THURSDAY, JULY 6, 1882

CLIFFORD'S MATHEMATICAL PAPERS

Mathematical Papers. By William Kingdon Clifford. Edited by Robert Tucker, with an Introduction by H. J. Stephen Smith. (London: Macmillan and Co., 1882.)

Mathematical Fragments; being Facsimiles of his Unfinished Papers Relating to the Theory of Graphs. By the late W. K. Clifford. (London: Macmillan and Co., 1881.)

ONLY those who wander much through the aridities of modern English mathematical text-books, whose duty compels them daily to read such literature, and who know

> "The mispent tyme, the service vaine,
> Whilk to considder is ane pane,"

can understand the pleasure of reviewing a book like Clifford's Papers. Here there is no occasion to yawn over page after page of commonplace, to mark with wonder the hundredth iteration of an ill-founded inference, to trace with languid amusement the method and arrangement of our ancestors, nay, the hereditary dots and dashes decrepid in the fourth generation. On the contrary, the novelty and variety alike of subject and of treatment is almost confusing, every page shadows forth some new idea, every line is informed with the personality and with the genius of its author.

Clifford was one of the bright spirits, all too few in number, who, in a generation, whose educational system is devoted to the encouragement of mediocrity and the cultivation of sciolism, saved the English school from the reproach of inability to follow their leaders. He was one of the select few who sat at the feet of Cayley and Sylvester, and shared their genius. When we compare him with the former of his great masters, he appears at first to want the steadfast purpose and rugged strength of our mathematical giant. The extreme, almost boyish vivacity of his style, and the refined elegance and studied variety of his methods give an impression of this kind which a nearer acquaintance with his work speedily dispels. Apart from his great originality, this elegance, popularity in the best sense, of style gave Clifford a specially important place among the leaders of the English School of Mathematicians, a place which there seems to be none left to fill. It was by his assistance that many were led to scale the almost inaccessible heights on which stand the structures of modern mathematics.

In some respects the exuberant philosophy of his popular works, especially his lectures, in which the more striking conclusions of modern mathematical science were presented to the uninitiated, must have harmed his reputation for solidity of thought. We are also inclined to doubt whether some of the enthusiastic non-mathematical souls that thought they had assimilated his teaching, really after all rose to the conception of Riemann's finite space of uniform positive curvature, in which the problem is solved of

> "Einer dem's zu Herzen ging
> Dass ihm sein Zopf so hinten hing,
> Der wollt' es anders haben."

Such a flight is given only to the sons of Genius, and to those who have in the first place painfully exercised their pinions in less ambitious journeys. Still these lectures of Clifford did good service in drawing the attention of the rising generation to the revolution that is taking place in the very elements of exact science. If every physical discovery of permanent or passing importance is to have its day in the drawing-room and the lecture-hall, why should the trumpet of mathematical progress not be blown occasionally in the streets of Gath and Ascalon? If too many be *called* in this way, some few may still be *chosen.* To these few the volume of Mathematical Papers will furnish the best help available in the English language to enable them to follow their calling. To our mind the popular lectures are cut too much after the passing fashion of the present day; and we should be surprised if the majority of those best qualified to judge of Clifford's work did not agree with us that it will be on the present volume that his future fame will rest. In our poor judgment there is ample fou dation.

It would scarcely be proper here to criticise the papers in detail, with the view of pointing out the exact amount of originality in each. Besides, even if the reviewer felt more confident of his judgment in such a matter, the task were a needless one, for it has been done already, in the admirable introduction, by an authority to whom every English mathematician will at once bow.

The Papers have a somewhat fragmentary aspect. This is due in part to the immense range of Clifford's mathematical sympathy, which led him to write on a great variety of subjects; but mainly to the fact that many of the papers are actually unfinished, some of the most important being indeed mere sketches. Clifford seems to have cared, comparatively speaking, but little for the mere mathematical *Art;* his interest was reserved mainly for methods and principles. Accordingly we find him much occupied with new and far-reaching theories; and many of the memoirs in this volume are merely the outlines of vast schemes of work, which life and leisure were denied him to accomplish.

Besides advances in the Theory of Algebraic Integrals, the development of Projective Geometry, and the enormous extension of analysis that is included under the title of Higher Algebra, two great generalisations have marked the progress of modern mathematical science. The first of these is the extension of the axioms of geometry, which originated with Gauss, Bolyai, and Lobatschewsky, and was perfected by Riemann, and the theory of an *n*-fold manifoldness (Mannigfaltigkeitslehre) of which tridimensional geometry in this extended sense is only a particular case, Euclidian geometry a more particular case still. The second consists in a somewhat similar extension of the Axioms, or more strictly speaking, of the Laws of Operation, of Algebra, begun independently by Hamilton and Grassmann, and resulting in the first instance in the Quaternions of the one and the Ausdehnungslehre of the other. Both these generalisations have been progressive, and both appear to be pregnant with mighty results for the future. Clifford seized upon them with the instinct of genius. They pervade and colour the whole of his work, and the student who wishes clearly to understand the tendency of much that he has done must begin by attaining some mastery over these fundamental novelties. Great assistance will be obtained from the elementary exposition of them given by Prof. Smith in his introduction to the Papers, pp. xl. *et seqq.* We should like, however, if we might venture to differ from so great an authority, to take exception to his definition of *flatness* by means of the notion of *planeness*, and to the introduction of the idea and the word *curvature* into an elementary exposition of the properties of space. This seems at best an explanation of the less by the more difficult; and, after all, the use in this case of the word *curvature* is of questionable propriety (although sanctioned by the highest authority), inasmuch as it suggests not only true but also false analogies. It is very well in the hands of a mathematician, to whom it suggests merely that a certain common apparatus of mathematical formulæ is applicable to a particular class of manifoldness and to a particular kind of surface; but to the mathematically untrained or half-trained reader the word suggests the paradox that portions of space on the two sides of a plane in elliptic space both are and are not congruent. Much harm has, we are persuaded, been done by this unfortunate usage of words. A similar piece of mystery making has been practised with n-dimensional space; the language of mathematicians concerning which has been retailed to ordinary simple-minded people as if it had the literal sense they naturally attach to it.

Clifford's papers on the geometry of hyper-space began with his translation of Riemann's famous Habilitationsschrift on the hypotheses which lie at the basis of geometry. He establishes a close connection between the generalised geometry and the generalised algebra in the Preliminary Sketch of Biquaternions, to our mind one of the ablest of his papers. He farther develops the subject in the memoirs "On the Motion of a Solid in Elliptic Space," "On the Theory of Screws in a Space of Constant Positive Curvature," "On the Free Motion under no forces of a Rigid System in an n-fold Homaloid." The kinematic of elliptic space as given by Clifford, and developed quite recently by Dr. Ball, forms one of the most elegant and attractive of modern geometrical theories. The starting point may be said to be the finding of the analogue in elliptic space to Euclid's parallel. In the modern geometrical sense a parallel (*i.e.* a line intersecting another at an infinite distance) cannot of course exist in elliptic space except as an imaginary line. If, however, we define a parallel as the straight equidistant from a given straight line, then through every point in space two parallels (a right and a left parallel as Clifford calls them) can be drawn to a given straight line. This appears at once by drawing at the given point a tangent plane to the equidistant surface of the given straight line, which it will be remembered is, in elliptic space, an anticlastic surface of revolution of the second degree, every zone of which is congruent with every other of the same breadth. This tangent plane meets the surface in two rectilinear generators, which intersect at the given point and have the property of equidistance from the given line. Parallels in this sense are of course imaginary in hyperbolic space, Euclid's parallel being the transition case for parallels in both senses. It seems a pity that a new word has not been used for this species of parallel.

It follows at once by synthetic reasoning of the simplest kind (in which we may in fact dispense with the aid of biquaternions or analytical aid of any kind) that almost all the properties of Euclidian parallels and parallelograms have their counterpart in the theory of Clifford's parallels, due attention being paid to the distinction of right and left. It is shown that a motion of a rigid body is possible in elliptic space such that every point moves in a right parallel, or every point in a left parallel, to a given straight line. A motion of the first kind is called a right vector, a motion of the second kind a left vector. The composition of two right vectors gives a right vector, and two left vectors a left vector; whereas the composition of a right vector with a left vector gives the most general motion of a rigid body, which Clifford calls a motor. It was to represent the ratio of two such displacements that Clifford invented his Biquaternion. Translation, strictly analogous to that in Euclidian space, *i.e.* rotation about the line at infinity does not exist in elliptic space. We may, of course, cause a body so to move that every point of it remains equidistant from a given line, and *in the same initial plane with that line.* Such a displacement is the same as a rotation about the polar of the given line, and is hence called by Clifford a Rotor. We have then the fundamental proposition, that every motor can be represented in an infinite number of ways as the sum of two rotors, but uniquely as the sum of two rotors whose axes are polar conjugates. It is the abolition of the line at infinity, whereby duality is made perfect, that gives the peculiar completeness and elegance to the properties of elliptic space, and fit it to be the paradise of geometers, where no proposition needs to wander disconsolate, bereft of its reciprocal.

To the second great branch of mathematical theory above alluded to, Clifford made exceedingly important contributions in his memoirs on the "Applications of Grassmann's Extensive Algebra," and "On the Classification of Geometric Algebras." Following, to some extent, in the footsteps of B. Peirce, whose epoch-making memoir has been given to the public at last in the *American Journal of Mathematics* for the current year, Clifford treats the subject with an incisive vigour all his own. The point of view (indicated by the word *geometric*) is no doubt limited, just as Peirce's is in another way; and there may be some doubt, as yet, as to the exact nature of the foundations upon which the reasoning rests. There is a lingering trace of the old sophistry in Peirce's work, here and there, at least so it appears to us; a reliance still upon ideas *a priori*, and a reluctance to abandon the restrictions imposed upon algebra by its arithmetical origin. Yet there can be no question as to the great value of the results already obtained and the immense extension of the mathematical horizon thereby effected. Already the attention of mathematical workers has been powerfully drawn to the matter, and there is hope that ere long another great theory equal in importance to the Mannigfaltigkeitslehre will drive its roots through the mathematical soil.

We have dwelt on two of the subjects touched upon in the "Papers," because they seem to us to be of the greatest immediate importance, and to show Clifford at his best as an original mathematician. But it must not be supposed that there is no other food for the mind mathematical in this volume. On the contrary, not one of these papers but is full of delight and edification, even for the most highly educated reader. The charming simplicity of their style, the omission of everything like superfluous detail, and the great variety and importance of the subjects treated, will make the book an indispensable *vade mecum* for the tyro in pure mathematics. We think with regret of the infinite use it would have been to us in our learning years; from it we could have gathered, easily and pleasantly, in the pliant hours of youthful leisure, what we are now constrained to glean, in the intervals of ordinary drudgery, from partial treatises, and articles in foreign periodicals often the driest of the dry.

We must not conclude this notice without alluding to the appendix to the volume of papers, the most important parts of which are the fragment of a treatise called "The Algebraic Introduction to Elliptic Functions," the Notes of Clifford's Mathematical Lectures, and the problems and solutions contributed to the *Educational Times*. The fragment on elliptic functions, which deals with the Theta functions, has great value, as it gives a treatment of the subject not to be found in any English text-book. The lecture notes will be most useful to such teachers of mathematics as are sufficiently alive to the need of some modification of our traditional methods to take advantage of them. They remind us of the irreparable loss we have sustained by Clifford's early death of a doughty champion in the reformation of our degenerate system of mathematical education, which strangles the youthful mathematician ere he is born. It is, perhaps, too much to expect that the veteran chiefs of mathematical science should enter into the work of the drill-sergeant of mathematical recruits. They cannot be asked to devote their time to the petty work of reorganising the teaching of geometry and algebra in our schools and colleges. The more reason that we should mourn the departure of one who was able to take his place with the gods immortal, and yet disdained not to mingle with us mortals in the dusty fray of the Trojan Plain.

The handsome folio of lithographed manuscripts relating to the Theory of Graphs, forms one more monument of Clifford's genius, and affords us one more reason to lament our loss. Fully as we appreciate what he has actually done for us, and much as we are grateful for it, we cordially sympathise with the feeling that prompted the editor of the papers to put on the title-page the saying of Newton concerning Cotes: "If he had lived, we might have known something;" for, if we measure Clifford's promise by his actual performance, we see that he certainly died before his work was well begun.

G. CHRYSTAL

OUR BOOK SHELF

Winters Abroad. Some Information respecting Places visited by the Author on account of his own Health. Intended for the use of Invalids. By R. H. Otter, M.A. 8vo., pp. 236. (London: John Murray, 1882.)

