed in NATURE, vol. xxv. p. 79. The name of George

de Alwis, who was merely employed to make accurate copies of his brother's drawings, need not be brought forward; Mr. Moore was perfectly aware who made the original drawings from nature. It is satisfactory to know that the preface will contain an acknowledgment of the real artist, but common honesty requires his name to be printed on every plate that he drew instead of "C. F. Moore." HENRY TRIMEN

R. Bot. Gardens, Peradeniya, Ceylon, January 9

The Collection of Meteoric Dust—A Suggestion

IN the Report of the Committee on Meteoric Dust, given in your report of the last meeting of the British Association (NATURE, vol. xxiv. p. 462), Prof. Schuster refers to the difficulty "found in the determination of the locality in which the observations should be conducted," as there are but few accessible places sufficiently sheltered "against any ordinary dust not of meteoric origin. The lonely spots best suited for these observations are generally accessible to occasional experiments only, and do not lend themselves easily to a regular series of observations." As it is highly important that such a regular series should be obtained, and that such observations should be made in places "sheltered as much as possible" from dust of terrestrial origin, I venture to think that these conditions would be complied with by employing suitably constructed *captive balloons*, carrying the collecting apparatus at the highest attainable altitude. By this means we should have the great advantage of not only making the experiments abroad, but the observations might also be made from some hill-top in the north of Scotland, sufficiently far from any manufacturing town to insure the necessary freedom from dust of terrestrial origin. B. J. HOPKINS

79, Marlborough Road, Dalston, E.

Colour and Sound

SOME weeks ago there appeared an account of a series of experiments connecting colour and sound; the following passage from Prof. Max Müller's Chips, ii. 104, may interest some of your readers:—"That Purûravas is an appropriate name of a solar hero requires hardly any proof. Purûravas meant the same as πολυδευκής, endowed with much light; for though rava is generally used of sound, yet the root ru, which means originally to cry, is also applied to colour, in the sense of a loud or crying colour, *i.e.* red (cf. ruber, rufus, Lith, rauda, O.H.G. rôt, rudhira, ἐρυθρός; also Sanskrit ravi, sun)." The following footnote occurs:—"Thus it is said, Rv. vi. 3, 6, the fire cries with light, *sokishâ* râraptî; the two Spartan Charites are called Κλητά (κλητά, incluta) and Φαεννά, *i.e.* Clara, clear-shining. In the Veda the rising sun is said to cry like a new child (Rv. ix. 74, 1)—I do not derive ravas from rap, but I only quote rap as illustrating the close connection between loudness of sound and brightness of light."

Both Greeks and Latins seem to have used the same words for colour and sound, cf. λαμπρός, λευκός, μέλας, σομφός, φαιός, &c.; clarus, fuscus, candidus, &c. Probably not only colour and sound, but smell, taste, and touch had in early times the like words to express degree; even as we find aspera lingua and odor asper; and as we say "a harsh taste" and "a harsh sound." Tastes and smells will be found to suggest colours to the mind exactly as sounds do. If this be so, may not this apparently curious connection be explained as a sort of "*unconscious* philological memory?" KARL PEARSON

Inner Temple, January 28

On the Climate of North Northumberland as Regards its Fitness for Astronomical Observations

A LETTER in the last issue of NATURE (p. 317) upon the above subject, not altogether agreeing with the published records of this station, I should like to ask the reverend gentleman whether his observations were taken promiscuously; at stated times, or extending from sunset to sunrise. As the summary does not "tally" with the "weather at time" or "weather since taken" *without a break* during 1881 at 6 p.m. and 9 a.m. daily, I am afraid that a misconception will be formed as to the weather here by the readers of NATURE, and as this station is about 300 yards from Mr. Perry's observatory, there must be a mistake upon one side or the other, or probably the astronomical and meteorological definitions of "completely overcast" are different. JOSEPH LINGWOOD

Meteorological Society's Station, Alnwick, February 4

Parhelia in the Mediterranean

ON the morning of the 27th inst. a curious sight was witnessed at this place. I was sailing on the Mediterranean, and the day was hot and sunny. A slight haze came on, and about noon a large halo with an orange tint surrounded the sun. Shortly afterwards two mock suns appeared, one on each side of the ring round the central sun. They were also tinged with an orange colour, and appeared to have comet-like tails. Reflected in the still blue water they were even more distinct than when looked at direct, as the water cut off the sun's rays. This singular spectacle lasted more than an hour, and was seen by many. The boatmen predicted bad weather, but it has not yet come. All through January we have had brilliant summer days, with cold starlight nights—the minimum thermometer descending to 38° and 36° almost every night. I send you a very rough sketch of the mock suns. CHAS. H. ALLEN

Mentone, Alpes Maritimes, January

SIR ROBERT CHRISTISON

NOTWITHSTANDING his advanced age, the announcement of the death of Sir Robert Christison will be received with universal regret. He died on January 27, from the effects of a cold caught a month previously. Sir Robert's father was for many years Professor of Humanity in the University of Edinburgh, where the son was born on July 18, 1797. He attended first the High School, and subsequently the Arts Classes at the University. Having been well grounded in literature and general science, he turned his attention to medical studies, and graduated as Doctor of Medicine in 1819. Proceeding to the schools of London and Paris, in the latter city he became a pupil of Robiquet, the eminent chemist and *pharmacien*, in whose laboratory he worked assiduously, and, as he used often to say in after life, with signal advantage. Here, too, he is understood to have prosecuted, under the celebrated Orfila, that study of toxicology to which he had all along shown a special bent, and in which he was destined to achieve so important results. Shortly after his return to Edinburgh the young physician was, in 1822, appointed to the University Chair of Medical Jurisprudence, in succession to Dr. Alison. This post he occupied till 1832, when he relinquished it to assume the Chair of Materia Medica, rendered vacant by the death of Dr. A. Duncan, and for the clinical duties of which he was well qualified by hospital practice; while for its general work he had been thoroughly equipped by those old studies under Robiquet, followed up, in the interval, by diligent examination of every fresh pharmaceutical discovery.

Dr. Christison was able to give to the science of Medical Jurisprudence a precision it had formerly lacked, and thus contributed in no small degree to its practical development. Very important in this connection was the publication, in 1829, of his "Treatise on Poisons," which was received at the time by physicians, jurists, and men of science generally, as the most philosophical exposition of the subject that had ever appeared, and is even now regarded as a work of great value. From his position as Professor of Medical Jurisprudence, Dr. Christison was naturally called upon to act as an expert in criminal trials; and it was not long before his appearances in that capacity secured for him the reputation of a highly important witness.

In exchanging the Chair of Medical Jurisprudence for that of Materia Medica, Dr. Christison was, so to speak, confirmed in that line of chemical research for which he had all along shown special predilection. In the laboratory he was noted as a peculiarly neat and clean worker—a qualification of the utmost importance in prosecuting, for example, delicate toxological experiments. Nor was his exactitude greater than the earnestness and enthusiasm with which he followed out any inquiry to its ultimate issues. The well-known case of the Calabar bean,

in which an experiment on his own person was only prevented from proving fatal by timely swallowing of his shaving water, was a significant indication of the thoroughgoing spirit in which all his researches were pursued. As a *pharmacien* he rendered valuable service to the profession in connection with the last edition of the "Edinburgh Pharmacopœia," merged since 1864, like those of London and Dublin, in the "Pharmacopœia Britannica," prepared under the auspices of the General Medical Council; and in his "Dispensatory," published in 1842 (second edition, 1848), he presented a commentary on the then existing Pharmacopœias, characterised, like his book on Poisons, by precision in details, and by the concise, yet happy expression of suggestive generalisations.

In the professorial chair Dr. Christison proved a singularly lucid and instructive lecturer. Himself strictly methodical in everything pertaining to scientific inquiry or professional routine, he fostered in his students habits of exact and well-regulated work. As the result of his incumbency, both the chairs he occupied gained no inconsiderable accession of usefulness and importance; while to that of Materia Medica he left a substantial legacy in the splendid museum, whose riches can never be appreciated till it is properly displayed in the new Medical School. By his students he was loved as well as admired; and once and again, in the course of his long career, old pupils scattered far and wide as busy practitioners, have shown themselves prompt to embrace every opportunity of doing him honour.

As a member of the Senatus Academicus, and Assessor for that body in the University Court—an office to which he was elected five times in succession—Prof. Christison took an active and prominent part in the management of college affairs. No member of the University was more energetic in pushing forward that great scheme of extension which, as now all but realised in a new Medical School, alongside of the new Infirmary, will doubtless raise Edinburgh to a yet higher position as a seat of medical education. The movement for better endowment of the University also found a warm supporter in one who was ever ready to advance what he believed to be the true interests of learning. An ardent lover of all manly exercises, the doctor was himself noted, in his youth, as the most accomplished athlete in the University. A story is told of his having, on one occasion, accomplished the rarely equalled feat of running from the College gate to the top of Arthur seat within twenty-five minutes. In after years, athleticism would often form part of the diversions with which the Professor and his friends relieved the cares of professional life. Even as an octogenarian the vivacious Professor continued to be remarked for the almost jaunty elasticity of his step.

By the Edinburgh Medical Faculty his eminence was duly recognised in his election on two distinct occasions—in 1838, and again in 1846—to the presidentship of the Royal College of Physicians, an honour which was fitly followed up by the Fellows according a place in their hall to his portrait by Sir John Watson Gordon. On the death of Sir David Brewster, he was elected president of the Edinburgh Royal Society; and in this office, held from 1868 to 1873, as well as in the vice-presidentship, which he had formerly filled, he acquitted himself with a distinction which the Society acknowledged by adding his portrait to their gallery of illustrious men. Assiduous in his attendance at the Society's meetings, Dr. Christison from time to time contributed papers to the *Transactions*. Among the subjects thus discussed may be mentioned that of fossil plants in the coal formation, and the remains of ancient trees found in Craigleith and other quarries, on the study of which he brought to bear the resources of chemical analysis. In 1857 Dr. Christison's position among Scotch physicians was fitly recognised in his being nominated by the Crown to represent the profession in Scotland at the General Medical Council. After having for many years held the honorary office of a Physician in Ordinary to the Queen for Scotland, Prof. Christison in 1871 was created a baronet of the United Kingdom, a distinction which was conferred on the recommendation of the then Prime Minister, Mr. Gladstone. In 1873 he celebrated the jubilee of his professorship, an occasion of which friends and admirers were eager to take advantage for testifying their appreciation of the veteran physician. In 1875 he presided over the Edinburgh meeting of the British Medical Association. The veteran's general standing as a scientific man was no less unmistakably certified in his being selected, in 1876, for the presidentship of the British Association for the Advancement of Science: though this honour, in deference to the advice of friends, who feared the effort might overtax his strength, he felt constrained to decline. It was not many months later that an illness, by which he was for a time completely prostrated, led to his resignation of professorial duty.

Sir Robert Christison was married in 1827 to Henrietta Sophia, daughter of Mr. David Brown, of Greenknowe, Stirlingshire. Mrs. Christison died in 1849; but there survive three sons, of whom Alexander, the eldest, born in 1828, was educated at the Edinburgh Academy and High School, and after serving in various capacities, is now Deputy Surgeon-General of the Bengal Army.

CONCERNING THE GAS-FLAME, ELECTRIC, AND SOLAR SPECTRA, AND THEIR EFFECTS ON THE EYE

THE spectra of the light from these various sources is a subject to which I gave some attention about two years ago, and a detailed account of my experiments may be found in the *Proceedings* of the American Academy of Sciences for 1880, p. 236. In this article it was shown that the colour of the sun was not what the average person would call white, but decidedly bluish. The sun's "golden glare" spoken of by Mr. Capron is entirely a subjective effect (except when near the horizon); and follows from the well-known law that bright lights tend to look yellow, and faint ones blue. If the highly magnified images of two diaphragms *equally* illuminated, one by the electric light and one by the sun, be cast upon a screen, the distinctly bluish character of the latter will be strongly marked. Indeed, the magnesium light is more blue than the electric, and hence probably is of a higher temperature, although being spread through a larger space, has less available heating power. As far as mere colour is concerned then, the electric light approaches nearer to the sun than does the gas-flame.

From subsequent experiments, however, it is my impression that colour has nothing whatever to do with the painful effects sometimes noticed in the eyes, after long and continuous work by artificial light. To test this question, I had a tin lamp-shade constructed, consisting of a tube six inches in diameter by eight in length. One end was closed by a reflector, and the other by a piece of very light blue glass. Two holes were made in the sides, through which passed the glass chimney of an Argand gas-burner. By experimenting with a shadow photometer, a position was found where the light received on a book was of the same intensity, and very similar colour, to that from a window in the daytime, at a distance of about six feet. A few minutes' reading, however, was sufficient to convince me that the new light was far more trying to the eyes than an ordinary gas-flame would be. The ill-effects being due to the intense heat thrown down by the reflector. And this I think is the source of the whole trouble in the ordinary gas-burner. The heat radiated by the flame, the heated chimney and shade, and reflected

from the printed page, and all other white paper lying on the table, dries the eyes, the lids, the forehead, and temples, Temporary relief may be found by bathing the face and eyes in water, but it is only temporary. The hot, dry air about the lamp is also harmful, and no doubt contributes its share of injury to the vision. These evils may both in part be remedied by placing a pane of glass so as to intercept the rays from the lamp before they strike on the book or the face. But it must be placed at such a distance from the lamp as not itself to become heated.

The hotter the flame, the whiter it is, and the more light is thrown off in proportion to the heat. Hence oculists are recommending such lights as the Student's and Moderator lamps, which burn with a small, hot, and very brilliant flame, as compared with that furnished by the Argand and fish-tail burners. We learn from statistics how alarmingly prevalent near-sightedness has become of late among students. Hence anything which will tend in the future to prevent this wide-spread defect will be a boon to mankind. And here is where the particular advantages of electricity come to the front. The fact that there are no gaseous products to radiate heat without light, taken together with the high temperature of the incandescent carbon, unite to give us the maximum of light with the minimum of heat. The ever-varying intensity of the arc light is at present a strong objection to it, but we may look forward to the success of the light from the incandescent carbon strip, [in the near future, with the assurance that we shall soon have a remedy for the most wide-spread evil that afflicts the human vision.

Boston, Mass., U.S.A. W. H. PICKERING

THE GREAT NEBULA IN ANDROMEDA

FEW objects in the heavens have been treated with such unmerited neglect as this which has not inaptly been termed the Queen of the Nebulæ. Notwithstanding its enormous magnitude, spreading out, as followed by the Harvard 15-inch achromatic, to $2\frac{1}{4}^{\circ}$ in length, (according to Bond—Trouvelot gives more), with a breadth of upwards of 1°; and its conspicuous brightness, readily perceptible with the naked eye, it has received little comparative notice. The reason probably may be the pertinacity with which it has hitherto resisted all inquiry, and defied the efforts of the most powerfully armed investigation; so that it seems to have been left on one side, as too unpromising for more than casual inspection. This however bears the character of a premature conclusion. Direct examination by the most powerful telescopes has done very little to solve the mystery of its nature. The reply extorted by the spectroscope is but partially intelligible. But we must not therefore despond.