THE places visited by the author are Australia, including Melbourne, Sydney, Queensland, and the Riverina, Tasmania, Algiers, Egypt, Cape of Good Hope, and Davos. He gives a short account of the places in the order in which he visited them, written in an easy readable style. The author's object in writing is to give invalids an idea of the easiest routes by which to reach health resorts, the kind of accommodation they may expect, the weather they must be prepared for, and the occupations and amusements which the several places afford. He has kept this object constantly before him, and has consequently produced a book which, notwithstanding its moderate size, clear, large type, and easy style, yet contains a great quantity of solid information which is quite trustworthy as far as it goes. From the nature of the work, embodying as it does the author's personal experience only, it is not complete, and might possibly mislead invalids who decided to follow the author without reference to the exact condition of their own lungs. For example, the author prefers the route to Egypt by the P. and O. steamers, and for many persons this may be excellent, but it involves a passage through the Bay of Biscay, with the possibility of rough weather, which to many invalids might be exceedingly dangerous. He has done good service to invalids by warning them of the necessity for warm clothing everywhere, but he speaks of throwing his coat on his bed as an additional covering, and so appears not to have had with him that greatest of all comforts to an invalid, an eider down quilt, which keeps him warm in bed, sofa, or chair, and when packed in a waterproof cover, is easily carried and serves at need for a pillow or footstool. In his remarks on Davos, the author observes, that through want of knowledge of the kind of cases for which the climate is suitable, many persons are sent there who would be much better elsewhere, and makes a most sensible suggestion that the authorities of Brompton Hospital should send thither a certain number of test cases. Proper accommodation and medical attendance would have to be provided for them, but the expense would not be very great, and might be met by special subscriptions for the purpose, while "the benefit to many of the sufferers and to the world at large might be incalculable." The origin of tubercle from germs, which has recently received such confirmation from Koch's experiments, as well as the increasing probability that under certain conditions these germs may be inoculated, afford a hope that consumption may ere long be brought, like typhoid fever, into the category of preventible diseases. But even after its causation is known as well as that of typhoid, cases will continue to occur from ignorance, stupidity, or negligence; but we may trust that it will no longer be the awful scourge which it is at present. To those who suffer from it, and who require to winter abroad, the present work will be a useful adviser and companion, and we would also strongly recommend its perusal to medical men who are personally unacquainted with the health-resorts to which they recommend their patients.

A Sequel to the First Six Books of the Elements of Euclid. By John Casey, LL.D., F.R.S. (Dublin: Hodges, 1882.)

THIS handy book has deservedly soon reached a second edition. In this way it will be seen that it has met a want. "The principles of modern geometry contained in the work are, in the present state of science, indispensable in Pure and Applied Mathematics and in Mathematical Physics; and it is important that the student should become early acquainted with them." The author appears to have thoroughly revised the text, and he has added many notes of interest, a few figures, we believe, and several problems: the enunciations occupy more space; that is, such terms as parallelogram are given in full, instead of being symbolically represented; but in the demonstrations the symbols are retained. An index has been added at the end.

We have noted a few errata: in the list of errata, for 4 read 74; p. 39, l. 15, "AB" should be "A C," as in first edition; on pp. 95, 157, the names of Sir W. Thomson and M. Mannheim are incorrectly printed; p. 110, the reference to *Educational Times* should be to the "reprint" from that journal; but these are very slight slips. We recommend Dr. Casey's book with increased confidence for use in the higher forms of our schools.

Il Telefono, il Microfono, la Bussola, Istrumenti Rivelatori delle variazioni atmosferiche. Di A. V. G. Mocenigo. 131 pp. (Vicenza, 1882.)

THIS little work deals with the physics of the earth as revealed by the telephone, the microphone, and the compass. Amongst the subjects dealt with are the perturbations of the earth's magnetism, atmospheric electricity, earth-currents, particularly in relation to their study by the aid of the telephone, and seismological movements of the earth's crust as revealed by the microphone. For the study of the latter class of phenomena the author has devised an earthquake-pendulum-microphone. In this instrument one piece of carbon is hung by a long wire vertically above another attached to a rigid frame, the upper carbon resting with very light pressure against the approximately flat top of the lower. Any disturbance of the verticality of the apparatus causes a variation in the contact, and gives rise to grating sounds in a receiving telephone. The author appears to attribute earth-currents to the rotation of the magnetic mass of the earth; and he proposes to utilise them for working telephones in regular fashion. A large part of the book is taken up with correspondence between the author and Signor de Rossi. S. P. T.

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.*]

An Observatory for Auroræ

J'AI l'honneur de vous annoncer que, dans le cours de l'automne prochain, j'ai l'intention de faire proposer au gouvernement norvégien la création d'un établissement ayant pour but l'investigation et l'observation de l'aurore boréale et des autres phénomènes du magnétisme terrestre.

En me permettant, M. l'Editeur, de vous communiquer ce projet pour vous en demander votre avis j'indiquerai en peu de mots les motifs qui m'ont porté à chercher la réalisation de cette idée, nouvelle encore sous bien des rapports.

La théorie du magnétisme terrestre est un des problèmes qui présentent à la science naturelle moderne les plus fortes demandes d'être examinés. Si la science n'a pu résoudre, jusqu'à présent, qu'une petite partie des nombreux problèmes noués à ce terrain de recherche—pourtant, à chaque progrès elle a pu prouver, de plus en plus clairement, l'énorme importance des phénomènes du magnétisme terrestre pour les relations physiques de la terre. Par la découverte de la connexion existant entre ces phénomènes et des évènements sur la surface du soleil, la question a gagné une portée cosmique.

Il sera inutile, M. l'Editeur, de vous rappeler le grand et important rôle joué dans toute la vie physique de la terre par les forces du magnétisme terrestre, par leur état changeant et par leurs périodes, soit qu'elles se présentent dans le jeu énigmatique de la lumière polaire, soit qu'elles se prononcent dans les mouvements changeants de l'aiguille aimantée, ou par leur influence sur le réseau télégraphique de pays entiers.

Aucun pays en Europe, peut-être même pas sur toute la terre, n'offre à l'investigation de ces phénomènes des conditions si favorables que la Norvège. Ayant une étendue de presque 2000 kilomètres —du 58me au 71me° N.—elle s'étend plus loin vers le Nord qu'aucun autre pays habité. Elle est plus rapprochée du foyer des perturbations magnétiques, qu'aucune autre partie du continent européen. La zone maximale de l'aurore boréale traverse la partie Nord et Nord—Ouest du pays. Un réseau continu de fils télégraphiques s'étend de son extrémité Nord à celle du Sud. Les lignes téléphoniques de Drontheim et de Bergen sont celles de toute la terre, qui sont le plus rapprochées du pôle.

A aucun autre pays ne s'adresse donc plus directement la demande de prendre l'initiative énergique de l'investigation des mystères du magnétisme terrestre.

Ayant reconnu ces nombreux avantages, si négligés jusqu'à présent, j'ai tâché, pendant ces dernières années, d'entreprendre, de ma propre initiative, et avec les ressources d'un seul individu, une partie de la grande œuvre qui nous reste encore sur ce terrain relativement si peu exploité. Dans l'automne de 1878 je fis, pour la première fois, répandre dans toutes les parties de la Norvége l'invitation à contribuer (Actes de la société des sciences de Christiania, 1880, No. 6) 839 observations de 154 aurores prises de Sept. 1878—Avril 1879 de 132 stations, principalement en Norvége.

Ce résultat me mit à même de prouver, que l'aurore boréale est un phénomène beaucoup plus fréquent, même hors des régions polaires, qu'on ne l'a supposé jusqu'à présent, et que, dans un territoire comme celui de la Norvége, il n'en manque presque jamais, même dans une année de minimum.

A compter de ce modeste début, l'entreprise s'est développée bien rapidement; non seulement la Suède et le Danemark, la Finlande, l'Angleterre, le Groenland et l'Islande sont aujourd'hui comprises dans le réseau d'observation. Le travail complémentaire à l'égard des observations de l'hiver de 1879-80, quoique fini depuis longtemps, n'a pas encore été publié; cette série est bien plus considérable et plus complète que celle du premier hiver, et contient 1600 observations de 249 aurores boréales prises de 357 stations. Le matériel de l'hiver de 1880-81 est bien plus riche encore que celue de l'hiver passé; il contient jusqu'à 5200 observations d'environ 300 aurores boréales, prises de 675 stations. Le résultat de l'hiver de 1881-82 sera probablement encore plus vaste; je suis en correspondance, dans ce moment avec 1000-1500 observateurs dans tous les pays de l'Europe septentrionale.

Comme supplément à ces observations des aurores boréales je suis parvenu à faire noter, à ca. 50 stations télégraphiques, suédoises et norvégiennes, toutes les perturbations ayant lieu dans les fils, avec indication de l'heure, de la force, de la direction etc. Il résulte de ce travail un matérial aussi vaste, aussi étonnant que celui des observations des aurores boréales, les perturbations télégraphiques se montrant aussi fréquentes que les aurores elles-mêmes, et presqu'aucun jour ne passe en Norvége, que les lignes n'éprouvent une perturbation quelconque. Dès que j'aurai reçu les observations d'une année entière, je pourrai les publier et les faire accompagner d'un atlas, montrant carto-graphiquement les perturbations télégraphiques de chaque jour, les aurores boréales et les orages observés le même jour, avec indication de l'heure et de l'endroit, ainsi que la quantité de nuages le soir sur tout le terrain d'observation.

J'ai réussi à construire un appareil qui, mis en communication avec un fil télégraphique, note graphiquement tous les courants perturbateurs selon l'heure, la force et la direction. Ce rhéographe sera bientôt mis en communication chaque nuit avec une ligne télégraphique (direction N.—S., longueur de ca. 1400 kilomètres) qui n'est pas employée pendant la nuit pour le service télégraphique; pendant la journée il sera mis en communication avec une ligne téléphonique spéciale.

A côté de cette activité, j'ai rendu compte des résultats déjà gagnés dans plusieurs traités qui sont, ou publiés ou en état de préparation. Sans compter les ouvrages déja cités, j'ai pu contribuer, d'après des observations prises en Groenland, à l'explication des périodes journalières, annuelles et celles d'onze ans de l'aurore boréale (voir "Sur les périodes de l'aurore boréale"—extrait de l'annuaire 1880 de l'institut météorologique danois). Dans un traité qui sera publié dans les actes de la société des sciences de Christiania, j'ai discuté la période dépendant du clair de la lune; dans "Archiv for Mathematik og Naturvidenskab 1881" j'ai publié une monographie assez détaillée de l'aurore boréale du 17 mars 1880. Je prépare enfin un catalogue de toutes les aurores boréales observées en Norvége depuis la période la plus reculée jusqu'a nos temps, dont le travail préparatoire est presque fini.

Je peux encore ajouter que je passerai l'hiver prochain (Septembre–Avril) à Kautokeino dans le Finmark (69° 1' lat. N., 21° 0' long. E. P.) pour y faire, en commun avec la station polaire norvégienne Bosekop, située à 100 kilomêtres plus loin vers le Nord, des observations surtout à l'égard de la parallaxe de l'aurore boréale.

Quoique j'aie trouvé tout appui et encouragement possible chez les gouvernements et les institutions scientifiques des royaumes du Nord, il est évident, qu'une organisation si étendue et si compliquée doit finir par épuiser les forces d'un seul homme, surtout comme je suis obligé de vouer la plus grande partie de mon temps à une activité différente. Il est également clair, qu'une entreprise, n'ayant pour appui que l'initiative individuelle, ne peut être poursuivie avec autant d'exactitude et de perfection, qu'étant basée sur une institution publique. Il me semble, enfin, que ces recherches sont d'une telle importance, qu'il est à désirer, qu'elles soient continuées si énergiquement et sur une échelle si complète que possible. Cela ne peut se faire, selon mon avis, que par la création, par l'état, d'un établissement spécial pour ces recherches. Les principes sur lesquels je voudrais voir basé un tel institut, les voici :

(*a*) L'institut sera établi à Drontheim (63° 27' lat. N., 8° 5' long. E.P.), endroit à peu près central dans le pays et mis en vive communication avec l'étranger par des bateaux-à-vapeur et des chemin-de-fer. Situé à 30° S. seulement du cercle polaire, il est assez rapproché de la zone le plus active des forces du magnétisme terrestre, ce qui, entre autres choses, est aussi prouvé par le fait que, pendant l'hiver de 1880–81, non moins de 62 aurores boréales ont été observées par un de mes observateurs, et que les perturbations télégraphiques y sont aussi très-fréquentes; dans la période 1 Julliet 1881–30, Avril 1881 on en a compté a pas moins de 122 jours (plus de 40₀/°) dont une partie insignifiante provenant des orages.

(*b*) Il sera construit pour l'institut, sur un emplacement à l'horizon libre, un édifice spécial, situé de manière à ne pas être gêné par la lumière artificielle. Sans compter l'appartement du directeur, l'édifice doit contenir une salle de travail, des cabinets pour les instruments, une tour, contenant une chambre à vue libre dans tous les sens et une plateforme.

(*c*) L'institut tâchera de devenir le point central des observations des aurores boréales en Europe. Tout en faisant lui-même toutes les observations possibles, il veillera sur la régularité des observations dans toute l'Europe septentrionale, dans l'Islande et dans le Groenland, il en chargera les navires navigant les mers arctiques etc.

(*d*) L'institut se fera également le centre des observations des perturbations télégraphiques, recues de toutes les lignes télégraphiques de Norvége et de Suède. Le rhéographe cité plus-haut sera employé à des observations nocturnes sur une ligne longue. De semblables recherches seront faites à l'aide des lignes téléphoniques de Drontheim.

(*e*) Sans compter les spectroscopes, les théodolites pour les aurores etc., l'institut sera pourvu d'une série d'instruments de variation, à l'action spontanée, placés dans un pavillon particulier.

(*f*) L'institut publie tous les ans les observations recueillies et classifiées par lui, ainsi que leurs résultats.

Je suis persuadé qu'un observatoire, basé sur ces principes, pourra rendre d'importants services à la science, et j'espère que la réalisation de cette idée sera accueillie avec joie par le monde scientifique.

J'adresse cette communication à vous, M. l'Editeur, et à d'autres autorités reconnues sur ce terrain de la science, pour que cette question soit soumise à votre jugement. Je vous prie de vouloir bien me communiquer votre opinion sur les mérites d'un tel institut, afin que le poids de votre nom me serve d'appui dans mes efforts pour la réalisation de mon projet—si toutefois l'idée gagne votre approbation, ce dont je ne doute pas. Si vous y ajoutiez encore la bonté de formuler des propositions eventuelles et des conseils pour l'organisation de l'institut, pour son plan de travail etc., je vous serais également très reconnaissant.

Dans l'espoir d'être honoré d'une prompte réponse, qui pourra être conçue dans quelque langue que vous deviez désirer, j'ai l'honneur, M. l'Editeur de vous prier d'agréer l'expression de mes sentiments les plus distingués.

Bergen en Norvége, Juin SOPHUS TROMHOLT

Hydrophobia and Snake-bite

IT has been the fashion of late, in newspaper and other commentaries on the numerous experiments in search of an antidote for serpent-venom, which are now attracting general notice in different parts of the world, to compare snake-bites with hydrophobia, and to raise hypotheses and suggestions that the remedy, when it is discovered, for the one, will be found also to effect the cure of the other. Such a surmise, one would imagine, must be based on a very superficial knowledge, even of the rough outlines of the two affections, and in total ignorance of their pathological characteristics. What are their points of similarity and distinction, dismissing all rhodomontade involving such terms as "ferments" and "active principles," "germs," and "vibriones"—expressions which are very convenient to make use of as signifying an *unknown something*, but which, in their literal meaning, indicate definite actualities, the existence of which has certainly never been shown by tangible demonstration in the present instances? Hydrophobia and blood-poisoning by a venomous snake-bite are alike, then, in being produced by an animal poison, commonly conveyed by the living animal; in being of intense virulence, accompanied by many parallel symptoms denoting violent constitutional disturbance, and great prostration of the vital powers; and, *in some cases*, in leaving certain post-mortem lesions which are identical. But there all likeness ceases; and even without considering the grand differences which exist between them, however viewed, I think we shall find these items of resemblance when analysed a very insufficient foundation for the theory of the probability of a common antidote. To begin with, the poison in one is a natural secretion, provided for the distinct physiological purpose of enabling the reptile to secure its prey; in the other, a new and morbid product generated by disease in a secretion naturally innoxious—whether by chemical decomposition or by the formation of new compounds from materials pre-existent there or from others specially eliminated from the blood, we cannot say. For it is to be observed that neither the microscope nor chemical examination has afforded us any clue to the mysterious ingredient which constitutes the toxæmic property of these fluids as yet. Then, in the second place, as to the acuteness of the symptoms of vital disturbance; neither the symptoms themselves nor their severity are specific to these affections, but are such as might be produced by any grave interference with the relation of tissues or function—a deadly mineral or vegetable poison, the rapid course of a zymotic disorder, violent concussion, or the rupture of an internal organ. Lastly, the occasional identity of the appearances after death from snake-bite with those which are constant in hydrophobia (notably those observed in the spinal cord) are little to be relied upon, partly on account of their comparative infrequency, and partly because they are not in themselves primary evidences of the introduction of the poison, but *tertiary* to it—secondary to the effects which result from the action of the altered blood and its new and vital function on other tissues. One is compelled to attribute such phenomena to something more than passive contamination (as the idea giving rise to some recent experiments would seem to be), and to recognise a defined potential agency in the new formation.

The fact that the hydrophobic poison is located, and undergoes a period of incubation at the seat of the original wound, even long after cicatrisation, and is not diffused in what we vaguely call the "system," draws a broad line of separation between the pathology of this disease and snake-poisoning, and renders it perfectly unique in the category of ills known to medical science. The constitutional symptoms never appear in less than three weeks after the bite, rarely under six, and may be delayed for twelve months. Could there be a greater contrast to the *impetuosity* of the changes sequent on inoculation with the poison of a serpent? Both the latter fluid and the saliva of a mad dog are incapable of producing their characteristic effects when absorbed through mucous membrane, but that is a circumstance common to most animal viruses.

There is a far greater similarity between the course of some of the rapidly fatal tropical fevers and a snake-bite, than there is between that injury and hydrophobia. The inception of a morbific agent—though of what nature, or through what channel, is uncertain; the almost *instant* development of acute symptoms—for, if there is any period of latency, it must be a very brief one; the intense disorganisation of the economy produced within a few hours; the nearly inevitable termination in death—all suggest a comparison which will not be thought strained or far-fetched by those who have witnessed the progress of these appalling diseases. My friend Dr. Fairbairn, of Rio de Janeiro, who has probably seen more of yellow fever than any man alive, and who has certainly met with greater success in his treatment of it than any other physician whose experience has been placed on record, called my attention to this resemblance, with which he had long been impressed, living in a region which afforded plenty of opportunities for observing both; so much so, that he expressed a conviction that many points of identity of process and morbid anatomy would eventually be revealed. His last words to me at parting were: "Now, mind—if you ever discover the antidote for snake-bites, you'll have a cure for yellow jack!" ARTHUR STRADLING

29, Woodford Road, Watford, Herts

The Rainfall of the Globe

IN reference to a paragraph in an article on the rainfall of the globe in NATURE, vol. xxvi. p. 206, Prof. Loomis states that the heaviest rainfall is met with in the rain-belt, which surrounds nearly the whole globe lying between the north-east and south-east trade-winds.

Having been engaged in collecting records of rainfall at sea for some time back, I may take the opportunity of saying that I have received data enough to enable me to give an estimation of rates per annum for this rain-belt.

That for the Atlantic Ocean is calculated at 133·37 inches per annum, that for the Indian Ocean at 80·55 inches per annum, that for the Austro-Chinese Seas at 107·96 inches; but none has yet been made out for the Pacific Ocean, owing to absence of observation altogether from that quarter.

In physical atlases the rain-belt is continued across this ocean in the same latitudes as it is found to exist in the Atlantic and Indian Oceans, but as yet it is only conjectural, and it may probably be found to cross in other spaces by direct observations taken at sea. The observance of rainfall on islands in the open oceans would appear to afford but imperfect means of judging of the rainfall at sea surrounding them. It is frequently found that they differ very materially, as at St. Helena, the island may be covered with mists, invisible, while the ship outside is sailing under a clear sky and fresh breeze.

The ocean rainfall, therefore, can only be made out by observations on board ships, and these are not easy to get, and also take up a long time in effecting. W. J. BLACK

Caledonian United Service Club, Edinburgh

The Recent Unseasonable Weather

MR. ARCHIBALD'S letter on this subject displays great ability, and is deserving of much attention by meteorologists. Nothing can be, I think, more interesting and important than a proper interpretation of the meaning of the facts of the weather of the late extraordinary and contrasted seasons. Will you, therefore, allow me shortly to make a few remarks regarding the comparison pointed out by Mr. Archibald as existing between the weather of India and that of North Europe.

In the "Report on the Meteorology of India," 1877, the reporter, referring to the Himalayan regions, says: "There are two periods of cold, (1) when the snow is accumulating; and (2) when it is dissolving; and the first occurs in January and February, the latter in April and May." Again, he says: "The conclusion appears to be very strong that during the early months of the year, one very important factor in determining the peculiar features of the season is, the amount of snowfall and of snow accumulation in the Himalayan regions during the winter."

For six years past I have observed the same thing hold *generally* in the north of Europe, a cold winter being followed by a late spring and an ungenial summer, and *vice versa.* This I would therefore be inclined to regard as a general law. The weather of June, however, serves to indicate the difference between the meteorological conditions of India and North Europe. It has been ungenial, I think, solely, on account of the exceptional force and warmth of the winds of winter causing a vast detachment of the ice in the polar regions. This ice has floated into lower latitudes—has come much nearer to us—and has produced, in melting, icy winds. These commingling with the warmer tropical winds, have produced in their turn the recent changeable weather.

Our cold spring winds usually come from the east of north, but the prolongation of cold winds which we experienced in the middle of June, came from the west of north, indicating their origin to be in the masses of ice floating for the most part probably between Iceland and the American coast. Thus the movable ice has caused a high atmospheric pressure and a low temperature. The fixed ice, however, which forms by far the largest area within the Arctic Circle, has been during this winter relatively diminished, and from it, therefore, we should expect less incursion of cold winds; therefore a finer summer.

While, then, the chief influence of warm westerly winds in winter is, as I believe, to produce a fine summer, their minor influence must be, particularly when strongly developed, as they have been during the past winter, by detaching an unusual quantity of Arctic ice, to produce unseasonable weather in early summer.

The same exception would take place in India, if we could suppose some part of the winter's accumulation on the Himalayas to be carried at the close of a severe winter down into the northern plains so as to distribute in melting, volumes of cold air throughout the otherwise warm atmosphere.

Dundee, July 3 DAVID CUNNINGHAM

Is the Axis of a Cyclone Vertical?

I AM not aware if it has ever been suggested, in explanation of the frequent (or rather, usual) incompleteness of cyclonic disturbances, that the axis of the cyclone may be inclined, and consequently only one side of the disturbance affect the earth's surface, the other half being at a greater or less elevation, according to the amount of the inclination, and thus (so far as wind currents are concerned at least) lost to us.

My own observations of storms in this country point to a southerly inclination of the cyclonic axis. I should be glad to know if observers in the southern hemisphere have traced any indications of a *northern* inclination in the cyclones there.

J. A. WESTWOOD OLIVER

Belle Vue, Springburn, Glasgow, June 25

THE idea propounded by Mr. Oliver, that the axes of cyclones are inclined, is no new one, nor is it the first time that a *southerly* inclination has been inferred to exist, to account for the preponderance of winds belonging to the southerly quadrants, and the comparative absence of those belonging to the northerly quadrants of cyclones in our latitudes.

The value of Mr. Oliver's opinion on this point must depend to a great extent on the nature of the observations on which he relies.

This supposed southerly inclination was formerly attributed by Andrau and other Dutch writers (according to Réclus), to the fact that a cyclone, starting from some point near the equator, must have its rotation-axis initially inclined to the terrestrial axis nearly at right angles, and that as it moves from thence polewards, the direction of its rotation-axis remaining fixed in space, it must *apparently* become gradually more and more inclined to the local horizon in a southerly direction. This explanation is ingenious, but there are many considerations, both theoretical and practical, which militate powerfully against it.

Another view—that of the Rev. W. Clement Ley, derived from observation (principally of the upper clouds)—makes the axis of a cyclone incline backwards as regards its direction of translation, and in favour of this notion, the retardation in the occurrence of the barometric maxima and minima on the summits of Mount Washington, Pike's Peak, and Mount Michell, noticed by Prof. Loomis, has been cited.

Ferrel, however, remarks that "a retardation of just about the same amount is observable in the occurrence of the times of maxima and minima in the diurnal changes of the barometric pressure at the summits of these same mountains, which cannot be explained by means of cyclones with reclining axes," so that in all probability the same cause acts in both cases, and is independent of any such special quality of cyclones as that inferred by Mr. Ley.

The hypothesis of Mr. Ley is, moreover, so much at variance with mechanical principles and with what we should naturally infer would take place, that, as Mr. Ferrel says, "we must hesitate to adopt it, without seeking further for some more plausible hypothesis to explain the observations."

The theory of cyclones, as developed by Ferrel and others, makes it far more probable that if there is any inclination at all, it will be *small*, and *forwards*, not backwards.