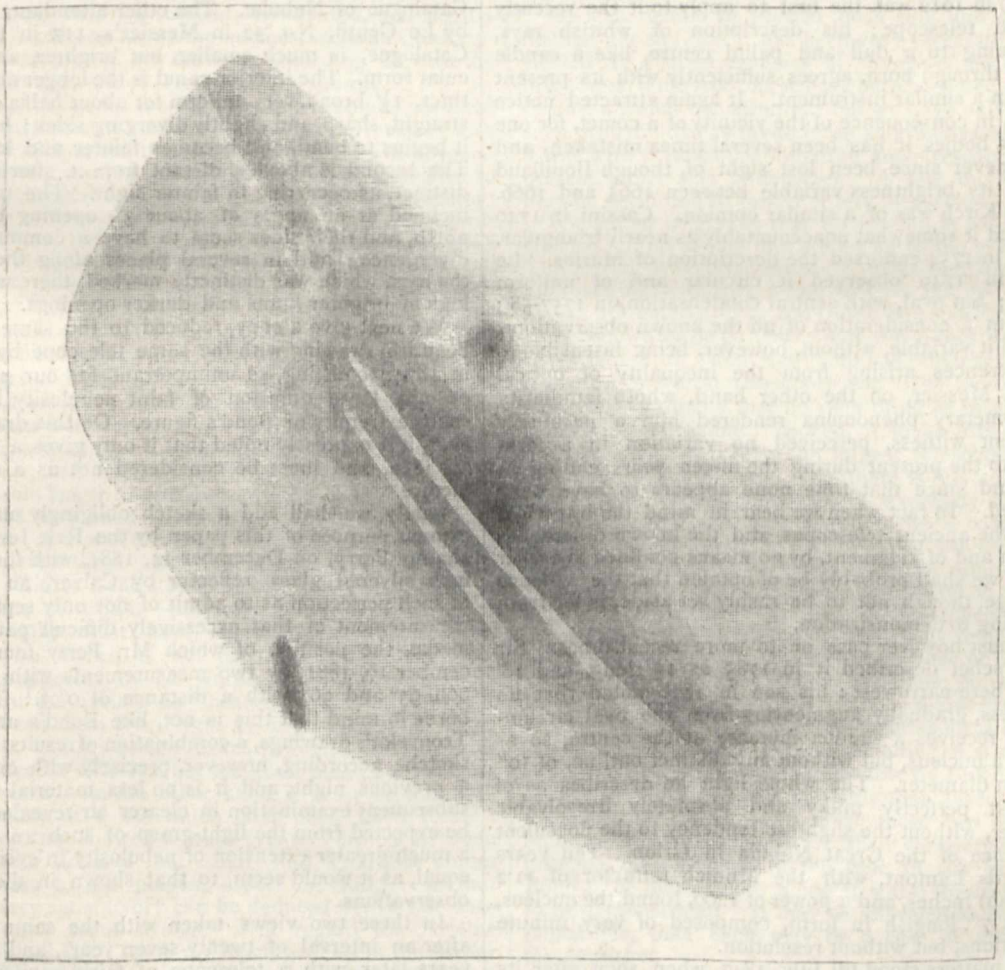

FIG. 1.—Bond, 1847.

The negative or ambiguous results hitherto obtained do not preclude—on the other hand they rather invite—attempts of a different kind. If again defeated, we are only where we were before. If in any measure successful, we may indeed find the mystery only increased by partial solution; but such, after all, is the progress and the limit of all earthly knowledge. An obvious line of inquiry presents itself in the present instance, which seems not to have been adverted to in modern times—the possible evidence of variation either in form or brightness; and the following notices, neither as exhaustive nor as minute as the subject would otherwise admit, have been chiefly put together with this view.

The history of this nebula, which includes the ancient evidence, such as it is, of variation, is in brief as follows.

The first mention of it, according to the late Prof. G. P. Bond, the eminent observer at Harvard College, Cambridge, U.S. America, to whose memoir we shall be indebted for a considerable portion of our materials, occurs in an ancient star-catalogue with charts, supposed to date back as far as the close of the tenth century,[1] where it is represented of an oval form. Its previous omission in ancient catalogues is more easily accounted for than the remarkable silence of Tycho Brahe and Bayer. Marius (Mayer) in 1612 was the first to apply to it the recently invented telescope; his description of whitish rays, brightening to a dull and pallid centre, like a candle shining through horn, agrees sufficiently with its present aspect in a similar instrument. It again attracted notice in 1664, in consequence of the vicinity of a comet, for one of which bodies it has been several times mistaken, and it has never since been lost sight of, though Bouillaud thought its brightness variable between 1664 and 1666. In 1676 Kirch was of a similar opinion. Cassini in 1740 described it somewhat unaccountably as nearly triangular. Mairan in 1754 endorsed the description of Marius. Le Gentil in 1749 observed it circular and of uniform density; but oval, with central condensation, in 1757-58; and, from a consideration of all the known observations, believed it variable, without, however, being insensible to the differences arising from the inequality of optical means. Messier, on the other hand, whose familiarity with cometary phenomena rendered him a peculiarly competent witness, perceived no variation in a form similar to the present during the fifteen years ending in 1771; and since that time none appears to have been suggested. In fact when we bear in mind the imperfection of the ancient telescopes, and the known differences of vision and of judgment, by no means confined to earlier periods, we shall probably be of opinion that the evidence of change, though not to be rashly set aside, is far from amounting to demonstration.

We must however pass on to more recent times. Sir W. Herschel described it in 1785 as $1\frac{1}{2}^{\circ}$ long, and 16′ broad where narrowest; his son in 1826 noted that its brightness, gradually augmenting from the oval circumference, receives a sudden increase at the centre, so as to form a nucleus, but without any distinct outline, of 10″ or 12″ in diameter. The whole light he describes as of the most perfectly milky and absolutely irresolvable character, without the slightest tendency to the flocculent appearance of the Great Nebula in Orion. Ten years afterwards Lamont, with the Munich refractor of 11·2 (? English) inches, and a power of 1200, found the nucleus, of about 7″, longish in form, composed of very minute granulations, but without resolution.

Thus matters stood till July, 1847, when, soon after its erection, the great Merz achromatic of Harvard College was brought to bear upon it, with the confirmation of the almost star-like nucleus, but, owing no doubt to the unfavourable background of the summer sky, it was not till September 14 that the two dark rifts or canals were detected, which form so strange and peculiar a feature in this grand object. But no resolution was attained. It was estimated that owing to the light and sharpness of this admirable instrument upwards of 1500 stars were visible within the limits of the nebulosity, without the least apparent connection with it. And on which side they may lie who will presume to say?

We may now give a reduction from the drawing of Prof. G. P. Bond, adequate to our present purpose, though, from the difference of material, far inferior in delicacy to the original steel engraving. Great pains were taken in delineation, and numerous measures were obtained from the divided circles of the instrument; but an important admission of his must be borne in mind as to possible error in the comparative brightness of the different regions.

The drawing includes, it will be observed, two bright patches, one on either side of the grand central mass, but each involved in its diffusion, and therefore presumably, though not demonstrably, a part of the same complex structure. The more distant one below to the left, or north-preceding (for our diagrams give the inverted or telescopic view), was discovered by Caroline Herschel in 1783, and is known as $H_{\frac{1}{2}}$V18, or No. 105 in the General Catalogue of Nebulæ. The other attendant, pointed out by Le Gentil, No. 32 in Messier's, 117 in the General Catalogue, is much smaller, but brighter, and of a circular form. The interior canal is the longer and more distinct, $1\frac{1}{2}'$ broad, very uniform for about half a degree, with straight, sharp, and slightly diverging sides; further north it begins to bend, and becomes fainter and less regular. The second is about 4′ distant from it, shorter, and less distinct, as occurring in fainter light. The two rifts are inclined at an angle of about 3°, opening towards the north, and their sides seem to have a common point of divergence; and in several places along the course of the axis, which was distinctly marked, there were gatherings of brighter knots and darker openings.

We next give a copy, reduced to the same scale, of a beautiful drawing with the same telescope by Trouvelot, in 1874; omitting, as unimportant for our present purpose, a large diffusion of faint nebulosity beyond the south extremity of Bond's figure. Of this drawing, however, it is expressly noted that it only gives a good general idea, and must be considered not as a map, but a picture.

Lastly, we shall add a sketch obligingly made for the express purpose of this paper by the Rev. Jevon J. Muschamp Perry, on December 14, 1881, with his great $18\frac{1}{4}$-inch silvered glass reflector by Calver, an instrument of such perfection as to admit of not only separation, but measurement of that excessively difficult pair γ^2 Andromedæ, the position of which Mr. Perry found, on December 10, 1881, by two measurements with a power of 600, 95° and 96°, with a distance of 0″·3.[1] It must be borne in mind that this is not, like Bond's and probably Trouvelot's drawings, a combination of results, but a single sketch; according, however, precisely with one taken on a previous night, and it is no less material to add that subsequent examination in clearer air revealed, as might be expected from the light-grasp of such an instrument, a much greater extension of nebulosity in every direction, equal, as it would seem, to that shown in the American observations.

In these two views taken with the same instrument after an interval of twenty-seven years, and a third six years later with a telescope of fairly equivalent power, we have before us the materials of an interesting comparison. The general similarity is obvious; but there are variations which it may not be well to ignore. One is, the form of the principal mass of light, spindle-shaped in

[1] The Persian astronomer Sûfi, Flammarion informs us, referred to it about the same period as a well-known object.

[1] The agreement is remarkable, in so close an object, with one of the Washington measures, 1880·039, 95°·8, 0″·35; their average for three years being 101°, 0″·358.

the earlier, globular in the two later drawings. This difference, while reminding us of the ancient variations of Le Gentil, may possibly not imply much, where no distinct outline is presented to rectify the judgment of the eye. But we have something more tangible in the length and form of the canals. Here, assuming equal care on the part of Trouvelot in designing, with that claimed by Bond both in delineation and description, we seem to have indications of change. It is true that Bond's account of the outer or shorter canal, as commencing a few minutes *n p* the other, does not altogether agree with his drawing; but this is not the sole instance of confused "orientation" in his memoir; and at any rate he describes its commencement as only 4′ of space distant from the other. Trouvelot, as will be seen, has extended it much further *s p*; and should it be objected that this slenderer termination may have escaped the eye of Bond, it is curious to find it strongly and independently confirmed by Perry in two sketches on different nights, and by his express statement that "the *p* rift extends further than the *f* rift on the southern side." The greater breadth which he has given in each sketch to both canals is also worthy of notice. Another point of disagreement between Bond and Trouvelot occurs in the form of the longer canal: the "perfectly straight, suddenly terminated, and slightly diverging" sides, as far as the nucleus, of Bond's description, confirmatory of his drawing, according ill with the sinuous direction which Trouvelot has shown.

This may suffice for the collation of the results obtained by great instruments. But a comparison yet remains with the appearance in smaller telescopes; and it will be found deserving of attention. Let our aperture be restricted to 5 inches achromatic, or an equivalent light in a reflector: then, with ordinary vision and customary skies, the three salient points, the great centre, Le Gentil's ball, and Caroline Herschel's cloud, though much dimmed and contracted, keep their places, but all the attendant nebulosity will be swept away. Such at least is my own experience. On October 5, 1863, a few hours before the strong earthquake-shock, that will long be remembered in this part of England, I caught a portion of the inner canal with a 5½ inch achromatic, and on August 24, 1864, I saw them both feebly, but certainly, with 8 inches of silvered glass, and have several times followed them with that mirror, and with my present 9½ inch aperture, for a considerable length: but though traced, I cannot say that they would have been discovered. And latterly, whether from decay of visual power, or want of purer air, I have failed to detect them. But the general result is unmistakable. Either Bond's drawing must have exaggerated —and that materially—the light which they traverse; or that light must have since faded. The latter it must be owned is not probable. Yet his figure is fairly supported by his words, where he gives both canals near the nucleus as "beautifully distinct," and the light between them ⅔ as bright as on the inner side of the longer one, and his design makes both rifts cleave, not as now, the feeble diffusion, but the great mass, not far from its very heart. On the other hand it must be admitted that probably at a not much later date, Lord Rosse's 3-foot speculum showed a much greater contrast between the opposite sides of that canal; and Trouvelot comes much nearer to the present aspect of things: so that nothing very satisfactory can be deduced here. The case however may seem stronger with regard to Caroline Herschel's nebula. There are discrepancies in the earlier values of its light. Her brother called it "pretty faint" with an area of 30′ × 12′, proving that he included with it much of the great nebula. His son, reducing it to 15′ × 7′, found it "pretty bright," though it stands as "very bright" in the General Catalogue. Bond shows it of a brilliancy superior to all but the light near the great nucleus and the centre of Le Gentil's ball. The Earl of Rosse, with the 6-foot mirror in 1876 complains of this delineation as "far too bright and sharply defined." Trouvelot again with a softer general effect has a small centre as bright as Bond; and this may perhaps be the nucleus faintly suspected by Sir John Herschel, and described by Lord Rosse in 1855 as bright and sharp: while the cautious and accurate d'Arrest (1861—67) using an 11-inch object-glass, and giving its size 12′ × 2½′, speaks of it as only moderately bright, much more so towards the centre, but without a genuine nucleus. These details, needless and tedious as they may possibly at first appear, are introduced chiefly from their bearing on our present inquiry as to the probability of change, but in some measure as illustrative of the uncertainty that hangs about such observations. Every one may not be aware of the breadth of margin required, where there is no distinct outline, and faint diffusions fade out of all but the purest skies, and dilate and shrink by turns under the anxious gaze, and estimates of brightness are precarious, and artistic talent is often dissociated from the observer's skill. But after all allowances there can be no doubt that the existing aspect of this (Miss Herschel's) nebula with moderate telescopes is much less reconcilable with the designs of Bond and Trouvelot than might have been expected.

We can neither at present push this line of inquiry further, nor say that it has been very successful. Had it yielded us distinct evidence of change either in form or brightness, it must of course have been accepted as decisive against a stellar constitution; but we have only met with such probabilities as invite close and long research; and it was with a view of stimulating such research that the present paper was undertaken. A few more remarks may be permitted to render it less incomplete.

We stated originally that no resolution has ever been effected. This seems undoubted as to the grand mass.[1] The Earl of Rosse had indeed thought such development approaching with the 3-foot mirror, but only from an aspect presented also by the Dumb-bell and Ring nebulæ, since known to be gaseous; and the 6-foot giant broke down in its turn: and Newcomb has remarked that "in the most powerful telescopes the light fades away so softly and gradually that no such thing as resolution into stars seems possible. Indeed, it looks less resolvable and more like a gas in the largest telescopes than in those of moderate size." But there is less unanimity as to the two companions. Bond expressly states that under high powers 105 appeared to be a coarse cluster of stars. The 6-foot at Parsonstown on the contrary effected no such result; and we may remember that Bond had imagined momentary resolution in the Orion nebula. As to the bright ball, the Herschels and Bond lay no claim to success; the latter only remarking that the field preceding it contained multitudes of very small stars on a very even milky nebulous ground. Lord Rosse's 3-foot gave it resolvable; the 6-foot was silent.

D'Arrest once says, "nucleus stellatus circa medium"; at other times finds a nucleus equalling a 9 or 10 mag. star.[2] It has been thought resolvable by Buffham, and I believe by Key, and has certainly that aspect in my 9½-inch speculum. But even were these two companions found to be of a starry nature, their connection with the principal mass (though in the case of 105 supposed by Bond to be indicated by a line of stars) would yet remain to be demonstrated. It may be improbable, but it is not impossible, that each may be a case of mere optical juxtaposition.

The telescope has comparatively failed. But the spectroscope remains—an instrument as superior in analytical as it is inferior in optical power. And here we get

[1] It is very remarkable that the usually accurate Humboldt should have so misapprehended Bond's meaning as to consider the 1500 stars scattered over the nebulous area as a proof of the resolution which he expressly disclaims.

[2] A similar appearance is so often ascribed in these beautiful observations to the centres of nebulæ, as to induce a suspicion of peculiarity, either of vision or of structure; in the latter case worthy of future attention.

some kind of reply; but still, except in one respect, an indecisive one. It precludes at once the idea of a simple gaseous condition such as that of the Ring Nebula, or the Dumb-bell, or the wonder in Orion: d'Arrest complains indeed of the feebleness of the principal spectrum; but all the three are continuous, as from stars. And yet they are peculiar, being deficient at the red end; at least this is expressly stated as to the central mass and the little ball. This peculiarity reappears elsewhere, not only among others in the beautiful nebulæ M 81 and 82, in Ursa Major, which are as yet unresolved, but in the great Hercules cluster M 13, and surely indicates some difference from ordinary stellar light. And again, as a fresh point of resemblance in general unlikeness, M 13, as well as our two nebulæ in Andromeda, is said by Huggins to have its continuous spectrum crossed either by lines of absorption or bright lines. So strange did this appear to that great observer that he was inclined to think in 1866 that perhaps the bright points in some clusters might not be of the same nature with true stars. At any rate the mystery, so far from being solved, seems only to be removed to a more inaccessible distance. What is that at which we gaze, overspreading field after field of the telescope with soft yet often vivid light? If gaseous, gas unknown, or in some hitherto unknown condition, or as Newcomb remarks, under an

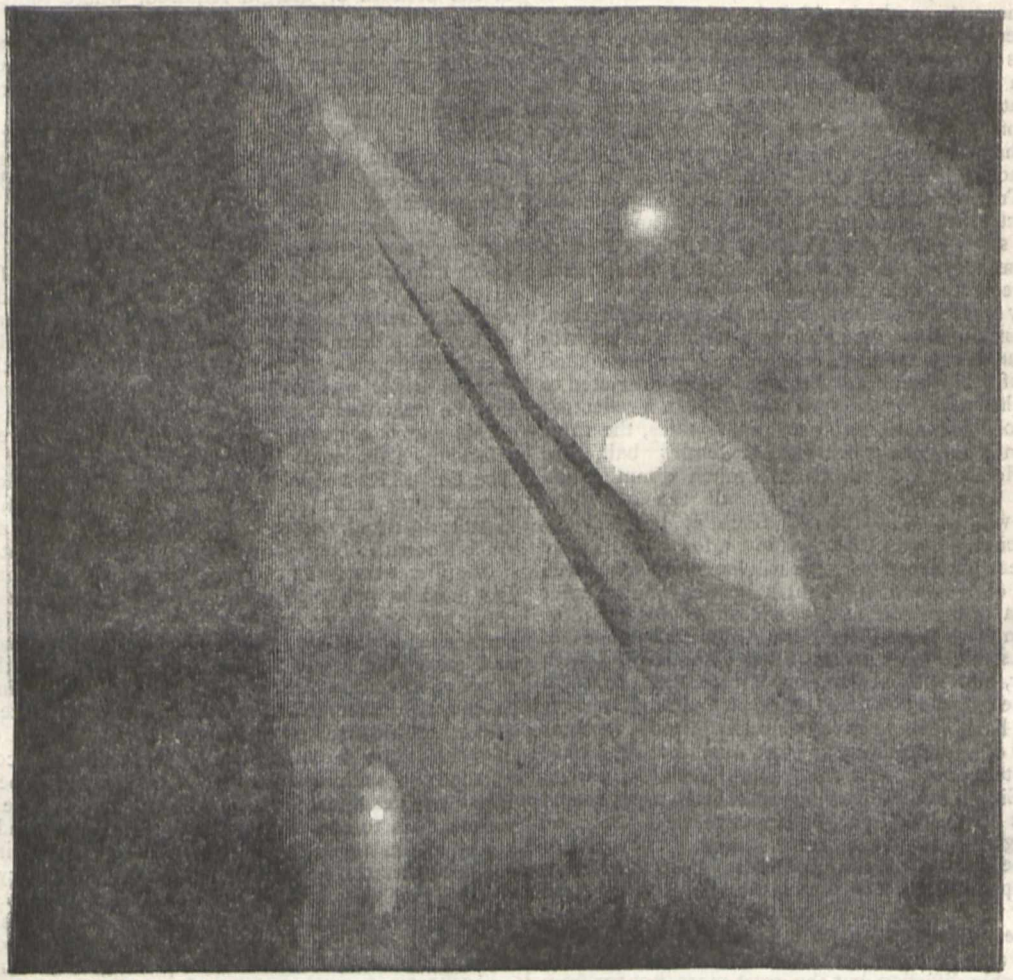

FIG. 2.—Trou-elot, 1874.

unintelligible amount of pressure. If stellar, how are its components so concealed, that neither in its extreme brightness, surpassing much, as I have especially noted, the great Orion nebula, nor in the evanescent faintness of its wide diffusion can they be insulated? If stars are there they must be numbered by hundreds of thousands; yet possibly of much lesser magnitude than we, from ancient habit, are apt unconsciously to associate with the idea of a star. The examination at least of many globular clusters has swept away old notions of size as well as distance; and there is no reason why bodies should not exist, not larger than the planets of our system, but emitting unborrowed light. And if such speculations may seem improbable, we may bear in mind that in venturing into these abysses we have intruded into a strange and mysterious region, where probability is left behind, and we have to deal with possibilities alone.

What again are those rifts, which seemed so strange to Sir John Herschel that he suggested the idea of the interposition of some less transparent material? Openings, perhaps, and indicating thinness of substance in the line of vision; openings which our earth, with its orbital velocity of 66,000 miles an hour, might possibly take years, possibly centuries, in crossing merely from side to side. This, however, must be observed, that they are not unparalleled in other nebulæ.[1] But what, in any case,

[1] Gen. Cat. 3106 (Com. Ber.); 3131 (Virgo); 3501 (Cape Obs.); perhaps

could be their origin? And how far are they shown to be unalterable?

And, in the last place, what is the distance or real magnitude of that luminous mass? Is it on this or the other side of the stars so profusely scattered throughout the same visible area? It may be nearer, or, more correctly speaking, less unimaginably distant, than we are apt to suppose. It might even show sensible parallax, if

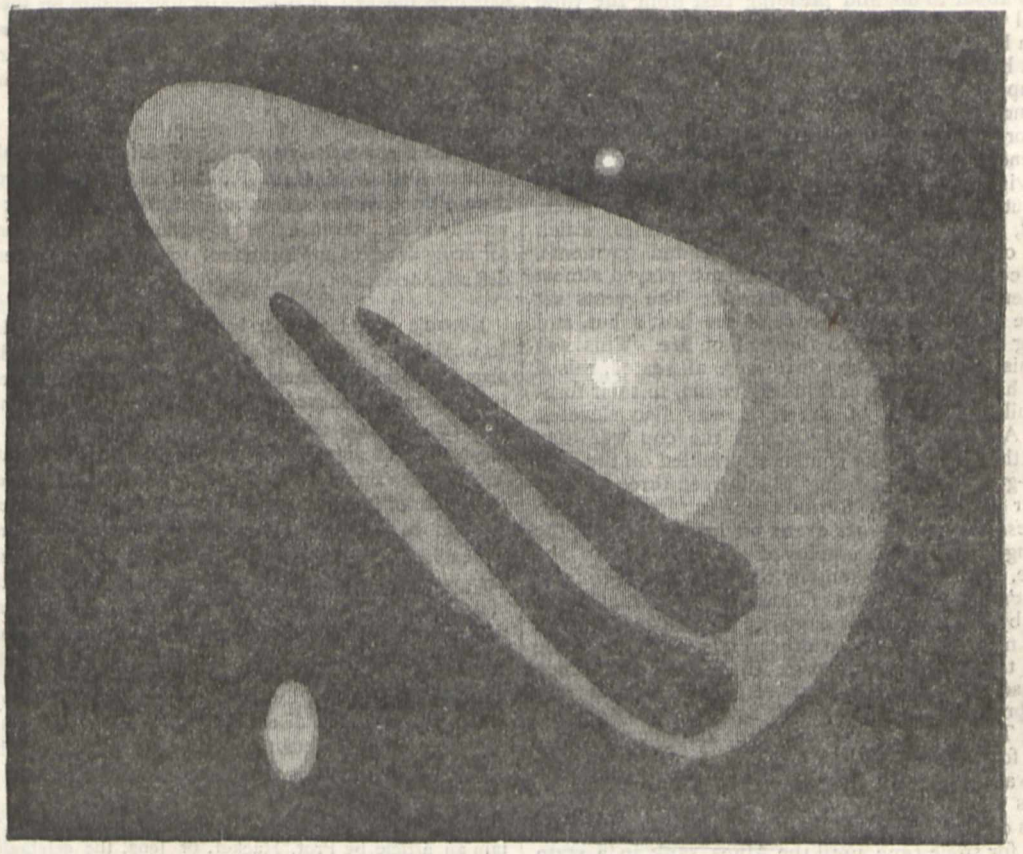

FIG. 3.—Perry, 1881.

d'Arrest's stellar point in 117 could be compared in position with neighbouring stars; and even so, an enormous extent must still be assigned to it. Or it may lie yet further away in the unfathomable depths of space, expanded to a gigantic size—the largest body in the visible universe—the greatest display as to magnitude of its incomprehensible Creator.

And with these inquiries as to a mystery never in all probability to be penetrated by man, our imperfect remarks shall close.

T. W. WEBB

A BEAR FESTIVAL AMONG THE AINOS

ALTHOUGH it is well known that the Ainos of Yeso worship the bear, and have a festival known as the "bear-festival," at which that animal is killed, no foreign writer, except the one whom we are about to mention, has ever actually beheld this ceremony. Dr. Scheube, of Kioto, in a paper recently published in the *Mittheilungen der deutschen Gesellschaft für Natur und Völker-kunde Ostasiens*, describes one at which he was an honoured guest. He observes that these celebrations are becoming rarer every day; in the various villages which he visited there had not been one for some years. The motives assigned for this cessation of an old custom, is that the Ainos are becoming *Japanised*, and that the expenses are too great. In those parts of the island where Japanese habits have penetrated most, the absence of the skulls of the bears, which are also objects of veneration, is very noticeable; and as the individual who gives a bear-feast is compelled to invite all his relations, friends, and neighbours, and to supply them with unlimited quantities of *saké* (rice-beer)—a beverage which is three times more expensive in Yeso than in Japan—the excuse on the score of expense is probably a valid one. It is, it seems, incorrect to say that the Ainos reverence the bear as they do their gods—the god of the fire or of the sea, for instance; but they respect the bear above all other animals. He is most useful to them; he supplies them with food, raiment, and even with medicine. On the other hand, when enraged, the bear is a terror to them; he destroys their houses, plantations, and domestic animals, and kills themselves. The animal intended for sacrifice is selected while it is still very young, towards the end of winter, it is nourished by the wife of its owner at first, and when it gets stronger is fed on fish alone. In the beginning it runs freely about the house, but as it increases in size and strength it is placed in a cage. About September or October, when it is a

4628 (Aquar. Gaseous). The first of these I have seen well with my 9½-inch speculum.

year old, and has become so strong that it attempts to break its cage, the time for the ceremony is deemed to have come, and the great event of an Aino's life is about to take place. He first addresses long prayers to the gods and to the relations of the bear asking pardon for what he is about to do, and pleading that from the time the animal came into his possession he has showered favours on him, and has maintained him as long as possible; but he is poor, the bear is growing large, and he finds it impossible to support him any longer. He has therefore no resource but to slay him; and for this act, which is forced on him by inevitable necessity, he prays for forgiveness.

On arriving at the scene of the ceremony the visitor found about thirty persons, chiefly residents of the place, assembled, and dressed in their gala costumes, which consisted chiefly of old Japanese brocaded garments. From the commencement to the end *saké* played almost as prominent a part as the bear himself. The guests sat around the fire-place in the centre of the host's hut, and an offering was first made to the god of fire. This was done in this wise. The Ainos, who were all seated, raised their left hands, holding a drinking vessel, to their foreheads, while the palm of the right was also elevated slightly. A small stick lying across the cup was then dipped in the *saké* and the contents sprinkled on the floor to the fire-god, the stick being then waved three or four times over the cup. A formula was uttered by each person present, and the *saké* drank in long draughts, the stick being meanwhile employed in holding up the moustache. A similar ceremony then took place in front of the bear's cage. This was followed by a dance around the cage by the women and girls. Offerings of drink were then made as before to other gods, and finally the bear was taken out of his cage by three young men specially selected for the purpose. The animal was killed by pressing the throat firmly against a large block of wood. The body was then cleaned, and placed neatly on a mat, food and drink being laid before it, and ornaments of various kinds being placed on its ears, mouth, &c. Mats were spread around the bear, the guests took their seats on them, and the drinking commenced. This continued for some time, until the Ainos sank in a state of helpless intoxication on their mats. The women in another part of the village meantime amused themselves with various dances, which Dr. Scheube describes at length.

The following day, as a rule, the debauch is continued. The body of the bear is then cut up in such a manner that the hide remains attached to the head. The blood was collected in vessels and drank by the men. The liver was cut out and eaten raw; the rest of the flesh was distributed amongst the partakers of the feast. The writer states that although hardened in a certain sense to the sight of blood, he could not look without horror on the sight of the drunken crowd with their faces and bodies smeared with blood. The skull of the bear—stuffed with charms—is placed in a sacred place on the east side of the house, and the mouth is filled with bamboo-leaves. It is then always preserved and venerated as a sacred object.

NOTES

MR. WILLIAM BOWMAN, LL.D., F.R.S., has been elected Honorary Secretary of the Royal Institution, and Dr. Warren De La Rue, F.R.S., Manager.

ON Monday the Royal Commissioners on Technical Education—Mr. B. Samuelson, M.P., Mr. Woodall, M.P., Prof. Roscoe, Mr. P. Magnus, Mr. Swire Smith, and Mr. Redgrave, secretary—visited Liverpool to inquire into technical science teaching. They met at the Free Library, and were furnished with information concerning its working by Sir James Picton. They afterwards visited several of the Board schools, and in the evening some of the science classes.

DR. P. L. SCLATER, the Secretary of the Zoological Society, will give the first of a course of four lectures on the Geographical Distribution of Animals, on Thursday next, February 16, and Mr. W. Watkiss Lloyd the first of a course of four lectures on the Iliad and the Odyssey, on Saturday, February 18, at the Royal Institution.