Ferrel thinks it possible that the elliptical form of the isobars and rain-areas is partly due to this forward inclination of the axis.

Moreover, the preponderance of southerly and westerly winds in our cyclones cannot correctly be adduced as an argument in favour of the southerly inclination of their axes, since it is mainly due to the fact that our cyclones are for the most part secondaries, moving within the periphery of a large, nearly permanent cyclone, whose centre generally lies not far from Iceland, and thus those winds and gradients predominate, which would tend to occur in that part of the large cyclone where we happen to be situated. E. DOUGLAS ARCHIBALD

OUR ASTRONOMICAL COLUMN

THE TRANSIT OF VENUS IN NEW SOUTH WALES, &c.—In his address as president of the Royal Society of New South Wales, read May 3, Mr. H. C. Russell, the director of the Observatory at Sydney, gave some account of his arrangements for the observation of the approaching transit of Venus in that colony. Provision was liberally made last year by the legislature, and a sum of 500*l*. has been placed at Mr. Russell's disposal for this purpose. With this he states he will be able to provide four high-class 6-inch equatorials, exactly similar to those which are to be used by European observers, and two of 4½ inches. There are remaining from the last transit one equatorial of 11½ inches, one of 7¼, one of 5 inches, one of 4¾, and one of 4¼ inches. He hopes to be able to take up four stations, in addition to the Observatory, with two observers and two telescopes at each point. In order to make the best of the chances of favourable atmospheric conditions, elevated points on the east coast of New South Wales, have been selected, which, it may be fairly anticipated, will have a clearer view an hour after sunrise than could be looked for near the sea-level. Mr. Russell remarks that in observing the transit of Mercury last November, the observers were stationed at Bathurst, Katoomba, and Sydney, places which he had thought were far enough apart to secure different weather; but the result showed that the weather was practically the same at the three stations. This induced the unpleasant reflection that it may prove cloudy all along the coast on December 6, and he had therefore gladly taken advantage of the recent commission to Lord Howe Island to make some inquiry as to its suitability as a station. It is found that an elevated spot is easy of access, and the weather at the hour and season is almost sure to be fine.

We have also received from the Imperial Observatory of Rio de Janeiro a report on the proposed arrangements to be made by the Brazilian Government for securing observations of the Transit. In addition to Rio, it is intended to establish a station at Pernambuco and to equip an expedition to Santiago de Cuba. The details are in charge of M. Cruls, acting director of the Observatory at Rio.

SOLAR PARALLAX FROM OBSERVATIONS OF MINOR PLANETS.—Mr. David Gill, H.M. Astronomer at the Royal Observatory, Cape of Good Hope, has arranged with a number of observatories in both hemispheres for corresponding observations of the minor planets, *Victoria* and *Sappho*, about the times of their oppositions in the present year. Victoria, in opposition on August 24, will be distant from the earth 0·89 of the earth's mean distance from the sun; and Sappho, which comes into opposition in R.A. on September 24, will be within 0·85, so that we have in each case a favourable opportunity of applying the method of determining the sun's parallax, which was advocated and also applied by Prof. Galle, the director of the Observatory at Breslau. In a communication to the *Astronomische Nachrichten*, Mr. Gill states that the necessary extra-meridian observations will be made in the southern hemisphere at the Cape, Natal, Melbourne, and Rio de Janeiro, and in the northern hemisphere at Dunsink (Dublin), Strasburg, Berlin, Bothkamp, Leipsic, Upsala, Moscow, Clinton, U.S., and probably at Kiel. From the clearer skies of the southern hemisphere, he believes that a fully corresponding number of observations will be secured there, notwithstanding the smaller number of observatories, and he invites co-operation from other establishments in the northern hemisphere, on this ground. A list of the proposed stars of comparison is given in his letter.

COMET 1882*a* (WELLS).—The Emperor of Brazil, telegraphing to the Paris Academy of Sciences (of which body his Majesty is a member), reports the visibility of this comet at Rio de Janeiro, on June 17, and that three days later the nucleus was very bright, and the tail 45° long. If there be no error in the telegram, the development of the tail must have been rapid after the perihelion passage.

Prof. Zona has made a communication to the Società di Scienze Naturali of Palermo, in which he describes the undulations in the tail observed there in the week following April 14. On the 17th, in a fine sky, it is remarked of the phenomenon—"Sembra che la luce della coda vada a poco a poco diminuendo stringendosi attorno il nucleo come se venisse da questo attratta, poi ad un tratto si spande di nuovo."

EDUCATION IN THE UNITED STATES[1]

THE great work of the American Bureau of Education continues, like that of a large Reference Library among men who know its value. About 100 inquiries a day are addressed to it, and 150 letters of information are sent out on subjects varying from the Semitic language to dress-making, and including everything that comes within the limits of education. Its latest report, in which everything is tabulated, down to the opening of a normal summer school only kept open for four weeks, and in which attention is called to many matters of special interest, cannot be gone through without advantage to educationists in any civilised country, and most of all to those in our own.

If we are accustomed to think that Americans look upon their country with complete satisfaction, and as standing ahead of the Old World, more particularly in the matter of education, we shall not find such self-praise in the Government reports. A very interesting *résumé* is given of what foreign countries are doing. Attention is called to the more thorough manner in which young persons aiming at commercial pursuits are instructed on the Continent, while England is quoted as an example to be followed of the higher education of women. It is satisfactory to find, in this Report also, that the province of Ontario, in Canada, stands at the head of educating countries. There a system of free schools and compulsory attendance was established in 1871; and while the number of children within the school ages of five and sixteen was 492,460, there were actually attending schools 489,015! On the other hand, it is surprising to find the illiteracy of a very large proportion of the population of Prussia, where of 40,000,000 persons (including infants, &c.), 25,000,000 were unable to read or write!

The schools requisite to supply education to so widely spread a population as that of America are far more numerous than in our crowded country. Naturally, therefore, it is a great difficulty to find sufficient teachers properly educated and qualified for this important work. It might seem, at first, that, in a country where, on an average, each individual is better educated than in England, there would be no lack of able teachers; but teaching is an art requiring a technical education as much as any other art; and the work of those who have not had this technical training is as clumsy as most amateur work is, and is found to have the fault of superficiality. The Bureau of Education is simply an office of information and reference; it has no central control over the various States; and one result of this is, that no uniform standard of capacity is required of those who present themselves as teachers, and two standards are to be found, not only in the same State, but in the same city. A more unsatisfactory difficulty still is the favouritism and even corruption, not unfrequent in appointing and dismissing teachers, who, in many cases, seem to go in and out of office like the nominees of a government. The picture of corruption on page xxii. must surely be an extreme case; but its possibility must add greatly to the difficulty of the situation. Pennsylvania's is called a proud record, there dishonesty among school-board officials is *almost* unknown; "a few thousand dollars would cover all the losses." These things tell greatly against the business of a teacher being an attractive one, and, to add to them, in many States, as in Virginia, diminished public funds have been allotted to the common schools; the number of schools has been reduced, and the salaries of the remaining teachers lowered. In some countries in that State the local boards determined to open no schools, and to use the income for paying off debts.

The small pay of teachers, in the lowest standards especially leads them to throw up that branch on the first

[1] United States Report of the Commissioner of Education for the year 1879. (Washington Government Printing Office, 1881.)

opportunity—a very mischievous thing in its results—for in nothing is it more true than in the case of education that what is well begun is half done. Hence a good infant school is an immense help to all subsequent stages, and *vice versâ*. So much is this deterioration felt in Michigan, where salaries of schoolmistresses have been reduced to the level of those of domestic servants, that the attendance at the primary schools has absolutely fallen off; and the explanation of it seems to be that these faults are well known to the intelligent public of the United States, and accordingly the children are being removed to private schools. The Commissioner very aptly quotes Roger Ascham's words:

"It is a pity that commonly more care is had, yea, and that among very wise men, to find out rather a cunning man for their horse, than a cunning man for their children. . . . To one they will gladly give a stipend of 200 crowns by the year, and loath to offer to the other 200 shillings. God that sitteth in heaven laugheth their choice to scorn, and rewardeth their liberality as it should. For he suffereth them to have tame and well-ordered horses, but wild and unfortunate children; and therefore, in the end, they find more pleasure in their horse than comfort in their children."

This is not a bright picture of the work of education in America. It certainly seems an indication that our brethren there are losing faith in the old rule, that what is worth doing at all is worth doing well, but it does not go very deep below the surface of so vast a work. On the whole there continues a steady rise in numbers of both schools and pupils, though not so large since 1875, as we should have expected in such a progressive country. This rise also is almost wholly in cities, again pointing to the difficulty of supplying the *number* of schools required in so wide-spread a country. In one of the most flourishing of these cities also, Chicago, it sounds more like the Old World to read that more than 2000 children are taught in underground rooms, where the light is so bad as to expose their eyes to serious injury! In New York and New Jersey, where population in its extremes of rich and poor keeps crowding together as in older countries, the school attendance is actually falling off. In Maine, New Hampshire, and Rhode Island the population is, curiously enough, at the present time decreasing, but school attendance is increasing; not quite one-third of the population attend daily; nearly two-thirds are on the books. In nearly all Southern States there is considerably increased attendance. The administration of the Peabody Fund has had a remarkable influence in developing the school spirit in the south, in awakening the people to a sense of their obligation with reference to the support of public schools and in maintaining a high standard for such schools. This last result has been accomplished by the wise policy pursued by Dr. Sears in insisting upon a certain degree of excellence in a school as the condition of receiving aid from the fund.

An increase of more than 50 per cent. in the number of students in the Schools of Science in 1878 led to the number of these schools being raised from 809 to 884; but this increase of pupils hardly kept up in 1879. Still science, though a long way behind theology in number of schools, is rapidly gaining ground upon it, and has already far outstripped it in number of students. In 1870 there were 80 schools of theology with 3254 pupils, which numbers have grown respectively to 133 and 4738; but the corresponding numbers for science are 17, increasing to 81, and 1413, increasing to 10,914! This has called for a large increase of teachers; and, accordingly, while in secondary schools the proportion of those receiving a scientific, to those receiving a classical, education is as 2 to 5, in the preparatory department of colleges the proportion is as 4 to 5. At some of these colleges there are workshops, where the use of tools is taught to students by their being used in the production of other tools and things useful to the establishment. The Massachusetts Institute of Technology has one of these workshops upon a plan designed at the Imperial Technical School of Moscow, Russia. The income of these scientific colleges is partly derived from the sale of lands allotted to them in each state; 30*l.* a year is charged to each pupil for tuition, but it represents but a small percentage of the income. The Cooper Union Free Night Schools of Science are well described as "an intelligent application of a great charity. Their purpose is the technical instruction of the labouring classes, and the means used are a free library and reading-room, free lectures, and two classes of schools, viz. the Evening Schools of Science and Art, and the Art School for Women. All money earned in the schools belongs to the pupil, and a number are thus enabled to support themselves while studying. A Telegraph Company has appointed a teacher in this school, who trains the pupils in their methods of working their instruments, and they have employed many of its graduates on their lines. Still the Report endorses the doctrine that even in technical schools, principles, not practice, must be the leading object of a school, and that even to those following a special business, a broad general culture is very important, and a want of it very much felt. After reviewing the various schools and institutions of this class in the United States, the Commissioner of Education is led to the conclusion that "the present condition of scientific and technical schools in our country is thus seen to be very promising. . . . Already they have excited the people to an appreciation of scientific methods and processes in their application to agriculture and the mechanic arts; and as the results of such methods are more widely known and more fully comprehended, the institutions rise in favour and influence, and the demand for their graduates increases."

Drawing is highly eulogised, and its importance insisted upon. In Massachusetts any town *may*, and every city and town having more than 10,000 inhabitants *shall*, provide for instruction therein; and a training school for teachers has been organised to meet their wants, with the result also of supplying designers to many manufacturers who were in want of them.

On the law schools in America, our Report observes that it is surprising that a profession which requires such thorough preparation, and which has in it so large a number of men of wealth, and one which occupies so important a place in the public affairs of the country, has done so little to endow its schools in the most substantial manner.

Medical men are very plentiful in the United States compared with other countries: 1 to every 600 inhabitants, while Canada has only 1 to 1200 inhabitants, Great Britain 1 to 1672, Germany 1 to 3000. A higher standard of examination is recommended, and an all-round education insisted upon. Only five schools at present require the highest amount of study to qualify a full practitioner.

A valuable branch of education is the training schools for nurses, which adopt a very high standard as to whom they receive for their important functions. A small sum, however, is *paid* to students, besides board and lodging, the latter of which is carefully provided them at a bright, cheerful home away from the hospitals where their duties are inculcated.