AT the comparatively early age of fifty-two years Major Sir William Palliser, C.B., M.P., died very suddenly from heart disease on Saturday afternoon. Sir William Palliser was universally known through the projectiles that bear his name, and for many practical applications of science in both offensive and defensive armament.

KÖNIG'S great tonometer is, we observe, announced for sale. It would be a great pity if the opportunity of acquiring this magnificent and absolutely unique collection of standard tuning-forks for the nation were thrown away. The collection was one of the finest things exhibited in Philadelphia, where it still lies, the project to purchase it for the University of Pennsylvania having fallen through. If it cannot be acquired for the national collection, of which a nucleus exists at South Kensington, surely it might be thought worth while to purchase it for either the Cavendish or the Clarendon Laboratory. But the nation that can give two thousand pounds for the plaster cast of the porch of a Spanish church can surely afford to buy the masterpiece of the master-maker of modern acoustical instruments, especially at the moderate price asked.

UPON the Island of Euboea fossil human remains are reported to have been recently discovered. The Greek Government has had the objects in question conveyed to Athens, where their scientific examination is now ordered.

THE February number of the *Deutsche Rundschau* will contain an article by Prof. Häckel, of Jena, the celebrated evolutionist, on his scientific researches in India, where he has been travelling since last autumn and still is.

IMPORTANT steps have been taken towards the execution of the French Metropolitan Railway, the principal technical difficulty being the crossing of the Seine. The first line to be constructed will originate from St. Cloud, and have its terminus at Vincennes. Its underground run will begin at the rue de Rome; other stations will be at the Opera, Bourse, Arts-et-Métiers, Place de la République, and Place de la Bastille. The track from the Place de la République to the Place de la Bastille is not yet decided upon, owing to the difficulty of crossing the Canal St. Martin's. The work will commence with the opening of a new street in the most densely-crowded part of Central Paris.

A "GEOGRAPHISCHE GESELLSCHAFT" was founded last month in the University town of Jena, under the presidency of Dr. Sehmid, one of the professors. Their *Mittheilungen* is to be a quarterly one, and is to chronicle the geographical and ethnological researches of missionaries. The first part is to appear towards the end of March. These societies are springing up all over France so fast that their very names slip one's memory, but in this country we are still content with one, no more having been heard of the feeble attempt made to start a Commercial Geographical Society at Manchester.

FROM the *Colonies and India* we learn that valuable and important discoveries of copper and iron ore have been made at

Tamworth in New South Wales, and that at Tamora the diamond drill has discovered water at a depth of 400 feet, the site of the boring being on a rocky hill 100 feet above the alluvial flat, on which the town is situated.

THE French Government has instituted a commission of inquiry into the actual position of working-men engaged in the industrial arts. The commission, composed of members of both houses of the French Parliament, engineers of the public service, and leading manufacturers, has held already two sittings in the Conservatoire des Arts et Métiers, where a special room has been fitted up for examining witnesses. The depositions are taken by shorthand writers, and will be published at full length, to support the recommendation of the committee.

WE are informed that the great Danish work entitled "Icones Floræ Danicæ," whose completion has been long anxiously desired by botanists, will be ready for publication in the course of 1883. The work, of which the 51st number has appeared, will in its entirety consist of fifty-four numbers, three of these being supplementary parts devoted to the consideration of Swedish and Norwegian plants not included in the flora of Denmark. Subscribers, or intending purchasers, should apply without delay for the copies they require to Prof. Joh. Lange, or to Messrs. Lehman and Stage, Copenhagen, as it is proposed to break up the plates as soon as the last number has been struck off. An exception will, however, be made in regard to a few of the plates, in view of the possibility of their being used in the production of three other works, which the publishers and editors of the "Icones Floræ Danicæ" propose to issue, provided a sufficient number of subscribers can be secured. These works are: (1) "Icones Floræ Grœnlandicæ," with letterpress and 330 plates; (2) "Arboretum Scandinavicum," including the indigenous trees of Denmark, with 160 plates; (3) Icones Plantarum Officinalium Scandinaviæ," with 300 plates.

M. PAUL BERT, before the resignation of the Gambetta Ministry, had instructed M. Dumas, the Permanent Secretary of the French Academie des Sciences, to draw up a list of scientific men who have died or received injuries while making experiments or researches for the advancement of science. Pensions, it was proposed, should be given to the widows and families of those who had fallen victims to their scientific ardour, whilst those whose injuries have not been fatal will receive substantial aid. We trust the change of Ministry will not affect this laudable proposal.

M. PLATEAU lately sought to estimate the distance to which the moon is mentally referred in the sky, by getting some one, after looking at that body, to project the accidental image on a wall, then move to or from the wall till the diameter of the image seemed equal to that of the moon; and he obtained the distance 51 metres. Again, Prof. Thirion, of Namur, got twelve students to draw on a black board a circle the size of the moon as it appeared to them. The circles varied from 19 to 79 ctm., mean 32 ctm., and it was inferred that the moon was mentally referred, on the average, to about 35 metres. Dr. Charpentier, by still another method, obtains the value 12·9 metres, so that there are great differences, and in any case the distance is much less than might have been thought. M. Plateau has further applied accidental images to finding the distance to which the imaginary celestial vault is referred. A spot in a white square of paper on a dark ground was looked at steadily at the side of an open window for twenty seconds, then the person looked skywards, above the opposite houses, then to one of these houses, and compared the sizes of the accidental images in either case. The sides of the two were by one person estimated as 5 to 6, by another as 4 to 5; and the width of street being about 30 metres, the distance assigned to the celestial vault is inferred to be in one case 30, in the other 29 metres. A similar result was got by night.

MOST encouraging to any, who have hitherto worked unsuccessfully towards establishing a Free Library, should be the picture of past and present which is given in the First Annual Report of that institution at Newcastle-upon-Tyne. The failure of the first effort in 1854, the cold feeling indicated by the very small number of votes against and for the adoption of the Free Libraries Act in 1872, the further delay till 1878 and 1880, contrast strangely with the handsome new building; the large proportion of borrowers to the population, the appetite for reading among these borrowers causing the large circulation, and the 23,000 well-selected and well-catalogued books (see NATURE, vol. xxiii. p. 262) which this report can boast of. The wisdom of the Newcastle committee in devoting money as well a labour to the purpose of thoroughly well doing this work of cataloguing is confirmed by the sale of 6000 such catalogues at 1*s.* each. The importance of the Juvenile Library comes out strongly also, nearly half the borrowers (4413) being under twenty-one years of age, and the turn-over of books being by far the greatest in that department. An immense work is being done by this means, and there must be room for much more power, being devoted profitably to the production of these influential works. This library is fortunate in its large spaces for stowing away Blue Books, Transactions, and newspapers, which no public library should be without, yet which fill up so much space; in its arrangements for home binding; it is fortunate in the fact that its 1*d.* rate brings in over 2800*l.* a year, and we hope that under the new Act to be brought in next Session, it will be fortunate in getting more.

IN a recent number of *Naturen*, Hr. Bergh has drawn attention to the powerful agency exerted by ice in severing rocks, of which he gives a striking instance occurring on the Aalesund in West Norway, where a low ledge rising out of the fjord is all that remains of a once extensive fjæld promontory, which in the year 1717 was suddenly blown up and precipitated into the water by the force of the ice within the interstices of the stone. The winter had been mild, and during a rapid thaw a considerable stream had welled up from the ice-covered summit of the fjæld, and carried its waters into every crevice of the rock, when a sudden change of wind brought about a sharp frost, which turned the descending waters of the newly-formed stream into ice, arresting their course within the interstices of the rock. The result was the explosion of the entire mass of the fjæld below the outbreak of the stream, and its projection from a height of more than 1500 feet into the neighbouring fjord, which engulfed the whole of the promontory, with its cultivated fields and farmstead. Simultaneously with the disappearance of the land below the surface of the fjord, a huge mass of waters was propelled against the opposite shore, carrying with it rusty anchors, boat-rafters, and numerous other objects which had long lain at the bottom. The disturbance extended a mile beyond the point at which the land was submerged, and the waters in retreating carried with them a wooden church which had stood fifty feet above the fjord, besides sweeping away all the fishing-boats for a distance of two and a half miles. Before this occurrence, which was attended by loss of life to about a score of persons, the headland had been much resorted to on account of the halibut, which abounded in the neighbourhood, but since that period the fish has never returned, a circumstance which, according to local popular belief, is due to the covering up by the infallen rock of certain submarine cavities and springs frequented by the fish.

A MOST interesting experiment has taken place at the Comptoir d'Escompte of Paris, one of the leading bank-

ing establishments, in its new building, rue Bergere 16. Not less than eighty electric regulators, and a large number of Swan lamps, have been illuminated by Grenet's battery. The illumination will continue every night after a very few days, when the new offices will be occupied by the staff of the Company. One of the peculiarities of this system is that the offices are illuminated by the Jaspar reflecting system, but it is the ceiling itself which is used as a reflector. The effect is splendid. The large hall is illuminated from the top by sixteen Serrin and Siemens' regulators. The arc is concealed by a ceiling of coloured lights. Swan lamps are used for the staircases, and the chambers where the valuables are kept. All the offices are connected with the head office by telephones, pneumatic tubes, and telegraphs. The battery is controlled by electrical agency. The fifty elements are placed in the upper part of the edifice as well as the tanks for keeping the liquid. When it is used it is collected in another tank placed in the lower part, from which it is carried by special carriages and brought to a special workshop at some distance. In this workshop the zinc is regenerated, as well as the sulphuric acid and the sesquioxide of chromium is changed again into chromate. The cycle of regeneration is complete, and we may give details as to its working. The suppression of reflectors and the use of the ceiling in their stead was devised by M. Corrayer, the architect of the Comptoir d'Escompte.

THE water of Lake Maggiore, which it has been proposed to convey to Milan, has lately been examined by Prof. Maggi by M. Certe's method, the samples being taken at 65 metres depth, and about 400 m. from the banks. Forty-eight hours after a little osmic acid was added, there was obtained a small deposit of dead organisms of bacterian form, none of which had appeared in the microscope. He found a solution of chloride of palladium to have also the effect of hardening those small organisms and so making them opaque and microscopically visible. Small irregular masses of protoplasmic nature, capable of taking colour from a magenta solution, were also thrown down. Prof. Maggi further treated the water of the lake with various colouring agents. Hematoxiline, methyl-violet, magenta, and Lione blue gave the best results. While the same small organisms and protoplasmic masses were manifested, only the latter, curiously, took colour. In spring water of Valcuvia, and rain water, microbes like those in the lake, not visible in a microscope of 800 diameters, were revealed by the colouring and hardening reagents. Prof. Maggi proposes to call these organisms *Aphaneri*, as distinguished from the bacteria and microbes, which, without reagents, are visible in the microscope (*Phaneri*), and among which are agents of infection, and which take colour from methyl-violet, magenta, &c. The Aphaneri, he thinks, are probably harmless.

Among the new subjects for prize competition announced by the *Reale Istituto Lombardo* we note the following: Illustrate with new facts of pathological anatomy and experimental physiology the doctrine of cortical sensory centres (for 31 May, 1884, prize 2000 lire); Monography of magneto electric and dynamo-electric machines, comprising the history and theory, and indicating the merits and defects of the different types with regard to their various industrial applications (for 31 December, 1883, prize 4000 lire); History of the life and works of Leonardo da Vinci (for 31 March 1886, prize 5000 lire); Geognostic, chemical, and physical study of the agrarian soil of a portion of Lombardy (for 31 May, 1883, prize 1500 lire and gold medal 500 lire). Further particulars will be found in the *Rendiconti* of the Institute

THE Birmingham Town Hall was crammed from ceiling to floor on Sunday night to hear a lecture on Natural History delivered by the Rev. W. Tuckwell, at the invitation of the Sunday Lecture Society. The subject was a "Day on the Hills," and the delight of the rough audience was unbounded at the wonders from bog and hill-top, pond and stone-quarry, revealed to them by the lecturer, who, without "preaching," gave more than once a religious turn to the discourse. Hymns were sung and sacred music performed before and after the lecture. The local papers point out that of the 3000 and upwards present the great majority were persons who do not usually attend church or chapel.

WE learn that Dr. Andrew Clark has consented to preside at a lecture on the "Dress of the Period," to be given by Mr. Frederick Treves, of the London Hospital, on Saturday afternoon, February 26, at the Kensington Town Hall, at 4 o'clock. The lecture is given under the auspices of the National Health Society.

THE Lake of Constance is now lower than at any time since 1805. At Hoernlin, on the Swiss side, some interesting Lacustrine habitations have been laid bare, and several valuable finds of nephrite axes and other objects have been made.

BEFORE leaving, the Minister of Public Instruction, M. Paul Bert, signed a decree establishing the Popular Observatory, which we have mentioned already in our Notes. The report was drawn by a Commission composed of Admiral Mouchez, M. Flammarion, and others.

M. FLAMMARION will start, in the month of March, a monthly astronomical paper, to be published by Gauthier Villars. Each number will be profusely illustrated.

ON Monday last the cuckoo was heard in the policies surrounding Halleath, Lochwaben, Dumfriesshire, the weather on that day being remarkably bright and warm.

WE have on our table the following books:—Elementary Physiography, by Andrew Findlater (Chambers); Original Gravity, by J. A. Nettleton (Lampray); Market Garden Husbandry, by W. H. Ablett (Chapman and Hall); Sahara und Sudan, by G. Nachtigal (Paul Parey, Berlin); The Honey Ants and Occident Ants, by McCook; The Water Supply of England and Wales, by C. E. de Rance (Stanford); Mountain Life in Algeria, by Edgar Barclay (Kegan Paul and Co.); Between the Amazon and Andes, by Mrs. Mulhall (Stanford); Vignettes from Nature, by Grant Allen (Chatto and Windus); The Story of our Museum, by the Rev. H. Housman (Society for Promoting Christian Knowledge); Year-Book of Photography, 1882, by H. Baden Pritchard (Piper and Carter); Outlines of Physiography, by G. Thom (J. Thin); Sounds and their Relations, by A. M. Bell (Trübner); Philosophy of Self-Consciousness, by P. F. Fitzgerald (Trübner); Consumption, by De Lacy Evans (Baillière, Tyndall, and Co.); Report of the Lightning Rod Conference (Spon); Sparks from a Geologist's Hammer, by Alex. Winchell (Trübner); Lessons on Form, by R. P. Wright (Longman); Myth and Science, by Tito Vignoli (Kegan Paul and Co.); Practical Microscopy, by George E. Davis (David Bogue); Aristotle on the Parts of Animals, translated by W. Ogle, M.D. (Kegan Paul and Co.); Transit of Venus, 1874, by Sir G. B. Airy (Stationery Office); An Old Chapter of the Geological Record, by King and Rowney (Van Voorst); Dental Anatomy, by C. S. Tomes (Churchill); Tunis, Land and People, by Chevalier de Hesse-Wartegg (Chatto and Windus).