More than 30,000 blind people are among the population of the United States, and their education is considered, like other education, a duty and not a charity, and is provided out of national funds. Again, the education of the feeble-minded is systematically provided for, as being necessary for the prevention of crime, and useful to individuals of all classes. This leads on to the most important question in a country where population is thickening even as much as in America, of Reform Schools. There, under the Michigan system especially, which all should investigate, it seems fully realised that prevention is better than cure; and that while these industrial homes are indubitably powerful in preventing the formation of criminals, prisons, on the other hand, are just as indubitably powerful in carrying it on!

Evening High Schools have been worked in several American cities, but hardly with results lending much encouragement to increase. One would think, however, that the knowledge gained at elementary schools by the age of fourteen would lead to a wish for more on the part of many, to whom a library only could not supply it. But free libraries are a great power in the United States. Forty-nine new ones were opened in 1879, containing 86,779 volumes, making a total of 3842 public libraries of all classes. The correspondence with the Bureau of Education on the subject of public libraries far exceeds that on any other subject; academies standing next, and art and science standing curiously low for a country like America. Yet local feeling varies even on a favourite subject like free libraries, the large manufacturing town of Paterson being without one like so many populous English towns.

Like free libraries also, agricultural education is a department in which England, notwithstanding the height to which husbandry has been brought there, stands lower than in any other country.

One can hardly, nevertheless, read this Report without feeling that spite of our shortcomings the advantages are not all on the side of America. Our compactness, plentiful supply of thoroughly-trained teachers, and, we must add, higher sense of honour in political transactions, perhaps owing in part also to the close inspection to which the works of every man are subjected here, entitle us to feel how far better we are placed, as far as meeting educational requirements goes, than the thin and scattered families of the United States.

MALAYO-POLYNESIAN LINGUISTICS[1]

THE learned authors have earned the thanks of linguistic students by issuing, in a separate form, this important contribution to a better knowledge of the Melanesian and Papuan languages, which was first published in the eighth volume of the *Philological Transactions* of the Royal Saxon Scientific Institute. It forms the first instalment of a series of papers intended to supplement the comprehensive and well-known treatise of H. C. von der Gabelentz, published at Leipzig in 1860 and 1873. To the languages dealt with in that work are now added two others: that of Mafór (Núfór), Geelvinck Bay, and a dialect current on the Astrolabe Bay Coast, North-East New Guinea, from materials supplied by Van Hasselt and Miklucho-Maclay respectively. To these notices are added the Papuan idioms spoken in the islands of Errúb and Maer, Torres Strait, and in Segaar Bay, near Cluer Gulf, South-West Coast of New Guinea, the former by Herr Grube, the latter from data supplied by H. Strausch to the *Zeitschrift für Ethnologie*, viii., pp. 405-18.

In the introduction, the question of the relations of the Papuan and Malayo-Polynesian linguistic groups is discussed at some length. It is satisfactory to find that the authors seem at last disposed entirely to abandon the views held by the elder von der Gabelentz regarding a possible, if not probable, fundamental unity of these families. The key-note of the objection to this theory is struck in the following paragraph, at p. 4:—"Assuming that the linguistic affinity were fully established, we should have at once a direct antagonism between anthropology and philology. Two linguistic groups are related; of the corresponding ethnical groups, one belongs to one, the other to another race of mankind. How is this possible?"

To many this may seem merely an old-fashioned *a priori* argument, of no value in itself unless supported by the evidence of facts, which have hitherto pointed at an opposite conclusion. But one of the most firmly established and universally accepted principles of anthropology maintains the evanescent character of human speech as compared with the relative fixity of physical types. Ethnologists are of accord as to the substantial unity of the Iranian, Semites, Berbers, Basques, Georgians, and other members of the so-called Caucasic ethnical stock. Philologists are, on the other hand, equally of accord as to the essential difference of the Iranic, Semitic, Hamitic, Basque, Georgian, and other linguistic groups spoken within this common Caucasian ethnical group. Here we have fundamental racial unity combined with organic divergence of speech, and the apparent contradiction is readily reconciled by the doctrine of the far greater permanence of physical, as compared with linguistic types. The race, even notwithstanding the intrusion of foreign elements, remains essentially one; the speech, presumably one originally, owing to its greater evanescence diverges in various directions to such an extent, that all traces of this original unity have long been effaced.

Coming now to the Oceanic area, where the Papuan and Malayo-Polynesian forms of speech, shown to be fundamentally one, while the physical forms are confessedly distinct, the case would be entirely reversed. Instead of physical unity, combined with linguistic disparity, we should have the opposite phenomenon of linguistic unity combined with physical disparity. Such a phenomenon is certainly neither intrinsically impossible nor altogether unknown to science, as appears, from the Persian-speaking Házérahs and Aimaks of North Afghanistan, or the French and English-speaking negroes of the New World. But where they occur, such cases are easily accounted for by political supremacy, social contact, superior culture, and other obvious influences. These influences have also been to some extent at work probably for many ages in the oceanic world. The Malays in the west, and the brown Polynesians in the east, both of kindred speech, and both of roving or piratical habits, have in this way influenced numerous Papuan and Melanesian peoples in their respective domains. Hence we find the Tagalas, Bisayans, and even some of the Negrito Aetas of the Philippines, as well as some of the Negrito Samangs of the Malay Peninsula, and most of the Formosan wild tribes speaking various more or less divergent dialects of the organic Malay speech. In the same way the Papuan Motu tribe of the south-east coast of New Guinea, many of the Melanesian Fijians, New Hebrides, and Solomon Islanders are found to be now speaking various more or less divergent dialects of the organic Polynesian speech.

It was precisely from these misunderstood facts that philologists had generally arrived at the surprising conclusion that, in point of fact, the Polynesian and Melanesian languages were essentially one, thus placing anthropology and philology in antagonism. The Melanesian and Papuan dialects selected by Hans Conon von der Gabelentz, and again quite recently by the Rev. Mr. Codrington, as the subjects of comparison, were not, properly speaking, Melanesian languages at all, but Polynesian forms of speech imposed by the restless Samoans and other Polynesians on these Papuan and Melanesian populations. Obvious instances are the almost pure Papuan Motu people speaking a tolerably correct Samoan dialect (Rev. W. G. Lawes), and the mixed Melanesians of Fotuna, in the New Hebrides, speaking idioms closely related to the same group.

But it is remarkable that the reverse phenomenon has not yet been recorded. At least no instance is known to the writer of a distinctly Malay or Polynesian tribe speaking a distinctly Papuan or Melanesian tongue. It is more than doubtful whether such a case will ever be discovered in this watery domain, where the Malays and Polynesians

[1] "Beiträge zur Kentniss der Melanesischen, Mikronesischen und Papuanischen Sprachen," von G. von der Gabelentz und A. B. Meyer. (Leipzig, 1882.)

have always been the aggressors, where the dark populations have always represented the passive or recipient element. On the other hand, wherever it has escaped from Malayo-Polynesian influences, or wherever it has been able to preserve its original speech in spite of those influences, this dark element will certainly be found speaking languages organically distinct from the Malayo-Polynesian. Mr. Man's recently published account of the Andamanese dialects shows that they differ in their morphology, in their glottology—in fact, in every respect, from those of Malaysia.

Mr. Lawes makes the same remark respecting the Koiari people, who occupy the highlands back of Moresby Bay in South-East New Guinea. And the authors of the work under review now find that the Mafór of Geelvinck Bay betrays, with many striking resemblances to the Malayo-Polynesian, "an astounding peculiarity of structure."[1] The "resemblances" are of a verbal character, due to known contact with the Malays, who have long frequented the waters along the north-west coast of New Guinea. The "peculiarity of structure," involving root modifications and something even approaching to inflection ("Quasiflexion"), as understood in the Aryan family, belongs to the organic Papuan linguistic type. This type is thus demonstrated to be fundamentally distinct from the Malayo-Polynesian, which shows no trace of these peculiarities. And thus also disappears the fancied antagonism hitherto supposed to exist between the linguistic and anthropological elements in the Oceanic regions.

A. H. KEANE

[1] "Gerade das Mafoor'sche aber wird in seinem Baue bei manchen auffälligen Aenlichkeiten eine erstaunliche Eigenthümlichkeit im Bildungsprinzipe aufweisen," p. 4.

THE SOLAR-COMMERCIAL CYCLE

IN an article printed in NATURE (vol. xix., pp. 588-90) I gave a table of the prices of wheat at Delhi, from 1763 to 1835, quoted, or rather calculated from data given in a brief paper of the Rev. Robert Everest, contained in the *Journal* of the (London) Statistical Society for 1843, vol. vi. pp. 246-8. Between the years 1763 and 1803 there was evidence of wonderful periodicity in the recurrent famine and abundance at that part of India. When recently engaged in examining more minutely the relation between these prices and the variations of solar activity, as indicated by Prof. Wolf's numbers, it has occurred to me that an inference may be drawn which I overlooked on the previous occasion.

In the accompanying diagram I have exhibited the prices in question together with Wolf's numbers as stated in the *Monthly Notices* of the Royal Ast. Soc. vol. xxi. pp. 77, 78. I have also indicated the dates of the Commercial Crises of the time according to the article on the subject in Mr. H. D. Macleod's "Dictionary of Political Economy," vol. i. pp. 627-8. It need hardly be said that the coincidence between the three classes of recurrent phenomena is of a very remarkable character, and goes far in supporting the relation of cause and effect which I had inferred to exist, both on empirical grounds and from the well-known fact that it is the cheapness of food in India, which to a great extent governs the export trade from England to India. But although the coincidence of commercial Crises in Western Europe with high corn prices at Delhi is almost perfect, it will be noticed that after 1790, the correspondence of the solar curve with that of prices is broken. Wolf does not recognise the existence of any sun-spot maximum between 1788 and 1804, and he believes that there was a minimum at 1798. According to Wolf's later researches (*Memoirs* Roy. Ast. Soc., vol. xliii. p. 302), these dates are respectively, maximum 1788·1, minimum 1798·3, and maximum, 1804·2.

But now arises the question to which I wish to draw attention. If the eleven-year solar periodicity was really interrupted in this long interval of 16·1 years, how comes it that the meteorological periodicity, as manifested in the corn prices at Delhi, was not interrupted. It is true that the price maximum of 1803 was a comparatively small one; but this was quite to be expected, considering that if there were an intervening solar maximum, it must have been a small one. May we not reverse the argument and infer that the evident relation between the previous sun-spot maxima and the succeeding scarcities at Delhi, would lead us to expect a minor solar maximum about the year 1797?

Standing alone, the presumption thus created would, doubtless, be of a somewhat slight character. But it is in the first place well known, that the data upon which Wolf based his numbers about this time, are less conclusive than in other parts of his series. His results, too, from 1801 to 1807 are expressly marked as doubtful, so that extrinsic information which might have little weight where there was abundance of reliable solar or magnetic observations may come in very usefully where doubts already exist. Now it happens that the late Mr. J. A. Broun inquired very carefully into the facts known about the solar variation at this time, his results being given in the *Transactions* of the Royal Society of Edinburgh, vol. xxvii. pp. 563-594, and in his article printed in NATURE (vol. xvi. pp. 62-64). Broun inferred from the observations of Gilpin, and from other data, that there was a small maximum about 1797, and that there were grounds for believing that the subsequent maximum "may really have occurred after 1806, when Gilpin's series terminated." Now, what Broun deduced from totally different data, is exactly what we should infer from the Delhi prices. If we are to believe that Indian meteorology depends upon solar variations, then it almost follows that there was a solar maximum about 1797. The consequence of this inference, however, is very important, because it goes to support the views of Lamont, Broun and others, that the solar period is about 10½ (10·45) years and not 11·1 as calculated by Wolf. It should also be pointed out that the temperature observations of Prof. Piazzi Smyth lead to a like result. The epochs of the heat waves are, according to him (NATURE, vol. xxi., p. 248), 1826·5, 1834·5, 1846·4, 1857·9, and 1868·8, giving an average interval of 10·57 years.

I may take this opportunity of asserting that the progress of events confirms belief in the eastern origin of the great commercial Crises.[1] In his important work, the "Précis du Cours d'Economie Politique" (vol. i. pp. 604-5), M. Cauwès while partially accepting the doctrine of periodicity criticises the particular views here advocated. He says:—

"Depuis longtemps les économistes ont signalé la périodicité de ces évolutions : MM. Juglar et Jevons prétendent même pouvoir la calculer d'une manière précise. Selon M. Jevons, l'ensemble des phénomènes serait renfermé dans un cycle de dix années et demie. De fait, les grandes crises économiques du siècle (1806, 1817, 1825-7, 1836-37, 1847, 1857,) s'échelonnent à dix années d'intervalle ou à peu près, mais les dernières, 1866 et 1873, seraient venues un peu avant l'heure, et celle de 1873 s'est prolongée au delà de toute attente." M. Cauwès in short accepts the six earliest crises of this century as sufficiently agreeing with the theory. The crisis of 1866 no doubt came about a year before it would be expected, which is a divergence of reasonable amount. The year 1873, however, is one which it would be impossible to introduce into the series. Now there doubtless were both in America and England in that year, a state of commercial stringency, a relapse of prices and other disturbances which might be mistaken for the signs of a

[1] As it is impossible to reproduce the explanations and qualifications contained in the article quoted above, or that at pp. 33-37 of the same volume of NATURE (vol. xix.), it is assumed that this article is read subject to those qualifications and explanations. In p. 588 col. *b* of the same volume, a *seer* of wheat was by a typographical oversight stated to be equal to 21 lbs. instead of the true weight 2 lbs.

true crisis. But such as it was, this crisis turned out to be just one of those exceptions which prove the rule. The following statistics of bankruptcy in the United Kingdom, as collected by Messrs. Kemp, and published in the *Mercantile Gazette*, show conclusively that the real collapse came in exact accordance with the decennial theory in the autumn of 1878 or early in 1879:—

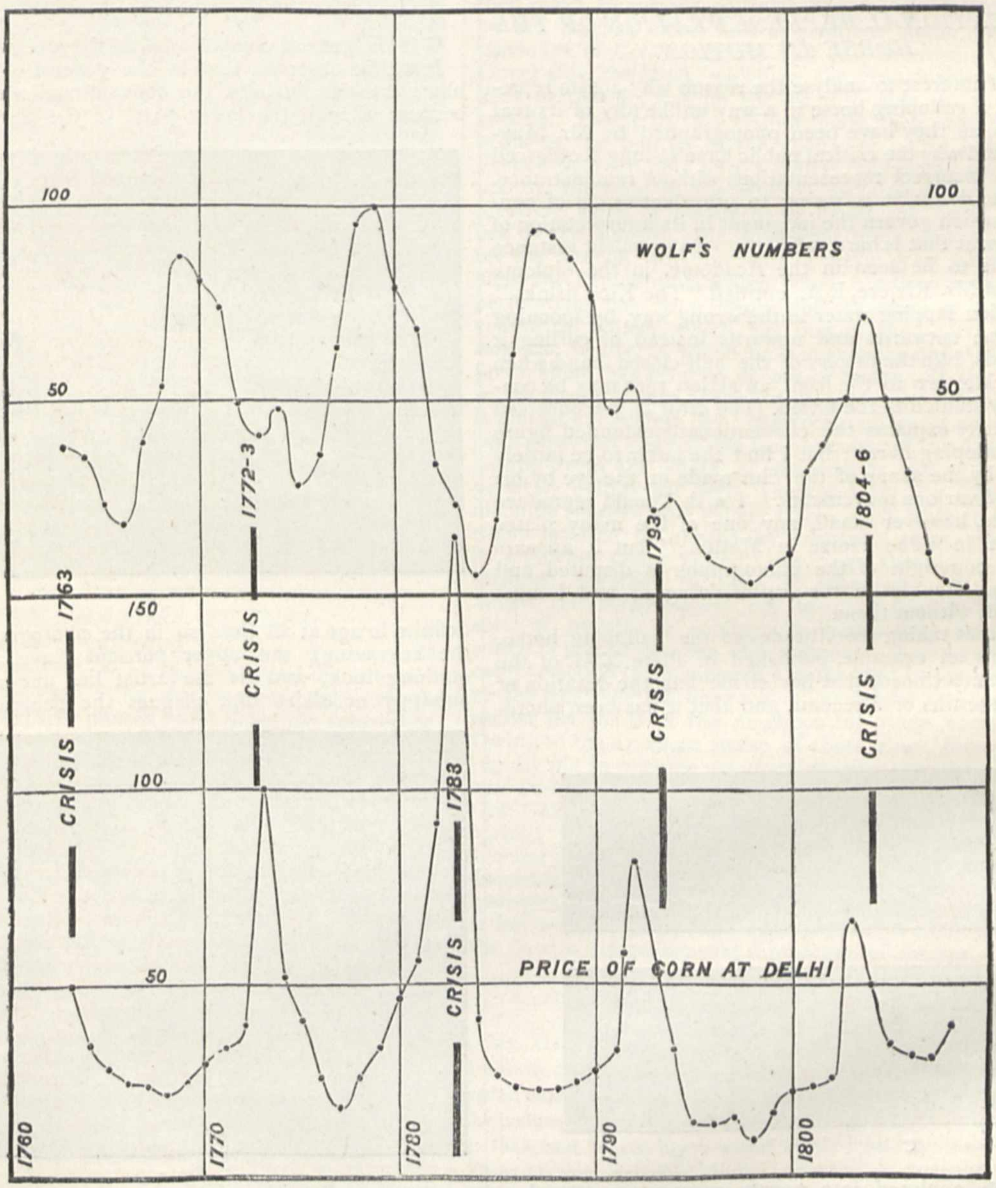
Year.	Number of bankruptcies.	Year.	Number of bankruptcies.
1870	8,151	1876	10,848
1871	8,164	1877	11,247
1872	8,112	1878	13,630
1873	9,064	1879	15,732
1874	9,250	1880	12,471
1875	9,194	1881	11,632

It will be remembered that the crisis of 1878 was precipitated by the failure of the City of Glasgow Bank owing to great losses of their customers in the Indian trade, the depression of that trade being caused by the recent famine in India.

As a good deal of misapprehension has arisen concerning the American Crisis of 1873, it is well to quote the following valuable statistics from the Annual Circulars of Messrs. R. G. Dun's mercantile agency:—

Year.	Number of failures.	Amount of liabilities in dollars.
1873	5,163	228,589,000
1874	5,830	155,239,000
1875	7,740	201,060,353
1876	9,092	191,117,786
1877	8,872	190,669,936
1878	10,478	234,383,132
1879	6,658	98,149,053
1880	4,735	65,752,000
1881	5,582	81,155,932

Although the amount of liabilities involved in the failures of 1873 was larger than in any subsequent year except 1878, the number of failures was less than in any year named except 1880. The average liability of each failure in 1873 was $44,274 compared with 22,369 in 1878. It is thus apparent that the crises differed entirely in character, and I believe that the collapse of 1873 was mainly due to the breakdown of values of properties necessarily following sooner or later upon the contraction of the paper



currency. In any case there was a very distinct maximum of failures in 1878, succeeded by a sudden reduction, and it occurred at a time differing by less than a year from the corresponding collapse in England. In the Dominion of Canada there was a very strongly marked maximum of failures at the same time as in England, namely, in 1879.

The theory of the solar-commercial cycle and of the partially oriental origin of decennial crises has received such confirmation as time yet admits of. I am, however, fully alive to the weight of some of the difficulties and objections which have been brought forward against the theory. These objections are far from being conclusive, and I may hope to give them in due time a satisfactory answer. But such answer must involve more detail than can be put into a brief article.

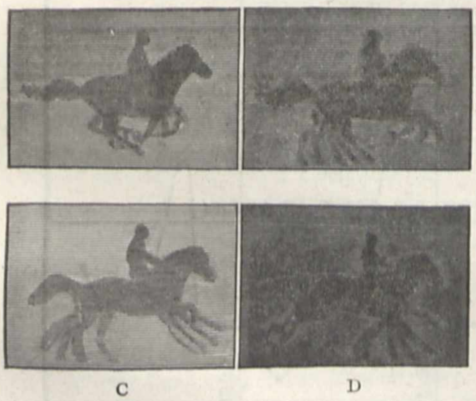
W. Stanley Jevons

CONVENTIONAL REPRESENTATION OF THE HORSE IN MOTION

It is of interest to analyse the reason why artists represent a galloping horse in a way unlike any of its real attitudes, as they have been photographed by Mr. Muybridge, and why the critical public have so long acquiesced in these incorrect representations without remonstrance. Partly, no doubt, it is owing to prevalent errors of conception which govern the judgment in its interpretation of a movement that is hard to follow. An excellent instance of this is to be seen in the Academy, in the diploma picture of Mr. Riviere, R.A., entitled "The King drinks." It is a lion lapping water in the wrong way, by spooning his tongue outwards and upwards instead of curling it backwards, like the fingers of the half-closed hand when the knuckles are to the front, an action that may be conveniently studied in the kitten. The error of preconceived ideas partly explains the conventionally extended figure of the galloping horse; but I find the latter to be largely justified by the shape of the blur made on the eye by his rapid and various movements. I wish I could reproduce on a scale, however small, any one of the many plates published in "The Horse in Motion;" but it appears that the copyright of the photographs is disputed, and there are difficulties in the way of doing so, and I must make shift without them.

I find that taking the attitudes of the galloping horse, Phryne, as an example, published in Plate XVI. of the book just mentioned, that her stride has the duration of about six-tenths of a second, and that it has been photographically analysed into twenty momentary attitudes. Also, that these may be arranged in four groups, which I will call A, B, C, and D. I have made photographic composites of each of these groups, and copies of them by the wood engraver are annexed.

A B



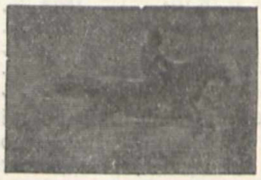
C D

A contains six attitudes, in which the legs are crumpled below the body.

B contains four attitudes, in which one or both of the hind legs are on the ground, and the fore legs are pawing in the air.

C contains five attitudes, in which both the fore and hind legs are extended.

D also contains five attitudes; the hind legs are flung back and the fore legs are on the ground.



G

G is the general composite of all the attitudes.

It will be observed that in the general composite the blur somewhat justifies the conventional representation, because though the lower parts of the limbs leave no definite image at all (less so in the photograph than in the engraving), the upper portions have a distinctly outflung look, and as the artist lies under the same unhappy necessity that plagues the geographer, who, when he has to put down a lake or river on the map must put it *somewhere*, although its real position may be uncertain, so the artist thinks he must put the lower parts of the four legs of the horse somewhere, and he is guided

Fig. 1.

Fig. 2.

in his decision as to the exact place by the direction of their upper portions.

I find, however, on trial that another cause of confusion lies in the difficulty of watching closely both the fore and the hind halves of the animal simultaneously. The eye wanders from one to the other and seizes the most characteristic attitudes of each, and combines them into a hybrid monster.

The accompanying composites, Figs. 1 and 2, each from four successive attitudes, will explain the process; it certainly tends to go on in my mind, and probably does

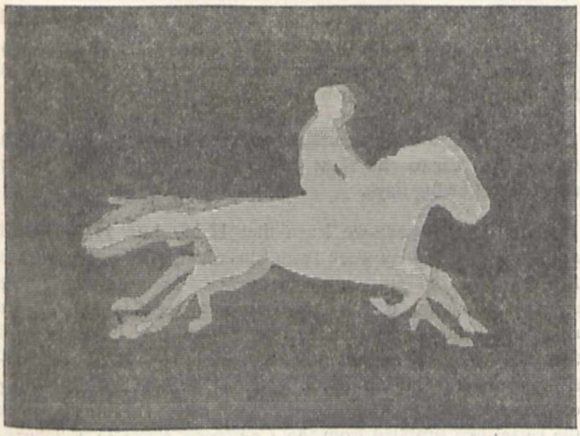


FIG. 3.

so in that of others. The first composite shows the hind legs distinctly; the second shows the fore legs distinctly; and if duplicates of the first and second woodcuts are each divided in two halves and the best defined half of each are united (in a way that might have occurred to Baron Munchausen if a second rider's horse had suffered as his own, and there had been a mistake in piecing them), a result, Fig. 3, is produced that shows a very fair correspondence with a not uncommon representation in sculpture. FRANCIS GALTON

THE CHANNEL TUNNEL

AT the meeting of the Paris Academy of June 26, M. Daubrée read a note on the geological conditions of the Channel tunnel. The works connected with the tunnel comprise three phases:—(1) Scientific researches; (2) preparatory works; (3) execution of the tunnel itself. The first phase was devoted to purely geological investigation, in the form of minute exploration of the French and English coasts, exact and detailed investigation of the sea-bottom in the Strait, borings made on *terra firma* which verified the nature, thickness, and inclination of the strata, and gave an approximate idea of the hydrological condition. Since 1879 the second phase has been entered on by verifying the previous scientific data, and preparing for the execution of the tunnel itself, experimenting in small galleries with machines and tools capable of being ultimately used in a work of exceptional importance. On the French coast, the geological investigation established a slight bulging of the beds at the place known as the *Quenocs*. On account of this bulging the inclination of the strata, which, in the strait is towards the north-north-east, is found, along the cliffs of Blanc Nez, turned towards the south-east, and the slope which, according to the first orientation, in the neighbourhood of the Quenocs, is about 0·05 m. per metre, is found, in the second, to be nearly 0·09 m. It is important then, to find in what conditions this bulging may modify the physical conditions of the banks forming the base of the Rouen chalk. For this purpose the French Association had dug, near Sangatte, two shafts of a depth of 86 m., which met the gault at 59 m. below the hydrographic zero, adopted in the maps in which the geological explorations of 1875-6 are recorded. The digging of these shafts, one of them 5·40 m. in diameter, showed that all the white chalk and the upper part of the Rouen chalk are water-bearing. These strata had thus to be abandoned.