WE are asked by the author to state that at the end of the third paragraph of the article on "The Recent Weather" in NATURE, vol. xxv. p. 285, the barometric pressures inadvertently quoted as 30·093, 30·079, and 30·076 inches, should obviously have been 30·930, 30·790, and 30·760 inches.

THE additions to the Zoological Society's Gardens during the past week include a Sykes's Monkey (*Cercopithecus albigularis* ♂) from East Africa, presented by Mr. H. Gunning; a Ring-tailed Lemur (*Lemur catta*) from Madagascar, presented by Capt. M.

P. Webster; two Badgers (*Meles taxus*) from Russia, presented by Mr. C. R. Meltzer; a Cinereous Sea Eagle (*Haliaetus albicilla*), European, presented by the Hon. M. Finch Hatton; two Common Barn Owls (*Strix flammea*), British, presented by Master Golden; a Mountain Ka-Ka (*Nestor notabilis*) from New Zealand, deposited; two Snow Buntings (*Plectrophanes nivalis*), two Mountain Linnets (*Linota flavirostris*), a Cirl Bunting (*Emberiza cirlus*), British, purchased.

OUR ASTRONOMICAL COLUMN

THE OBSERVATORY OF MELBOURNE.—The sixteenth annual report to the Board of Visitors of this Observatory has been issued by the Director Mr. Ellery. The staff now consists of the Government Astronomer, the Chief Assistant, Mr. White, and three junior assistants. Mr. White takes charge of the meridional work, and on Mr. Turner devolves the observation, drawing, and photography in connection with the great telescope, and obtaining daily sun-pictures with the photo-heliograph. The large telescope almost monopolises the services of a workman. The actual work with this instrument during the year ending June 30, 1881, to which the Report refers, was performed on sixty-eight nights, twenty-four of which were devoted to lunar photography, unfavourable weather, or bright moonlight is stated to have interfered on 125 nights, while eighty-two nights were occupied with the great influx of visitors to the Observatory, during the continuance of the Melbourne International Exhibition. Twenty-two nebulæ of Sir John Herschel's Catalogue were observed and sketched, with a new one, preceding No. 3705 by 1m. 7s., and 4′ 30″ south. The majority of the nebulæ observed agree well with Herschel's description, but Nos. 4502, 4510, and 5012 do not accord with his measures; 3430 is found to be much more suddenly condensed in the centre, and 3734 is much fainter than he describes. The nebula surrounding η Argûs was carefully compared on three occasions with drawings of 1875, but no decided change could be detected. During the year, 175 photographs of the sun were obtained showing a marked increase of spots and disturbances of the surface. The magnetical and meteorological work and progress of intercolonial meteorology are also subjects of the report. The Government had approved of the purchase of a new transit-circle more adequate to the requirements of the day than the existing instrument, and the necessary amount had been placed upon the estimates.

THE OBSERVATORY OF CORDOBA.—Dr. B. A. Gould, writing on December 22, mentions that the first volume of the Cordoba astronomical observations was finished, and he expected to forward it to Europe during the ensuing week. A meteorological volume would follow immediately.

THE GREAT COMET OF 1881.—The following places depend upon the last ellipse calculated by MM. Dunér and Engström of Lund:—

	At 12h. Berlin M.T. R.A. h. m. s.	Decl. ° ′
Feb. 11	0 10 15	+55 2·8
13	0 14 24	54 57·6
15	0 18 30	54 52·9
17	0 22 34	54 48·5
19	0 26 36	54 44·6
21	0 30 37	54 41·0
23	0 34 35	54 37·8
25	0 38 32	54 35·1
27	0 42 27	54 32·7
March 1	0 46 20	54 30·6

On the first date, the comet's distance from the earth will be 3·76, and on the last date 4·14, the earth's mean distance from the sun being taken as unity.

PROBLEMATICAL SUN-SPOTS.—As a somewhat similar case to that recorded by Sir William Thomson in last week's NATURE, we may recall an observation by Lichtenberg on November 19, 1762, described in a letter from his brother in Zach's *Allgemeine geographische Ephemeriden*, 1798, p. 260; the observation had been mentioned in Götting's *Taschenbuche* for 1787, p. 121. In Lichtenberg's diary he had entered the particulars as follows: On November 19, 1762, as, in company with a friend, v. Pöllnitz of Reinheim, he was journeying from Wurzburg towards Erlangen early in the morning, one of great cold and thick vapours, their attention was directed at sunrise, by the conductor of the vehicle, to something upon the sun's disk; he had not wholly risen in an unimpeded view, was of a blood-red colour, and, as usual, seemed magnified. Under these circumstances Lichtenberg says he saw with the naked eye, to his no small surprise, a dark, well-defined spot, the diameter of which he estimated at more than a twelfth of the apparent diameter of the sun: "etwas unter dem Mittelpunkte gegen den nördlichen Rand." It is added "Die vollkommen runde Gestalt und der völlig reine Ausschnitt liessen auch beim ersten Anblick schon etwas Anderes als ein gemeinen Sonnenfleck von seltener Grösse vermuthen. Er dauerte auch nicht lange, so sah ich deutlich, dass ich mich in meiner Meinung nicht geirrt hatte, denn der Körper hatte seine Stelle merklich verändert." The journey to Erlangen was hastened in the hope of arriving there before the egress of the spot, and on reaching the town Lichtenberg says he hurried to Prof. Arnold to secure confirmation of his observation, but although immediate steps with that object were taken, the body was found to have passed off the sun, which appeared round and spotless.

The brother who communicated these details to Zach, considered that in conjunction with a diagram, it followed that the object had described a chord of nearly 70° on the solar disk in about three hours; the direction being from the north limb towards the south.

GEOGRAPHICAL NOTES

THE French African traveller, M. de Sanderval, has returned to Paris from his expedition to Timbo. His principal object was to find the route which European travellers have searched for for more than a century, and which is destined eventually to become the main route by which civilisation will progress from the coast to the Upper Niger and the Soudan. During his first journey in 1879 M. de Sanderval obtained permission to construct a railway from the Iman of Timbo and grant of a district of 12,000 square kilometres. The maps and notes of the traveller will be presented to the Academy by M. de Lesseps.

AT the meeting of the Geographical Society on Monday last, Mr. Cuthbert E. Peek read a paper on the journey across Iceland which he made last summer in company with Mr. E. Delmar Morgan and Mr. J. Coles. Mr. Delmar Morgan afterwards gave an account of an excursion which he made by himself to Askja, the only Englishmen who have visited it before having been Messrs. Watts and Leek. The interest in Mr. Peek's expedition centres almost entirely in the fact that he had been entirely trained to the use of instruments, &c., at the Geographical Society under Mr. Coles, the instructor, and the result shows that the system adopted is useful and effective.

IN the Geographical Society's *Proceedings* this month, the only papers are those read at the meeting of January 16, and alluded to in our issue of January 26. The map on which the routes of Mr. Thomson and the Rev. C. Maples are laid down, is a useful contribution to the geography of East Africa. A note on Mr. O'Neill's journey in the interior of Mozambique dissipates all hopes which may have been formed that he had visited the snow-clad mountains there. Mr. O'Neill appears to have reached a point within sight of the lofty peak Namuli, said by natives to be capped with snow, but owing to clouds he could not verify this statement. Much useful information will be found collected together under the head of Père Duparquet's journeys in Ovampo-land. The remainder of this issue is largely devoted to foreign societies, among the reports of which will be found authoritative accounts of Dr. Stecker's work in Abyssinia, and Mr. Poliakof's in the Island of Saghalien.

IT is stated that Col. Prjevalsky intends shortly to start on another expedition to Tibet, and we hope that this time he may at length succeed in reaching Lhassa.

COL. VENIUKOF has furnished the French Geographical Society with some notes of Dr. Regel's new journey in Central Asia, principally in Karategin and Darwaz. His explorations commenced on the banks of the Macha, near the Zarafshan Glacier, whence he went first to Garm, the capital of Karategin, traversing the mountains by the Pakshif defile, and descending into the valley of the Kizil-su by the little river Sor-bokh. From Garm he went to Kela-Khumb, traversing on the way the valley of the River Wakish or Wakhia, and the Kamchirak, Sagridesht, and Khubu-rabat passes, the first of which is 9500 feet above the sea. Further on he followed the valley of the Oxus as far as the confluence of the Warij, which the natives

consider one of the two principal sources of the Amu-daria, the other being the Pianj. According to their statements the Aksu, which waters the Pamir, is an affluent of the Wanj, and does not fall into the Pianj near Kala Wamar, the affluent of the Pianj being called the Chuntuk-daria, which flows out of the Yashil-kul. In order to assure himself of the truth of these statements Dr. Regel followed the Wanj as far as Tesh-i-Senghi, and he found that the river contained abundance of water. He intended to spend the winter at Darwaz, in order to resume his explorations in the spring, and it may be hoped that he will succeed in solving the last remaining mysteries of the Pamir.

MR. S. E. PEAL'S account of his expedition in 1879 to the Nongyang Lake and to the pass over the Patkoi Range will be found, with map and panoramic sketches, in Part 2, No. 1, of the Bengal Asiatic Society's *Journal* for 1881.

THE following despatch has been received at the London office of the *New York Herald*:—"Irkutsk, February 1, 1882, 2.45 p.m. Our three boats left Semenofsky Island on the morning of September 12, bound for Barkin, ninety five miles distant. We got clear of ice at noon. Heavy gale from north-east, and boats dispersed during night; captain's boat, loaded deep, lost mast and sails. We made land on the evening of the 17th, shoal water. Boat abandoned two miles from beach; party waded and reached deserted village, Sagastor; 'cached' log books; proceeded south on the 19th. Delong's last record found reads as follows:—'Saturday, October 1st.—Fourteen of the officers and men of the *Jeannette* reached this hut on Wednesday, September 28, and having been forced to wait for the river to freeze over, are proceeding to cross to the west side this morning on their journey to reach some settlement on the Lena River. We have only two days' provisions, but having been fortunate enough thus far to get game in our pressing needs we have no fears for the future. Our party all well, except Ericksen, whose toes have been amputated in consequence of frostbites. Other records will be found in several huts on the east side of the river, along which we have come from the north.—(Signed) GEORGE W. DELONG.' Three subsequent records had been found. Ericksen died October 7; party in great distress for food. Noros and Nindemann sent ahead for relief, October 9. They marched south fifteen days, and were found in a starving condition, October 24, by three natives, who took them to a settlement. They could not make themselves understood. News of them reached us October 29. Immediate search commenced, and party traced to a wilderness on left bank of Lena. Natives refused further work, and return to Bulong; was necessary to get Russian assistance.—November 28.—A large party is now searching, having to dig out everything deeply covered with snow. The wilderness devoid of game. Very prompt and efficient action by Russians. Every effort is being made. Jack Cole's tranquil to-day; violent only at times; softening of brain. My left eye ruined, and right one badly impaired. Other men well. Jackson has telegraphed me from Orenburg.—JOHN DANENHAUER." Semenofsky Island is probably a small island marked Semenov in the map in the "Voyage of the Vega," on the north-west of Stobovoi Island in the New Siberia group. Barkin is on the north-east point of the Lena delta, where there is a winter tent. Sagastyr, where they landed, is at the mouth of the most northern branch of the Lena delta. The engineer Melville has made arrangements for a thorough search for the missing party, at once.

THE PRIZES OF THE PARIS ACADEMY OF SCIENCES

THE annual distribution of prizes at the Academy of Sciences took place on Monday February 6. M. Wurtz, president for the year 1881, was in the chair. The list of laureates was read by M. Dumas.

The prize of 240*l.* for any improvement in the French naval forces was awarded to M. Sébert for his apparatus for measuring the velocity of projectiles, and to M. Brault for his study of naval meteorology.

The Lalande Prize was awarded to Prof. Swift of Rochester, (U.S.) for the discovery of seven comets in the brief interval of four years. Another astronomical prize was awarded to Mr. D. Gill, director of the Cape Observatory, for his determination of the solar parallax by observations of Mars.

The prize in Physics was awarded to M. Planté for his accumulators, and the Commission records the wonderful experiment which was executed by this physicist when he obtained a tension of 1200 elements with two Bunsens. Amongst the other prizes which may present some special interest are the following:—M. Briot, for his work, "Sur les Fonctions Abeliennes"; M. Etienne Gilbert, "Étude sur les Philtres, Charmes, et Poisons." No prize was awarded for the question "to ascertain by direct observations and experiments the influence of exterior objects on the structure of vegetative organs," but a sum of 60*l.* was delivered to M. Mer to encourage him to work again at the same question which remains open for competition in 1882. One of the Monthyon Prizes was awarded to Dr. Favre for his work on Daltonism, and another to Dr. Paul Richer for a treatise on hystero-epilepsy. M. Collin took the interest of the Breant Prize for his work on "Epidemical Affections." This prize, originally destined for a remedy against cholera, amounts to 4000*l.*, and the interest is distributed every year, to avoid indefinite accumulation. A posthumous prize was awarded to M. Henri St. Claire Deville for his discovery of the law of dissociation. The rules forbid the Academy to give such an honour to any of its living members, and it is the first time on record that it has been given to a departed one.

When the long series of laureates was recited, M. Bertrand, perpetual secretary for the section of Mathematical Sciences, read the *éloge* of Leon Foucault, the inventor of the gyroscope, electric light regulator, siderostat, silvered glass telescopes, determination of velocity of light, &c. M. Leon Foucault was born in Paris in 1819, he died in the same city in 1868, and never travelled abroad. He was self-educated, having passed his honours only when already illustrious. M. Bertrand has written the preface to the collection of his scientific works, published in 1878 by his mother—a large 4to volume of 600 pages. M. Leon Foucault was besides a very active and successful writer, having been the scientific editor of the Feuilleton of the *Debats* for years. His successor is now M. de Parville.

INSTITUTION OF MECHANICAL ENGINEERS

THE Annual General Meeting of this Institution was held at the Institution of Civil Engineers, Great George Street, on January 26 and 27.

The Annual Report of the Council drew attention to the subjects of experimental research, of which some account has already been given in NATURE. With regard to riveted joints, it appears that a long and elaborate series of experiments have been carried on for the Committee by Prof. Kennedy, at the Engineering Laboratory, University College. These experiments dealt exclusively with steel plates and rivets, and were directed first to ascertain the constants of resistance to tension, shearing, &c., in mild steel, the knowledge of which is necessary in order to design the strongest form of joint, and secondly to test joints designed on the basis of the values thus discovered, as against other joints, made purposely to have an excess or defect in one or other of the areas through which fracture might take place. The work has been completely successful; the correctly-designed joints giving decidedly the best results, and thus affording a satisfactory verification of the value determined for the constants. The experiments have further brought out strongly the fact that joints in iron and steel must be designed in a very different manner to give the best results in each, the reason being that the shearing resistance of the rivets is about the same in iron and steel, while the tensile resistance is much higher in the latter than the former. Hence the deduction that manufacturers, who have been content simply to transfer to steel the rules they have been in the habit of using for iron, have thereby involved themselves in serious error.