On the other hand, the base of the Rouen chalk allowed only a very small portion of water to pass. There, then, the tunnel should be pierced, as the stratum appeared to proceed without interruption from France to England. The water penetrating the works is fresh, and of good quality; at the upper part only some slightly salt veins were found. Nevertheless, the communication of the water-bearing strata with the sea is proved by the oscillation of the water-level in the shafts according to the tide, and by the invariable increase at high water. M. Daubrée then refers to further galleries dug on the French and on the English sides, and excavations made with the machines of Col. Beaumont and Mr. Brunton. On the Dover side, the chalk, which on the French side was but little permeable, was, on the English side, quite impermeable. Owing to this circumstance, they were able to begin at the bottom of the shafts, at 29 m. below the French hydrographic zero, a gallery advancing under the sea by following in the stratum an almost regular descending slope of 1-80th, or 12·5 mm. per metre. The bed on the English side, somewhat more powerful than on the French side, presents a very great regularity. Thus the Beaumont machine, which has been used in the perforation, has been easily able to trace a perfectly cylindrical gallery, which has now reached 1800 metres from the shafts, of which 1400 metres are under the sea. So far there has been no access of water. In the banks which form the base of the Rouen chalk, the rock in mass is almost completely dry; the access of water which has been observed has entirely the character of small springs issuing from the joints of fracture or cleavage. The perfectly cylindrical form produced by the Beaumont machine renders the gallery where such leakage occurs easily isolated by means of cast-iron rings prepared in segments easily united, the rings themselves being clamped together to form a tube of any length. When the water spurts out in considerable force, a sort of mastic or minium is successfully employed, which is placed between the segments of the rock, and compressed in the manner of a water-joint by the pressure of the rings against the rock. The mastic also seems to render the joints of the neighbouring rings water-tight. Owing to the excellent make of these rings, they can be rapidly put in position; a complete ring can be placed in half-an-hour, and several experiments in the Shakespere Cliff Gallery have proved that by this simple process the springs encountered can be completely blocked. On account of the slope on which the English gallery descends, its extremity recently reached 51 m. below the hydrographic zero, at a point where the depth of the sea at low water is 5 m.; there is thus 46 m. of chalk between the floor of the gallery and the bottom of the sea.

NOTES

MR. GEORGE GRAY, Honorary Secretary of the Philosophical Institute of Canterbury, Christchurch, New Zealand, writes under date May 20:—"I have been requested to forward you the inclosed resolution passed at a meeting of this Institute May 4, 1882, and to ask if you would kindly insert the same in the Notes of your valuable journal. Resolution proposed by C. Chilton, M.A., seconded by G. Gray and carried:—'That this Institute desires to place on record its high appreciation of the great services that have been rendered to science by the late Dr. Charles Darwin, and its deep sense of the loss that science has sustained through his death.'"

AT a meeting of the Executive Committee of the Darwin Memorial Fund, held on June 30 at the Royal Society's Rooms, Burlington House, it was announced that the total subscriptions already promised or received amounted to £2487 13*s*. It was decided that the memorial should take the form of a marble statue; and a sub-committee was appointed to make the necessary arrangements. It was agreed to ask the trustees of the British Museum for permission to place the statue in the large hall of the British Museum (Natural History), South Kensington. The sub-committee consists of the following:—Mr. W. Bowman, Sir J. D. Hooker, Prof. Huxley, Mr. C. T. Newton, and Sir F. P. Pollock, with the Chairman, Mr. W. Spottiswoode, Pres. R.S., the Treasurer, Mr. John Evans, Treas. R.S., and the Hon. Secretaries, Prof. Bonney and Mr. P. Edward Dove.

WE would draw the attention of our readers to a letter which we print this week from Dr. Sophus Tromholt, relative to the establishment of an observatory in Sweden for the Aurora Borealis "and other phenomena of Terrestrial Magnetism." Dr. Tromholt, it will be seen, is anxious to obtain for his proposal the opinion and advice of those familiar with the subject. Doubtless some of our readers might in this matter render useful help.

IN the sitting of the Paris Academy of Science of July 2, M. Berthelot, who had crossed the Channel with M. de Lesseps to visit the English works of the Channel Tunnel, gave an enthusiastic description of the galleries excavated at Dover, and the working of the Beaumont machine.

DR. ZIEGLER of Freiburg has recently prepared five wax models illustrating the development of the head of *Sinedon pisciformis*, *Salmo salar*, and *Rana temporaria*, founded upon the investigations of Dr. Ph. Stöhr of Wurzburg. These models are likely to be of great service to students in mastering the development of the skull, being greatly superior for this purpose to the best diagrams. The price of the series, conveniently packed in two boxes is 55 marks.

THE splendid dining-room and picture-gallery, together with the grand staircase of Stafford House, the residence of the Duke of Sutherland in Mayfair, have now been fitted up with the incandescent lamp of the British Electric Light Company, and the arrangements have been made by Mr. W. Mackie, who has been entirely successful in producing a fine effect. There are about 250 lamps displacing 8000 wax candles, and they are fed by the current from six Gramme machines of B type. The field magnets of these machines are excited by the current from two E Gramme machines, it being found preferable to adopt this plan. The power is derived from a 20 H.P. (nominal) steam-engine built by Marshall. The lamps are all in parallel circuit, so that the total resistance of the lighting circuit, including leading-wires of copper, is only 0·6 ohms. The leads consist of copper strand wires ⅛th of an inch in diameter, properly insulated and protected. The pure character of the incandescent light, together with its sanitary and artistic advantages, is causing it to make its way in West-End mansions.

A SPECIAL meeting of the Anthropological Institute will be held at No. 4, Grosvenor Gardens, S.W., the residence of Gen. Pitt Rivers, F.R.S., the President of the Institute, on Tuesday, July 11, at half past eight o'clock, p.m., when the following papers will be read:—1. Note on the Egyptian Boomerang, by General Pitt Rivers, F.R.S., President. 2. On the Longevity of the Romans in North Africa, by the Right Hon. Lord Talbot de Malahide, F.R.S., President of the Royal Archæological Institute. 3. On Neolithic Stone Implements, &c., from Wásá on the Gold Coast, by Capt. R. F. Burton and Commander V. L. Cameron, R.N., C.B. 4. Exhibition of Bushman Drawings, by Mr. M. Hutchinson, with Note by Mr. W. L. Distant.

THE Anniversary Meeting of the Sanitary Institute will be held in the Royal Institution Theatre, Albemarle Street, on Thursday, July 13, at 3 p.m. An address will be delivered by Edward C. Robins, F.S.A., F.R.I.B.A., entitled: "The Work of the Sanitary Institute of Great Britain." The chair will be taken by His Grace the Duke of Northumberland, K.G., President of the Institute.

THE late Dr. Karl Remeis has left a sum of 20,000*l*. to found an astronomical observatory in his native town of Bamberg, Germany. He has besides given the future observatory a 10-inch refractor and several other instruments.

THE great summer excursion of the Geologists' Association will be this year to the West Riding of Yorkshire, on July 17 and five following days.

FROM the *Scotsman* we learn that H.M. ship *Triton* arrived at Granton on Sunday week from Sheerness, where she had been fitted up for the prosecution of deep-sea investigations. The steamer is commanded by Staff-Commander Tizard. At the request of the Royal Society, the *Triton* has been detached for two months to investigate certain questions of physical geography in the Faroe Channel, which have a bearing on the results of the *Challenger* Expedition. On Monday week the vessel was supplied from the *Challenger* office in Edinburgh with dredging and sounding gear, deep-sea thermometers, and other apparatus. Mr. Murray and his assistants are to join the vessel at Stornaway in the course of three weeks; and she will be engaged for about six weeks in investigating the Faroe Channel. After completing this work, the *Triton* is to come into Oban to take on board Prof. Tait, and convey him to the North Atlantic, where, in a depth of 2000 fathoms, he proposes to test certain experiments which he has been performing on the *Challenger* deep-sea thermometers. (See NATURE, vol. xxv., pp. 90, 127.) In regard to the proposed Faroe expedition, it may be remembered that an exploration of the channel in question was made by Staff-Commander Tizard and Mr. John Murray, during the summer of 1880, in H.M.S, *Knight Errant*, the results of which were recently submitted by Mr. Murray to a meeting of the Edinburgh Royal Society. On that occasion Mr. Murray referred to the discovery by the *Lightning* and *Porcupine*, in 1868-9, of two contiguous areas having widely different bottom-temperatures, called by Dr. Carpenter the cold and warm areas respectively. At that time, he said, there was no suspicion of the existence of a sub-marine ridge separating those two areas. Certain theoretical considerations, however, based on some of the general results of the *Challenger* expedition, induced Commander Tizard to express the opinion that these two areas were separated by a ridge rising to within 200 or 250 fathoms of the surface. When a divergence of temperature was observed at some distance above the bottom in adjoining areas, it was inferred that a ridge intervened, and that the point of divergence indicated the height of the ridge. It was to make soundings in reference to this question that the *Knight Errant* was detached (see NATURE, vol. xxii. p. 405). Referring to the probable limitation of the British fauna, Mr. Murray remarked that since the depth limit had been disproved by the finding of animals at all depths, an artificial limitation must be substituted, and he thought it would be a temperature limit, for Arctic, British, and deep-sea species were obtained by the *Knight Errant*. There were climates on the surface of the sea, as well as on land, each having its peculiar fauna, and this surface fauna could be traced on the bottom by the dead shells found in the deposit.

FROM the Cape of Good Hope we receive the Report for 1881 of the South African Museum, which, under the superintendence of Mr. Trimen, is prospering and increasing. The following paragraph is of some interest:—"Upon trustworthy information that in a part of the Beaufort West district some unusually fine and perfect remains of extinct Saurians were accessible, the Trustees in October last despatched the Acting Curator to make an examination on the spot. Mr. Oakley reported that he had met with a large quantity of fragmentary remains of the *Dicynodon* group (some of which he brought with him), and that he had reason to believe, from the best local information obtainable, that in the bed of the Klein Leeuw River there existed an almost perfect fossil skeleton of a Saurian of great size, which, though recently visible, had become hidden by alluvial deposits. In transmitting this report to Government on November 1, the Trustees strongly recommended that a sum of 200*l*. should be placed on the estimates for 1882-83, for the purpose of defraying the cost of procuring for the Museum the more perfect of these fossil remains, and of conducting further investigations into South African palæontology; and they were informed in reply that every consideration would be given to their proposal when the time for framing the estimates should arrive. In reference to their subsequent communication on the subject, dated February 9, they now desire respectfully to renew their recommendation, as it is most desirable that the extinct *Dicynodontia* and allied reptilian forms, so characteristic of the past life of South Africa, should be as completely represented as possible in the Colonial Museum." We trust the necessary funds have been granted, and that the Trustees will see that it is for the best interests of the Colony that such an institution as this be maintained in complete efficiency.

THE surveyor to the Finnish Government, Herr Rodas, states that on June 25 this year he carefully measured the height of a hole, bored according to authentic records 2 inches above the level of the sea on the coast of Österbotten on June 25, 1755, and discovered that that part of the coast had risen, in 127 years, 6 feet 4 inches, or more than half an inch per year.

A SECOND earthquake of a far more violent character than the previous one, was felt at the town of Luleå in Sweden on June 23 at 7.30 a.m., the shock extending as far as the towns of Haparanda and Pitia. It lasted fully a minute, and went from south-west to north-east. People awoke from their sleep, and those about could only stand with difficulty, and that no accident occurred is due to the circumstance that all houses are constructed of wood. Whilst the tremor lasted subterranean noises could be heard similar to the rapid movement of heavy artillery on a hard road. There was no disturbance of the sea, the weather was clear and no wind, the temperature being 20° C., barometer high.