With regard to the other subject, the hardening and tempering of steel, the Institution have just published some very interesting researches made for them by Prof. Abel, C.B., F.R.S., and also by Prof. Chandler Roberts, F.R.S. The former has shown, by the analysis of thin disks of hardened and unhardened steel, the high probability that in unhardened steel the carbon is present as a definite carbide of iron (probable composition Fe_6C_5), eliminated from the iron in a more or less crystalline form; that on heating, this compound is dissolved in, or assimilated by, the metal; and that sudden cooling does not allow time for the elimination to take place, the carbide thus remaining dissolved, more or less completely, and giving a corresponding degree of hardness to the mass. Prof. Chandler Roberts' researches bear on a suggestion which had been made, that the hardening of steel was connected with the occlusion and exclusion of gases by

the metal, in the process of heating and cooling. This he has shown to be unfounded, by heating steel (previously deprived of all occluded gas) to bright redness in a vacuum tube, and then plunging it in mercury, when it was found to harden just as usual. The same followed when a coil of wire was heated *in vacuo* by an electric current, to expel the gas, and then quenched in mercury.

The first paper read was by Mr. J. J. Tylor, on meters for registering small flows of water. The many forms of water meter in use are sharply divided into two classes: piston meters, in which the water is made to flow into a cylinder under a piston, and to escape when the cylinder is full, the number of cylinderfuls being measured; and inferential meters, in which the water is made to turn a fan of some kind, presumably at the same speed as that of the water itself, and the number of revolutions of this fan is measured. The latter class has often been supposed to be less reliable than the former, especially when the quantity passing is small; but the paper gives the results of several comparative experiments, which show that an inferential meter is at least as accurate as a piston meter for all except the very smallest flows, and that for these neither form is fully to be depended on. In practice, however, it is found that, even in small tenements, little or no water is drawn at so slow a speed as to render meters unreliable. Various tables were given showing the great advantages of the meter as detecting waste, the amount of which, under our present water system, is enormous. Good reason is given for believing that ten gallons per head per day in small houses, and fifteen in large houses, is an ample allowance for the real wants of the population; and yet twenty-seven gallons per head is the regular supply of the London water companies. This is probably the most gigantic specimen of organised waste in the world. The means of stopping it are well within the compass of science, and the expense would not be very great; but with the present anarchy in everything connected with metropolitan government, it is, we fear, hopeless to expect the matter to receive attention.

To prevent this waste it is not necessary (as Mr. Tylor pointed out in the discussion) to place a meter in every house. Although many Continental towns are supplied on that system, it would be difficult of introduction in London, and it may be questioned (as various speakers did question) whether it would be worth the expense. The "district meter" system practically accomplishes the same end without this difficulty. On this system a meter is connected with a train of clockwork and drum, so as to register the amount of water passed during successive intervals, say of ten minutes each. The consumption in the different districts of a town, each containing some hundred houses, is measured for 24 hours each, by simply placing the recording meter successively on the mains supplying them. If any of the diagrams thus obtained show special anomalies, the cause can be inquired into: for instance, if a district shows a large quantity of water passing in the small hours of the night, it is obvious that there is serious leakage somewhere; and the inspector proceeds to make a nocturnal tour, and to listen at the stopcocks of each house successively, by which means he can soon detect where the fault lies. In instances given by Mr. Tylor, the use of this simple plan had been effectual in reducing the consumption by fully one-half in particular districts. The system has been applied to the Houses of Parliament; and the consumption of water during some of the prolonged debates of last session has thus been recorded for the benefit of posterity.

The second paper was by Mr. A. A. Langley (engineer to the Great Eastern Railway), on the system of dredging introduced by M. Bazin, the celebrated hydraulician, on the rivers of France. Nothing can be more simple than this arrangement. An ordinary centrifugal pump is worked on board the dredger, and a flexible pipe leads from the pump to the bottom of the water, where it terminates in an elbow-shaped nozzle. The sand and gravel is sucked up the pipe, passes through the pump, and is conveyed along an open channel to the side of the dredger, where it falls into a hopper barge or is otherwise disposed of. On this system the water pressure, as will be seen, is used to facilitate the raising of the sand to the surface; whereas in all other dredgers it is a hindrance rather than otherwise. It thus forms an excellent adaptation of scientific principles; and though not applicable for clay or hard ground, is much cheaper and more rapid than other forms in the removing of sand and shingle. It has also the great advantage that it can be worked in rough water, since a moderate rise and fall of the vessel does not affect the flexible pipe.

There is another point of interest in connection with this dredger. When first started at Lowestoft it was found impossible to make it work with anything like speed or economy, owing to the rapid wear of the cheeks and blades of the pump, which were cut by the sand exactly as glass is cut in the sand-blast process. After many trials the evil was stopped by the simple process of protecting the blades of the fan by pieces of thick india-rubber, which from its softness and elasticity yields to the cutting action, and thus escapes much injury itself, while it prevents all injury to the cheeks. This peculiar property of india-rubber has, we believe, been previously utilised in connection with the sand-blast process, but it has never been adopted on so large a scale, and it certainly deserves to be very widely known.

In the course of the discussion Mr. Charles Ball, who has worked a large number of these dredgers, mentioned that he had forced sand thus dredged for a distance of 600 yards through horizontal pipes, by the mere action of the pump. To prevent the silt from settling during its passage along open troughs, he had inserted a light angle iron in an undulating line along the inside of the trough, so as to give the water a continual twisting motion as it travelled onwards. The great difficulty was to prevent the water from ceasing to flow, either from the sand accumulating above the pump, or from old sacks and other rubbish choking the nozzle. The former was got over mainly by making the discharge-pipe horizontal, and giving it a siphon bend, which kept the water always within it, and prevented any difficulty in starting the pump; and the latter by making openings in the nozzle, just above the grating, which were covered by an indiarubber band having slits in it. When the grating got choked and a vacuum began to form inside the nozzle, these slits opened to the pressure, and allowed the water to flow in.

The third paper was by Mr. E. B. Ellington, on hydraulic lifts for passengers and goods. The risks which attend the use of ordinary chain lifts were minutely described, and also the way in which these are removed by the use of direct acting hydraulic lifts, in which the cage rests on the top of a column of pressure-water, both in ascending and descending. The chief difficulty with such lifts is to balance the dead weight of the cage and attachments, so as to save the needless expenditure of power in raising these each time; and an ingenious arrangement of hydraulic cylinders is described, by which this is attained without the use of counter-weights or chains. A table of experiments on lifts of this and other types is given, which shows the efficiency to be very high, ranging from 75 to 80 per cent. The discussion on this paper was adjourned, for want of time, to the next meeting.

THE CHEMISTRY OF BAST FIBRE[1]

IN a previous paper (see *Chem. News*, 43, 77, and *Chem. Soc. Jour.* xxxviii. 666) the authors established the following points:—The chemical similarity between the non-cellulose constituents of monocotyledonous and dicotyledonous fibres; the resolution of the jute fibre by chlorine into cellulose (using this word in a general sense), and the chloroderivative of an aromatic body, $n\{C_{19}H_{18}Cl_4O_9\}$; all bast fibres examined (flax, hemp, manilla, esparto, &c.) yielded a similar body; the reactions of this substance suggested the hypothesis that it was a complicated derivative of tetrachlorquinone; jute fibre was resolved by boiling dilute hydrochloric or sulphuric acid into a soluble carbohydrate and an insoluble compound of the aromatic body with the more stable form of the cellulose; dilute nitric acid resolves the fibre into cellulose and a nitroderivative of the aromatic constituents $n\{C_{25}H_{31}(NO_2)O_{23}H_8\}$; no constituent of the nature of pectose was found. From these facts the authors drew the conclusion that jute fibre consists of cellulose intimately associated with a complicated body allied to the quinones, in fact, a *cellulide* after the type of the glucosides, the aromatic body being united to cellulose in place of glucose. They also observed that the chlorinated body, when treated with a solution of sodium sulphite, develops a magnificent purple colour; this reaction was applied for the detection of bast fibres. In the present paper the authors have continued this line of research. To the aromatic constituent of the jute fibre the authors assign the formula $C_{19}H_{22}O_9$. The resemblance of this formula to that of catechin, $C_{19}H_{18}O_8$, $3H_2O$, suggested a comparative investigation of the latter substance; both catechin and catechu-

[1] Abstract of papers by C. F. Cross and E. J. Bevan at the Chemical Society, January 19.

tannic acid yielded a chlorine derivative resembling that mentioned above, which gave a brilliant magenta colour with sodium sulphite. Moreover, from a specimen of jute fibre which had become rotten through shipment in a damp state, a body was extracted having all the properties of a tannin. Esparto resin, when fused with potash, furnished phloroglucin and much protocatechuic acid. The general identity of these non-cellulose constituents with the class of astringent substances or tannins is thus fully established.

The authors then give details as to the bromine and chlorine compounds obtained from Esparto resin; they next investigate the action of caustic alkalies on the chlorine derivative $C_{18}H_{18}Cl_4O_9$ of jute-fibre, by which action two atoms of chlorine were removed, as is the case with chloranil. By the action of bromine on jute-fibre a brominated compound was obtained similar to that from Esparto resin. As regards the constitution of these derivatives the authors are inclined to believe that their molecule is built up round chloranil as a centre. Chloranil, when boiled with sugar, forms a brown substance which behaves with alkalies and chlorine exactly like the aromatic substance obtained from bast fibres.

The authors next consider the wider problem of the relation of the cellulose to the non-cellulose constituents of bast-fibres and the relation of both to the life of the plant. In these points they have been anticipated by the investigations and inferences of the physiological botanists Sachs, Sachsse, &c., who have stated that cellulose is directly derived from starch or its physical equivalents sugar, fat, or inulin, and is not a product of the resolution of a proteid molecule; this formation of cellulose is attended with the evolution of carbonic anhydride. The chemical changes are expressed by Sachsse thus:—

$$n(C_{36}H_{60}O_{30}+_{30}O)=n(_{30}CO_2+_{24}H_2O+C_6H_{12}O_6);$$

the molecule $nC_6H_{12}O_6$ is then transformed into substances having the atomic ratio $C_6H_{10}O_5$. The formation of cellulose usually occurs in those portions containing no chlorophyll; the formation of starch, on the other hand, is associated with the presence of chlorophyll and the evolution of oxygen. The lignification of fibres originally consisting of pure cellulose is held by Sachs to be a modification of the cell-substance (cellulose), and not an infiltration of substances from the contents of the cell. This change is expressed by Sachsse thus:—

$$\underset{\text{Cellulose}}{C_{24}H_{40}O_{20}}=5H_2O+\underset{\text{Lignin}}{C_{18}H_{24}C_{16}}+C_6H_6O_5.$$

Sachsse thinks that it is to this more highly oxidised molecule $C_6H_6O_5$ that the origin of the tannins is to be referred. The authors dissent from this equation, and think that bodies resembling metapectic acid $C_8H_{14}O_9$ are formed. Such bodies have been found by Kolbs in linen-fibre, and by the authors in the portions of the jute-fibre near the roots (jute-cuttings). Sachs maintains that the tannins are degradation products of cellulose and are to be looked upon as excreta, like urea in the animal. If now the extreme terms of the developmental series are the cellulose and the tannins, it devolves upon the chemist to investigate the intermediate stages of the transformation. The authors therefore treated jute fibre with dilute (5 per cent.) sulphuric acid at moderate temperatures; as a result of these experiments they conclude that the jute fibre consists for the most part not of cellulose, but of a transition form between the original carbohydrate and its ultimate modification of a soluble astringent. To this transitional modification the authors give the name of *bastose*, as the authors consider there are many celluloses, so also there will be many forms of bastose. The aromatic derivatives derived from these bastoses the authors propose to call *bastins*. The authors then adduce various arguments to prove that the conversion of carbo-hydrates into aromatic bodies is possible. Thus Hoppe Seyler, by heating starch to high temperatures with water, formed pyrocatechin. Gun-cottons or nitrocelluloses degrade spontaneously into bodies of the pectic class, and the authors, by the action of strong sulphuric acid on dextrin at 7 per cent., obtained a black substance which furnished a chlorinated product resembling in its properties the chlorobastin previously described. The formation of the black substance was accompanied with that of acetic and carbonic acids. The authors conclude the paper with the results of several miscellaneous researches bearing on the subject. The stony concretions of pears can be converted into cellulose, and a chlorobastin giving the colour reaction with sodic sulphite. The origin of tannins, the reactions of jute substance under high pressure, the reduction of indigo by jute, the reaction of linseed oil with sulphuric acid, and additional observations on the chlorobastins, are the titles of these miscellaneous researches. The authors finally embody their results in a diagrammatic survey or genealogical tree: Carbonic anhydride and water, by the action of light, protoplasm and chlorophyll, form starch; starch and oxygen during the growth of the plant give off CO_2 and H_2O, pectin and cellulose being formed. The starch passes through bastose to bastin. Bastose can be split up in various ways by chlorine into cellulose and chlorobastin, by dilute sulphuric acid into furfurol, acetic acid, &c., and tannins (insoluble) by decay into pectic acid, and tannins (soluble) by nitric acid into cellulose and a nitro body. Bastin, by fusion with KHO, furnishes phloroglucin and protocatechuic acid, and by chlorination carbonic acid and chlorobastin.

NOTES FROM THE OTAGO UNIVERSITY MUSEUM

I.—*On a New Method of Preserving Cartilaginous Skeletons and other Soft Animal Structures*

ON reading Professor Miall's account of the employment of glycerine jelly for the preservation of anatomical preparations (NATURE, vol. xviii. p. 312), it occurred to me that many of the more solid and less complicated structures, usually kept in spirit, might possibly be preserved by thoroughly impregnating them with glycerine jelly and then allowing them to dry. I was able to make very few experiments in this direction before leaving England, but during the present year I have tested the method I am about to describe enough to make me feel tolerably confident in recommending it as of especial value for cartilaginous and partially ossified skeletons, and useful also for such things as hearts, stomachs, and other viscera, and for the exoskeletons of Crustacea, Echinoderms, &c.

I will first describe the method adopted in preparing the skeleton of a fresh Elasmobranch. The fish is eviscerated, the gills removed and placed in strong spirit, and the body plunged into water a few degrees below the boiling point. An immersion varying from a few seconds to a few minutes serves to soften the muscle and connective tissue to such an extent that they can readily be stripped from the cartilage without injury to the latter. This I find the only satisfactory way of cleansing many parts of the elasmobranch skeleton, notably the vertebral column. In the case of the gills even a momentary immersion in hot water is liable to cause a separation of the cartilages; they are therefore best prepared in the cold, after the ligaments have been well hardened with alcohol. After the remainder of the skeleton is cleansed it may either be put through the preserving process at once, or previously hardened in alcohol—the latter alternative is the best, since it diminishes subsequent shrinking, but it is not essential and may very well be dispensed with in the case of large skeletons, for the sake of saving the otherwise large expenditure of alcohol. I need hardly say that it is always advisable to separate the skull from the vertebral column, the pectoral fin from the shoulder girdle, &c., as in this partially disarticulated condition the skeleton is more easily manipulated, besides being more convenient for future use. In the case of large sharks it is also necessary to divide the vertebral column into pieces small enough for the vessel used in the preserving process.

The various parts of the skeleton, with or without previous hardening in alcohol, are then placed in "glycerine fluid" of the following composition:—

Glycerine	1 litre.
Water	1 ,,
Alum	20 grm.
Corrosive sublimate	10 ,,

This fluid is a modification of Wickersheimer's, the chief alteration being the omission of alcohol: the alum may also be omitted if the specimen has been hardened with alcohol. After remaining in the fluid until thoroughly permeated—two days to a week, according to size—the skeleton is transferred to the following glycerine jelly:—

Gelatine	150 grm.
Glycerine	1 litre.
Water	1 ,,
Corrosive sublimate	10 ,,

The jelly is kept at a heat just sufficient to melt it, in an earthenware vessel (neither the glycerine fluid nor the jelly should be allowed to come in contact with metal), over a water

bath, and the specimen is retained in it for about three or four days. It is of course advisable to have vessels of various sizes, so as not to use more jelly than is absolutely necessary. I find that a small pudding-basin, a vegetable-dish, a soup-tureen, and an earthenware foot-bath form a very useful set of vessels; a galvanized iron wash-tub serving as an excellent water bath. For ordinary purposes I use gelatine-glue instead of pure gelatine, the former being only one-fourth the price of the latter. Phenol may be substituted for corrosive sublimate.

After removal from the glycerine the specimen is thoroughly drained, and placed in a dry room protected from the dust. Such parts as the vertebral column, the fins, and, in most cases the skull may be left to dry without further care, but thick or strongly curved structures, such as the jaws and shoulder girdle, should be fastened out while drying with strappings of tape, small wooden or cardboard supports, &c., as otherwise a certain amount of twisting is inevitable.

When no more shrinking or "buckling" is perceptible—it is generally advisable to allow some weeks for this—the specimen is varnished with a solution of white shellac in rectified spirit. This should be done in a warm room, as the slightest damp produces precipitation of the shellac. After two or three coats of this varnish the cartilage is found to have a dry and smooth but not too glossy surface.

In mounting the skeleton the best way is to support each part separately on a light wire cradle, so that it can at any time be removed for examination. If it is found necessary to articulate any of the parts, it is advisable to use platinum wire.

In preparing the chondrocranium of Teleostei (*e.g.* Salmo) it is again advisable to have recourse to parboiling: the membrane bones can then be easily removed and the cartilaginous brain-case, Meckel's cartilages, and the branchial arches prepared as above. Skeletons of earlier mammalian fœtuses must be put through the process *in toto*, the chief disadvantage of this method being that the bones, being impregnated with gelatine, never become very white. In later fœtuses the epiphyses of the long bones and other cartilages are readily removed, and may then be prepared separately. In disarticulating mammalian skulls it is a good plan to remove the mesethmoid and prepare it in the above method, thus preserving an important part of the skull which the student, as a rule, never sees unless he takes the trouble to dissect it out for himself.

Up to the present time my two assistants—to whose care and patience it is only right that I should express my indebtedness—have prepared entire skeletons of Carcharodon, Cestracion, Raja, Ceratodus, and calf fœtus, chondrocrania of Alopecias, Acanthias, Salmo, and Petromyzon, and mesethmoid of the sheep. Some of these have now been prepared for several months, and the small amount of shrinkage may be gathered from the fact that an entire skeleton of Ceratodus lost only 1-36th of its length, and that the membrane bones of the Trout, which were separated from the chondrocranium before the preparation of the latter, fitted afterwards into their places with great accuracy. I have not yet, however, been thoroughly successful with the jaws of the Elasmobranchs, as hitherto there has always been a slight cracking of the superficial calcareous crust, which in the jaws is much thicker than elsewhere; but as this is sometimes seen, to a slight extent, even in spirit specimens, I do not at present see how to prevent it entirely. With purely cartilaginous structures the success of the method is very marked: for instance, the gill-arches of Cestracion and of Raja, prepared with the delicate branchial rays, and in the former genus, the extra-branchial cartilages have, after several weeks, their flexibility and translucency unimpared.

Other organs, for the preservation of which I have found this method successful, are hearts, stomachs, intestines, &c. Even the entire alimentary canal with the liver spleen and pancreas of, for instance, a skate, may be prepared with a tolerable amount of success. All these soft parts must, of course, be first thoroughly hardened with alcohol or chromic acid. I have also obtained a fairly good preparation of the skate's brain *in sitû* with the intracranial portions of the cerebral nerves, but as far as my present experience goes, I hardly think that my method is likely to be as successful as Giacomini's for brains (*Journ. of Anat. and Phys.*, January, 1879).

I may mention that I have tried a modification of Giacomini's method for cartilaginous skeletons, but hitherto have not found it so successful as the glycerine jelly process.

I have had some little success in preserving Crustacea, Echinoderms, &c., so as to retain their natural colour and flexibility, but further experiments are wanted in this direction. I have also made one or two attempts to apply the method for the preparation of skins of fishes, amphibia and reptiles for stuffing: the few experiments already made show a distinct improvement upon the ordinary dried skins, both in the preservation of the natural colour and in the diminution of shrinking. Some modification of the process may possibly be useful for the wattles, &c., of birds. In spite of the obvious objections to stuffed specimens, they could be ill-spared in a public museum, neither skins nor spirit specimens being suited to replace them, and it would certainly be an advance in museum technique, if, for nstance, the ordinary brown, shrivelled, and highly varnished pecimens of fishes could be replaced by something a little more life-like.

T. JEFFERY PARKER

Dunedin, N.Z., November 3rd, 1881

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—In a Convocation held on February 7 the sum of 250*l.* was voted to the Linacre Professor for apparatus for the Physiological Laboratory.

Dr. T. K. Chambers, Christchurch, has been nominated to represent the University in the General Council of Medical Education in place of the late Prof. Rolleston.

The Curators of the Bodleian library have elected Mr. E. W. B. Nicholson, M.A., of Trinity College, as Bodley's Librarian in place of the late Mr. Coxe.

The Examiners for the Burdett Coutts Geological Scholarship have given notice that the examination will be held on Monday, February 27 and three following days, at 10 a.m. The scholarship is tenable for two years, and is open to all members of the University who have passed the necessary examinations for the degree of B.A., and shall not have exceeded their twenty-seventh term.

SCIENTIFIC SERIALS

Journal de Physique, January.—On the limits of electrolysis, by M. Berthelot.—Note on Prof. Clerk Maxwell's memoir on the theory of maintenance of electric currents by mechanical work without using permanent magnets, by M. Brillouin.—Experimental researches on Purkinje's phenomenon, by MM. Macé de Lepinay and Nicati.—Varnish for writing on glass, by M. Crova.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol. xiv. Fasc. xviii.-xix.—Zoological annotations, by Prof. Pavesi.—On protistological analysis of drinking water, by Prof. Maggi.—Another case of a single kidney in man, with incomplete development of the spermatic vesicle and the prostate on the defective side, by Prof. Sangalli.—Vines and their enemies in 1881, by Prof. Garovaglio.—On some fossils of the Upper Jurassic found in the western Venetian Alps, by Dr. Parona.—Experimental researches on the physiological and therapeutic action of cocaine, by Prof. Morselli and Dr. Buccola.—Reduction of integrals of algebraic functions to integrals of rational functions, by Prof. Formenti.—The double quadratic transformation of space and its application to the non-Euclidian geometry, of space, by S. Aschieri.

Fasc. xx.—Reports on works presented and on prize competitions, also announcement of prize subjects.

Atti della R. Accademia dei Lincei, vol. vi. fasc. 3.—New series for expressing the heliocentric coordinates in function of the mean anomaly, by S. de Gasparis.—Contribution to the anatomy of leaves, Part II., by S. Briosi.—On the present regression of glaciers of the Alps, by S. Stoppani.—Reports on prize competitions. The royal prize in biology (10,000 lire) is divided between Prof. Mosso and Prof. Trinchese, the work of the former being sphygmographic researches on the circulation of the blood in the human brain; and that of the latter on Italian maritime fauna (describing several new species), and on the early development of mollusca. The Royal prize in mineralogy and geology (10,000 lire) is awarded to Prof. Taramelli, for a work on the geology of the Venetian province. In physical science Prof Poloni is awarded a prize of 1500 lire, for a memoir on the permanent magnetism of steel at different temperatures.—The salient features of these and other memoirs are noted.

Vol. xi. fasc. 4.—Researches on movements of the intestine, by Signori Mosso and Pellacani.—On the action of halogenated

organic radicals on the potassic compound of pyrol, by Signori Ciamician and Dennatedt.—Contributions to the anatomy of leaves (continued), by S. Briosi.—On linear differential equations, by S. Casorati.

La Natura, January, 1882.—Considerations on some relations between the velocity of efflux, the specific heat, and the mean squares of the molecular velocity of gases, by Dr. Nachs.—On the rapidity with which light modifies the electric resistance of selenium, by Prof. Bellati and Dr. Romanese.—On the products of electrolysis of various acid and alkaline solutions, with graphite electrodes, by Dr. Bantoli and Regrasogli.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 8.—"The Vibrations of a Vortex Ring, and the Action of Two Vortex Rings upon each other." by J. J. Thomson.

The first part of the paper contains a discussion of the vibrations which can occur in the figure of a vortex ring, whose cross-section is small compared with its aperture. It is proved that if the equations to the circular axis of a vortex ring are—

$$\rho = a + a_n \cos nt$$
$$z = \beta_n \cos nt$$

ρ being the distance of a point on the circular axis from the straight axis, and z the distance of the point from the mean plane of the circular axis, then—

$$a_n = A \cos\left(\frac{\omega e^2}{2a^2} \log \frac{2e}{a}\, n \sqrt{n^2-1}\, t + B\right)$$
$$\beta_n = A \frac{\sqrt{n^2-1}}{n} \sin\left(\frac{\omega e^2}{2a^2} \log \frac{2e}{a}\, n \sqrt{n^2-1}\, t + B\right)$$

where ω is the angular velocity of molecular rotation, and e the the radius of the cross-section of the vortex core; e is small compared with a.

Thus the time of vibration for such a displacement in the circular axis is—

$$2\pi / \frac{\omega e^2}{2a^2} \log \frac{2e}{a}\, n \sqrt{n^2-1}$$

or if T be the velocity of the vortex—

$$= 2\pi a / Tn\sqrt{n^2-1}$$

This shows that a vortex ring with small cross-section of core is stable for all displacements of its circular axis. Sir W. Thomson has proved that it is stable for all alterations in the shape of the cross-section of its core.

The second part of the paper contains an investigation of the action of two vortices upon each other when the shortest distance between them is large compared with the diameter of either of the vortices. The amount of the disturbance each vortex experiences is worked out in the paper, but it may be sufficient to quote here the general effect of the collision which is given by the following rule:—the vortex which first passes through the point of intersection of the direction of motion of the two vortices is deflected towards the direction of motion of the other, it increases in radius and energy, and its velocity of translation is diminished, the other vortex is deflected in the same direction as the first, it diminishes in radius and energy, and its velocity of translation is increased.

"On Melting Point." By E. J. Mills, D.Sc., F.R.S. (Abstract.)

The author gives a list of twenty-three aromatic compounds, the melting-points of which he has determined in terms of the air thermometer. The average probable error of a single result is about 0°·015. The numbers obtained, which range from 42° to 121°, obviously represent a set of thermometric standards, free from most of the grave inconveniences presented by the ordinary mercury-glass thermometer. In some cases they are shown to be proportional to the numerical value of the formula, a law which, it is suggested, may be in the limit the real law of melting-point. The original memoir contains a full description of apparatus and methods.

Royal Society, January 12.—"On the results of Recent Explorations of Erect Trees containing Reptilian Remains in the Coal Formation of Nova Scotia," by J. W. Dawson, C.M.G., LL.D., F.R.S., &c.

The explorations referred to were carried on chiefly in the beds at Coal Mine Point, South Joggins, Nova Scotia; and their object was to make an exhaustive examination of the contents of erect trees found at that place and containing remains of Batrachians and other land animals.

A detailed section is given of the beds containing the erect trees in question, with lists of their fossil remains. The most important part of the section is the following:—

	Ft.	In.
Sandstone with erect *Calamites* and *Stigmaria* roots	6	6
Argillaceous sandstone, *Calamites*, *Stigmaria*, and *Alethoptiris Cuchitica*	1	6
Gray scale, with numerous fossil plants, and also *Naiaidites*, *Carbonia*, and fish scales	2	4
Black coaly shale, with similar fossils	1	1
Coal, with impressions of *Sigillaria* bark	0	6

On the surface of the coal stand many erect *Sigillaria*, penetrating the beds above, and some of them nearly three feet in diameter at the base and nine feet in height. In the lower part of many of these erect trees there is a deposit of earthy matter, blackened with carbon and vegetable remains, and richly stored with bones of small reptiles, land snails, and millipedes. Detailed descriptions of the contents of these trees are given, and it is shown that on decay of the woody axis and inner bark they must have constituted open cylindrical cavities, in which small animals sheltered themselves, or into which they fell and remained imprisoned. These natural traps must have remained open for some time on a sub-aerial surface.

In all twenty-five of these erect trees had been discovered and extracted, and the productive portions of them preserved and carefully examined. Of these fifteen had proved more or less productive of animal remains. From one no less than twelve reptilian skeletons had been obtained. In a few instances not only the bones, but portions of cuticle, ornamented with horny scales and spines, had been preserved.

The Batrachians obtained were referred to twelve species in all. Of these two were represented so imperfectly that they could not be definitely characterised. The remaining ten were referable to the two family groups of *Microsauria* and *Labyrinthodontia*.

The *Microsauria* are characterised by somewhat narrow crania, smooth cranial bones, simple or non-plaited teeth, well-developed limbs and ribs, elongated biconcave vertebræ, bony scales and plates on the abdomen, and horny scales, often ornate, on the back and sides. They show no traces of gills. The species belonging to this group are referred to the genera *Hylonomus*, *Smilerpeton*, *Hylerpeton*, and *Fritschia*. The characters of these genera and of the several species are given in detail and illustrated by drawings and photographs, including microscopic delineations of the teeth of all the species, with their internal structure and the microscopic structure of their bones, as well as representations of their cuticular ornamentation and armour.

The Labyrinthodonts are represented by only two species of *Dendrerpeton*, which are also described and delineated.

About half of the reptilian species described are new, and those previously described from fragmentary remains are now more fully characterised, and their parts more minutely examined.

The invertebrate animals found are three species of land snails and five of myriapods, besides specimens supposed to represent new species of myriapods and insect larvæ, not yet fully examined, and which have been placed in the hands of Dr. Scudder, of Cambridge, U.S.

The memoir, consisting in great part of condensed descriptions of the facts observed, does not admit of much abridgment, and cannot be rendered fully intelligible without the accompanying plans, sections, and drawings. It closes with the following general statement:—

"The negative result that, under the exceptionally favourable conditions presented by these erect trees, no remains of any animals of higher rank than the *Microsauria* and *Labyrinthodontia* have been found deserves notice here. It seems to indicate that no small animals of higher grade inhabited the forests of Nova Scotia at the period in question; but this would not exclude the possibility of the existence of higher animals of a larger size than the hollow trees were capable of receiving. Nor does it exclude the possibility of higher animals having lived contemporaneously in upland situations remote from the low flats to which our knowledge of the coal formation is for the mo t part confined. It is to be observed also that as some of

the reptilian animals are represented only by single specimens, there may have been still rarer forms, which may be disclosed should other productive trees be exposed by the gradual wasting of the cliff and reef."

Physical Society, Jan. 28.—Dr. Stone, in the chair.—New Member, Mr. W. Lant Carpenter.—Mr. T. Wrightson read a paper by himself and Prof. W. Chandler Roberts, F.R.S., on the fluid density of metals. The results were obtained by the process described in a former paper to the Society, on the fluid density of bismuth. The mean results were for copper, 8·217; lead, 10·37; tin, 7·025; zinc, 6·487; silver, 9·51; iron (No. 4 Foundry, Cleveland), 6·88. These results are slightly less than those given by Mallet's process, but they are sufficiently close. For bismuth the fluid density found by the authors is 10·055, which is slightly more than that given by Mallet's method (9·82). The authors consider their method satisfactory. It consists in suspending a ball of the solid metal from a spiral spring, and allowing it to dip into a crucible of the same metal in a molten state. The movements of the spring as the ball melts are recorded by a pencil on a band of travelling paper.—Mr. C. Vernon Boys read a paper on apparatus for calculating efficiency. The object of such machines is to automatically divide and continuously record the quotient of the speeds with which two things are turning. If the two things are the records of two of Boys' integrating machines (previously described to the Society), one finding work put into, and the other work sent out from any combination of mechanism, then the quotient gives the efficiency of the combination. If one measures work or current, and the other time or turns of a machine, the quotient measures the value of horse-power per hour or current per turn. Mr. Boys described four machines of the kind acting on two principles, from which he names them logarithmic and harmonic dividers. They all derive their actions from motions of pure rolling The simplest is made by hanging a magnetised steel reel on to a pair of iron cones, which are turned by integrators. The reel travels about and continuously shows the value of the quotient.—Mr. Boys then read a paper on a *new current meter*. The rate of a pendulum clock depends on gravity, and is proportional to the square root of the strength of gravity. That of a watch depends on the strength of the hair-spring, and is proportional to the square root of its strength. The force due to an electric current is proportional to the square of the current strength. Hence if part of an electric circuit is capable of vibrating under electromagnetic force, the speed of vibration will be proportional simply to the current strength, for the square of the speed measures the force, and the force is proportional to the square of the current. If, then, such a contrivance takes the place of the balance of a pendulum-clock, the clock will measure electric currents instead of time. To keep the indications true, the maintaining power must be so contrived that the amplitude does not vary much, or the parts must be so arranged that the force is directly proportional to the displacement. Mr. Boys showed several ways of producing a controlling power. The first was a combination of solenoids, one passing through the other, and in which the force was proportional to the displacement. Being without iron, it applies to the case of alternating currents. In another a small armature is mounted on the balance staff, and around it are the two poles of an electromagnet, which forms part of the circuit. In a third form, which is unaffected by residual magnetism, two crescent-shaped pieces of iron forming the sides of the balance pass through two fixed solenoids. In all these cases the direction of the current does not matter. The maintaining power may be any ordinary escapement drawn in the usual way. It may also be independent of clockwork, an impulse being given to the balance electrically at each swing. A meter of this kind was shown in which the controlling power depends on iron crescents and solenoids, and in which a portion of the main current is shunted through secondary solenoids when the balance is in its neutral position; at which time a variation in the currents in the controlling solenoids has no effect in disturbing the period of oscillation. Such a meter is regulated by an adjustible weight, if it goes too fast or slow. Being independent of gravity it will work equally well anywhere. Prof. John Perry thought Mr. Boys' devices very promising, and mentioned that Prof. Ayrton and he had invented a very simple current meter not yet described. Dr. Coffin pointed out that electric clocks of a certain class were really current meters. Prof. Guthrie remarked that in Mr. Boys' meter practically no work was taken from the current. Reference was made by Dr. Stone and Mr. Lecky to Hipps' clocks, the latter testifying to their efficiency.—Capt. Abney, R.E., then exhibited some experiments on the phenomenon of phosphorescence. Balmain's luminous paint, calcium sulphide, and other substances give out a violet light after having been excited by daylight. Capt. Abney found that when the spectrum was allowed to fall on an excited surface of Balmain's paint the blue rays enhanced this violet light, and the red end of the spectrum extinguished it. This was shown to the meeting, and the red end of the spectrum appeared on the paint in well-defined black bands. Similarly, the light from an electric lamp passed through a sheet of red glass extinguished the phosphorescence. Capt. Abney's researches further showed that there is a series of octaves in the blue end of the spectrum which refuse to quench the violet light. He found the mean wave-length of the rays exciting the phosphorescence to be 4300. Prof. Guthrie also showed that calcium sulphide tubes glow in violet light.

Anthropological Institute, January 10.—Major-General Pitt-Rivers, F.R.S., president, in the chair.—Hugh Felvey and Mrs. Bathoe were elected Members of the Institute.—Mr. Bryce-Wright exhibited a series of sixteen portraits of the Incas, copied from the originals in the Temple of the Sun.—Mr. Worthington G. Smith exhibited some stone implements from the north-east of London.—General Pitt-Rivers, F.R.S., read a paper on the entrenchments of the Yorkshire Wolds, and excavations in the earthwork called Dane's Dyke, at Flamborough. At Dane's Dyke the author had found flints and flint flakes, clearly proving that the constructors and defenders of the earthwork used flint, and lived not later than the bronze period. The whole district was the scene of the operations of a people much earlier than the Danes, and therefore the term "Dane's Dyke" was a misnomer.—In the absence of the author the Director read a paper by Mr. J. R. Mortimer, on the discovery of ancient dwellings on the Yorkshire Wolds.

Institution of Civil Engineers, January 24.—Mr. Brunlees, vice-president, in the chair.—The paper read was on "The Analysis of Potable Water, with special reference to the determination of Previous Sewage Contamination," by Mr. Chas. W. Folkard.

SYDNEY, N.S.W.

Linnean Society, November 30, 1881.—Dr. J. C. Cox, president, in the chair.—The papers read were: By the Hon. Secretary, for Baron F. von Mueller, K.C.M.G., on two new species of New South Wales plants.—By J. J. Fletcher, M.A., B.Sc., on the existence after parturition of a direct communication between the median vaginal cul-de-sac, so called, and the uro-genital canal in certain species of kangaroos.—By the Hon. William Macleay, F.L.S., on two new species of snakes from the western interior of New South Wales. Mr. Macleay stated that these new species had been discovered by Mr. James Ramsay, of Tyndarie, near Bourke; they were a new species of *Diemenia*, which it was proposed to call *D. ferox*, and a new species of the genus *Aspidiotes*, named *A. Ramsayi*, after its discoverer.—By the Rev. Wm. Woolls, Ph.D., on the flora of New South Wales, being the sixth paper on this subject by this well-known botanist.—On the Cypreæ of New Caledonia, by Mr. J. C. Rossiter, of Numea, N.C.; communicated through Mr. John Brazier, C.M.Z.S.—On a new species of *Therapon*, *T. Macleayana*.—On two new birds from the Solomon Islands: (1) a kingfisher, *Halcyon salmonis*, allied to *H. chloris*, but without the white nape patch or superciliary stripe; and all the under surface white, the under-wing coverts white, the upper surface of a much brighter blue; (2) a Rhipidura, *R. tenebrosa*.—On the habitats of *Pachycephala olivacea* and *Pycnoptilus floccosus*, and their occurrence near Sydney, by Mr. E. P. Ramsay, F.Z.S., C.M.Z.S., Curator of the Australian Museum.—Exhibits—Mr. Ramsay exhibited specimens of the following new and rare birds from the Island of "Ugi," in the Solomon groups:—1. *Ptilopus Eugeniæ*, Gould. (2) *Ptilopus Lewisi* (Ramsay), similar to *P. Eugeniæ*, but without the white head. 3. *Ptilopus Richardsii* (Ramsay), a very remarkable species, having the head, neck, and breast of a light french grey, tinged slightly with pale olive yellow, the crown is of a very pale lilac, the scapulars beautifully painted with rose down the centre of each feather. 4. *Ptilopus Johannis* (Sclater), said to be identical with *P. ceraseipectus* of Canon Tristram, and of which *P. solomonensis* of Gray is the female. 5. *Chalcophaps mortoni* (Ramsay) resembles *C. chrysochlora*, but has no shoulder patch, and is larger. 6. *Trichoglossus* (*Charmosyne*) *Margarethæ* (Tristram), male and female, the female alone being previously

known, the male differs in having no yellow on the sides of the uropygium, this part being crimson, like the flanks and belly. 7. *Nasiterna finschi* (Ramsay), males and females; the male is distinguished by having a stripe of red down the abdomen, and the feathers round the lower mandible more distinctly tipped with blue; *Rhipidura tenebrosa* (Ramsay) being of a dull olive brown, with a few white-tipped feathers on throat and sides of the head.—Dr. J. C. Cox, F.L.S., exhibited several specimens of wood carvings from the Solomon Islands; also two drills used by the natives of Rubiana in building their canoes, and a fish-trap made of cordage, used by the natives of the same island.—Mr. Brazier exhibited a very fine collection of Cypræa, viz.:—*Cypræa hirundo* 2, *neglecta* 2, *cylindrica* 2, *errones* 3, *moneta* 4, *lynx* 5, var. *Caledonica* 1, *Isabella* 1, *caurica* var. *obscura* 3, *stolida*, var. *Crossei* 2, *Arabica* 7, *vitellus* 4, *scurra* 1, *staphylæa* 1, *mappa*, var. *nigricans* 2. These fourteen species were all distorted or malformed, with the extremities rostrated, and the base arched. Three fine varieties of *C. tigris*, four fine varieties of *C. crebaria*, and one fine pink variety of *C. mappa*. These three species are normal.—The Hon. William Macleay exhibited dried specimens of the two plants described by Baron Müller, also a large peculiarly-shaped gall of a manna-producing coccus on a gumtree branch, and a rare heteromerous beetle (*Zopherosis Georgii*), both sent by Mr. Palmer. Mr. Macleay also exhibited some samples of a bark said to be used by the natives of New Caledonia and New Hebrides to procure abortion, and a mass of a kind of gutta-percha from a new Caledonia tree. These two exhibits were sent by Mr. E. L. Layard, C.M.G., British Consul, Noumea. Mr. Fletcher exhibited a large number of microscopic sections. A special vote of thanks was awarded that gentleman for his very valuable paper on the uro-genital organs of the kangaroo.

PARIS

Academy of Sciences, January 30.—M. Jamin in the chair.—The following papers were read:—On the theory of repeated proofs, by M. Bertrand.—On some applications of the theory of elliptic functions, by M. Hermite.—On a criticism in the last number of *Memoirs* of the Italian Society of Spectroscopists (p. 256), by M. Faye. M. Tacchini says there is not perfect parallelism between spots and protuberances. M. Faye (who regards these phenomena as in mechanical connection) contends that from the nature of the observations this is not to be looked for, but merely a general accord.—*Résumé* of meteorological observations made during 1881 at four points of Haut-Rhin and the Vosges (continued), by M. Hirn. The great excess of water which falls in the higher regions is met by the useful regulative action of mountain forests; and disastrous results have followed the extensive destruction of wood on the Vosges.—On various problems of relative motion, by M. Gilbert. He analyses the action of M. Sire's polytrope, gyroscopic pendulum, &c.—On the hematic crisis in acute maladies with sudden defervescence, by M. Hayem. This crisis, occurring near the end of acute disease, is chiefly characterised by a temporary increase of hematoblasts in the blood; in forty-eight hours their number is nearly doubled; in twenty-four hours more it diminishes considerably, and ere long the normal state is recovered, in which there is about one hematoblast to twenty red corpuscles. The abnormal ratio between these elements at the time of greatest accumulation of hematoblasts is represented nearly always by the same figure (seven on the average; variation limited between eight and six). The hematic crisis indicates an effort of sanguineous reparation.—On a class of binomial linear differential equations with algebraic coefficients, by M. Appell.—The death of M. Billet, Correspondent in Physics, was announced.—On the oscillatory character of the cause producing the variable distribution of spots on the sun's surface, by M. Spoerer (with annotations by M. Faye). M. Spoerer's data (here tabulated) with M. Carington's, prove that the sun-spot activity (which is concentrated between 6° and 35°) advances slowly from 35° towards the equator, increasing to a maximum at 18°; then proceeds, with diminution, to 5° or 6°, where it disappears. A new cause now brings out some spots in the higher latitudes again, and the same series is reproduced. M. Spoerer calls attention also to an alternating preponderance of each hemisphere in production of spots (but this is less marked).—On asymptolic integrals of differential equations, by M. Boussinesq.—On the generation of surfaces and curves with double curvature of all degrees, by M. Vanecek.—On the combination of carbonic acid and water, by M. Wroblewski. His results obtained in compressing and liberating carbonic acid in contact with water, point he thinks, to the existence of a hydrate of carbonic acid, easily dissociable, and producible by pressure (like M. Ogier's chlorhydrate of phosphide of hydrogen). The critical pressure which must be produced in order to the phenomenon occurring is the tension of dissociation of the hydrate formed.—Silicomolybdic acid, by M. Parmentier.—On new combinations of aldehydes with iodide of phosphonium, by M. de Girard.—On the vapour-density of chloride of pyrosulphuryl, by M. Ogier.—On the formation of an aldehyde-acetone and a glycol of the aromatic series, by M. Burcker.—Researches on pilocarpine, by M. Chastaing.—On the relations of the vasomotor system of the *medulla oblongata* with that of the spinal cord in man, and on the alterations of these two systems in the course of sensitive *tabes*, by M. Pierret.—On the formation of blighted grains of wheat, by M. Prillieux.—Attempt at reproduction of Wollastonite and of Meionite, by M. Bourgeois.—On a multiplying anemometer applicable to measurement of the velocity of wind in mining galleries, to meteorological observations and to determination of the velocity of water-courses, by M. Bourdon. This is a system of convergent divergent tubes. In one such tube, made according to Venturi's proportions, is fixed concentrically a second much smaller, and having its divergent end exactly at the point where the truncated summits of the cones of the larger tube unite. (For very small velocities a third tube may similarly be fixed within the second.) A hollow sleeve is fixed round the union of the truncated cones of the wide tube; its interior communicates with that of the latter and with a manometer, on which the pressure is read. If a manometer at the mouth of the large tube register 1 with a current, the other manometer will register *e.g.* 6; the pressure here is negative and due to acceleration of the velocity of the current.—On some atmospheric phenomena observed during the recent period of high pressures, by M. Vinot. General de Nansouty, on the Pic du Midi, records exceptional purity of sky; the zodiacal light was seen on January 1 (a very rare thing), and the earthshine and thin crescent of the moon, only 25h. 46m. old, were also seen in January.—Observations in a balloon, of the opaque cloud which covered the Paris region for some days, by M. de Fonvielle. The cloud was hardly 300 m. thick. In the upper part the guide rope got covered with hoar-frost. The temperature of the cloud was about 5° below zero.—Relief map of France, on the scale of $\frac{1}{800000}$, by M. Guillemin.

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