THE Parkes Museum, which was first instituted in 1876 as a memorial to the late Dr. Edmund Parkes, and in order to promote the health of the community for which Dr. Parkes so successfully devoted the best years of his life, was incorporated on June 28. The museum has been temporarily located in University College, Gower Street, since its establishment, and a proposal for permanently keeping it in connection with the College has been under consideration for some time, but the probability is that those who desire to see the Parkes Museum established as an independent institution in a building of its own will have their wishes gratified. Negotiations are now being made for acquiring such a building in a more central position than University College. The Museum is not rich pecuniarily, but its objects are of such growing importance that the necessary funds will no doubt be forthcoming. The objects of the Museum are "to aid, promote, and encourage the acquisition and diffusion of knowledge of hygiene in all its branches, and of all matters relating thereto, especially in connection with personal *régime*, food, domestic sanitation, means of safety and rescue, architecture, engineering, naval and military hygiene, and State medicine.

WE regret to notice that the Austrian Polar Meteorological Expedition has not been able, on account of the state of the ice, to land on Jan Mayen Island. The *Pola* put back to Tromsö, and was to make another attempt after fourteen days; we hope she will be successful.

AN International Geographical Exhibition is being held at Copenhagen.

THE French expedition to Cape Horn will leave this week without any further delay.

LIEUTENANT SCHWATKA is organising an expedition for the exploration of Northern Alaska.

THE Report of the Imperial Mint, Ôsaka, Japan, for the year ending June 30, 1881, being the eleventh report of the Mint, shows that during the financial year gold coins to the value of 490,585 yen (dollars) was struck, this being rather more than during the previous year. In the silver coinage there has been great activity, 5,089,113 one yen pieces having been struck, this being a larger number than ever before finished in a year. Nearly 74 millions of copper coins were struck during the year, their aggregate nominal value being over one million yen. The total value of coin issued by the Imperial Mint since its commencement in 1871, to July, 1881, amounted to yen 97,596,529,·79. The reports of the Assayers to the Imperial Japanese Mint, of the Royal Mint, and of the United States Mint, testify to the highly satisfactory manner in which the standards of weight and fineness are kept up. The soda-works within the Mint-ground are now in operation, and small quantities of sulphate and carbonate of soda have been turned out. The sulphuric acid-works did not produce so large a quantity of acid as in former years, but another works has been established in Osaka by a private company, showing that chemical industry in Japan is not standing still. The work carried on at the Osaka Mint, both as regards quantity and quality, is in the highest degree creditable to the two foreign *employés*, Mr. Gowland, the chemist, assayer, and technical adviser, and Mr. McLagan, the engineer, as well as to the staff of native officials and workmen.

CAPTAIN CONDER and Lieutenant Mantell, R.E., have returned from their first campaign in Eastern Palestine, bringing with them the results of their work. These include the map of a large district, covering 500 square miles of country, with a very large quantity of notes, plans, drawings, and photographs concerning the antiquities of Moab and Gilead. Captain Conder will proceed at once to arrange these materials for publication. He has also brought with him a considerable quantity of notes, and additional information made by himself and his party in Western Palestine. These will be included in the next volume of the Society's great work, which will be delayed a month or two on their account.

THE Municipal Council of Paris has voted a sum of 40*l*. as a subsidy to the Academy of Aërostation for the purpose of trying to photograph Paris with the help of captive balloons.

THE July number of the *Proceedings* of the Royal Geographical Society is of unusual interest. Along with excellent maps we have Mr. D. D. Daly's account of the surveys and explorations in the native States of the Malayan Peninsula, 1875-82; a translation of Dr. Albert Regel's account of his journey in Karateghin and Darwaz; and some interesting details as to Capt. P. de Andrada's journeys to Masinga and the Mazoe on the Lower Zambese. This number contains the report of the anniversary meeting.

A WELL-ATTENDED meeting was held last week to consider the desirability of presenting a testimonial to Mr. Ernest Hart in recognition of his eminent public and professional services. It was unanimously resolved that an appeal for subscriptions should be made to the medical profession and the general public in support of this movement. It was agreed that the testimonial should take the form of a portrait of Mr. Ernest Hart, to be presented to Mrs. Ernest Hart. It was announced that already over 100 influential members of the medical profession had expressed their desire to contribute to the fund. Mr. Spencer Wells was appointed treasurer, Mr. Arthur Myers, surgeon to the Coldstream Guards, and Mr. Noble Smith (24, Queen Anne Street, W.), were appointed hon. secs., and an executive committee, with power to add to their number, was appointed.

IN a recent communication to the Vienna Academy, Dr. Paulsen has described a singular series of experiments with reference to the course of air in the nasal cavity in breathing. Conclusions as to this path have been drawn from structure, but Dr. Paulsen adopted the method of lining the nasal cavity in the head of a dead body with small pieces of red litmus paper, and then causing ammoniacal air to be inhaled and exhaled through the windpipe. The changes of colour in the paper proved that the expiratory and inspiratory currents take nearly the same course, and that the main portion passes, not through one of the nasal passages, but along the septum in an arching course, convex above. The course of air-currents was investigated under varying conditions of ventilation, &c., also the behaviour of secondary cavities. Some old and new experiments on the act of smelling are explained on the basis of the facts elicited.

FROM the woody tissue of some plants (according to recent researches by Herr Max Singer, Vienna) four substances can be extracted by means of hot water: 1. Vanillin, which seems to be one of the most widely distributed plant-substances; it is found even in decayed wood and in brown coal. 2. A substance which shows the reactions of coniferin. 3. A species of gum soluble in water. 4. A substance soluble in water, and coloured yellow with muriatic acid, not identical with any of those already specified. Moreover, woody tissues (also elder pith) contain the wood gum discovered by Thomson. In what relation these substances stand to the hypothetical lignine is not determined, but the way in which they can be separated from the wood, one after another, by water, renders it probable that what is called lignine is a mixture of several chemical entities.

THE Academy of Sciences has nominated M. Bertrand as its representative at the inauguration of the Fermat statue, which will take place on August 20 next, in a small country town of Tarn-et-Garonne, where this illustrious mathematician was born, at the beginning of the 17th century.

THE additions to the Zoological Society's Gardens during the past week include a Diana Monkey (*Cercopithecus diana*) from West Africa, presented by Messrs. L. and J. Boljhon; a Bonnet Monkey (*Macacus radiatus*) from India, presented by Mrs. Norris; two Tovi Parrakeets (*Brotogerys tovi*) from Columbia, presented by Major Langford Brooke; two Uvean Parrakeets (*Nymphicus uvæensis*) from Uvea, Loyalty Isles, a New Zealand Parrakeet (*Cyanorhamphus novæ-zealandiæ*) from New Zealand, presented by Mr. E. L. Layard, H.B.M. Consul, New Caledonia; an American Robin (*Turdus migratorius*) from North America, presented by Col. Verner; a Yellow Wagtail (*Motacilla flava*), a Marsh Tit (*Parus palustris*), British, presented by Mr. H. Grant; four Speckled Terrapins (*Clemmys guttata*) from North America, presented by Mr. C. D. Ekman; a Common Snake (*Tropidonotus natrix*), British, presented by Mr. Poyer Poyer; nine Fire-bellied Toads (*Bombinator igneus*), a Lacertine Snake (*Cœlopeltis lacertina*), a Back-marked Snake (*Rhinechis scalaris*), European, presented by Mr. G. A. Boulenger; a —— Newt (*Notopthalmus viridescens*), from America, presented by Messrs. Sargent; an Undulated Grass Parrakeet (*Melopsittacus undulatus*) from Australia, deposited; a Canada Goose (*Bernicla canadensis*), British, a Sharp-nosed Crocodile (*Crocodilus acutus*) from Central America, purchased; two Geoffroy's Doves (*Peristera geoffroii*), bred in the Gardens. The following insects have emerged during the past week:—Silk Moths: *Actias selene*; Moths: *Hypochera io*, *Ceratocampa imperialis*, *Deilephila vespertilis*, *Deilephila euphorbiæ*, *Sciapteron tabaniformis*, *Sesia muscæiformis*, *Sesia empiformis*, *Zygæna filipendulæ*, *Plusia concha*; Butterflies: *Apatura iris*, *Vanessa polychlorus*, *Lycænia iolas*, *Aporis crabægi*.

DISTRIBUTION OF AWARDS, NORMAL SCHOOL OF SCIENCE AND ROYAL SCHOOL OF MINES

THIS took place in the Lecture Theatre of the South Kensington Museum on Saturday, June 24. The Vice-President of the Committee of Council on Education, the Right Hon. A. J. Mundella, M.P., took the chair.

Col. Donnelly, after some introductory remarks, said:—In the report of the school, which you have before you, Sir, there is a paragraph from which some people might possibly imagine that the necessity for training teachers in science was not thought of when the general scheme of aid to science instruction was considered and promulgated in 1859, and that it was not until that scheme had been in operation for a few years that the necessity for training science teachers came to light. Now, Sir, I was present at the deliberations which took place on the framing of that Minute of 1859, and although it is a long time ago I have a very distinct recollection of all that occurred.

But I would here wish for one moment to digress, and recall the memory of a remarkable man who was deeply connected with those deliberations, and to whom they owe so much. He has but recently been taken from us, and though Sir Henry Cole had for several years ceased his connection with this institution, I am sure it needs no excuse from me that on this, the first public ceremony which has taken place since his death, I recall to you for one moment his memory. We cannot but all remember how much this place, and science and art instruction, I mean of course elementary science and art instruction, owe to Sir Henry Cole. No one would be so foolish as to suppose that even if Sir Henry Cole had not lived and worked we should not at the present time have had a system of elementary science and art instruction in the country; but it is given to a few men here and there, now and then, to have a clear view before them, and to have that energy and indomitable perseverance, which enables them, as it were, to put on the hands of the clock, and to impress a form and reality on what in the hands of other men would probably have remained vain imaginings. Sir Henry Cole was such a man; and no one who, like myself, worked for some fifteen or sixteen years under him, could fail to be impressed with that remarkable personality; with his boundless sympathy in all progress and work; and with his extraordinary *vis viva* which communicated some at least of his zeal and devotion to all who came in contact, and were working, with him.

Well, Sir, to recur to the deliberations with regard to the Minute of 1859; numbers of educational doctors were consulted; they all proposed, and I believe it was about the only suggestion in which they all agreed, that the first thing to be done was to establish a system of training teachers at some central institution, such as the School of Mines in Jermyn Street, which when it was first established had that object in contemplation. Fortunately—most fortunately—that advice was not followed. You will remember, Sir, that a noble lord, your predecessor in the office you now hold, has been somewhat twitted with prophesying something with regard to the steam-ploughs in Asia Minor. The day will no doubt come when his lordship will have the laugh of the scoffers. But a cargo of steam-ploughs in Asia Minor at the present moment would be a no more hopeful consignment than a number of trained teachers issued from a central establishment, to make their living by science instruction, would have been in 1859. We had to trust to a much ruder implement, if I may say so, and we had to trust to that local implement being brought out and set in motion by a system of payments by results, and right well many of those local teachers have done their work. I should remind you, Sir, that the system of paying on results, which has had so large a development since in various directions, was first tried here. This is not, however, the occasion for discussing the general system of science instruction, and science payments, and I only advert to it at the present moment to call attention to what has grown out of it to supplement it, and that is the arrangement for bringing science teachers from the country up to London for short courses of instruction in the summer. That is a system which I believe obtains in no other place or country; I believe it is most invaluable. This point also illustrates another fact, and that is that the Normal School of Science is not the outcome of some cut and dry report of a commission, founded possibly on a foreign example, but it is the natural outgrowth of what has been found to be required. It has grown so as to suit its environment, and so far is a thoroughly English institution; and now that it has in the fulness of time—I will not say that the time may not have been a little too full—now that it has come out in its full plumage, I think the country may be congratulated on this. It has a scientific educational institution fairly provided with apparatus and appliances; but it has what is far more valuable. It has a staff of professors whose position in the scientific world for the work they have done, whose power of teaching and imparting knowledge, and whose zeal in the cause will, I believe, bear comparison with the staff of any other similar institution, or seat of learning in this or any other country at the present time.

The Chairman:—I have now the pleasure of calling on Prof. Huxley, the Dean of our re-organised institution.

Prof. Huxley:—Mr. Mundella, under ordinary circumstances the address the Dean of the School is called upon to make on occasions of this kind is confined to a statement of the condition of the school, and to an account of the manner in which the various departments of instruction are thriving or otherwise. But as this institution, the Normal School of Science and Royal School of Mines, is extremely young—in fact has not yet completed the first year of its existence—I think, with your permission, it may be well that I should call the attention of those who have honoured us by their presence to facts with which your official mind is perfectly familiar, but of which they cannot be expected to have cognisance.

As Col. Donnelly has just remarked, this institution has not been so much made as it has grown; it is therefore a particularly English institution, inasmuch as in that respect it resembles the British constitution, which, from an abstract and logical point of view is probably not the most symmetrical and reasonable fabric that ever was raised, but which has the great merit of having grown out of the actual conditions of life, and of possessing the power of adapting itself to the incessant changes of our social state. The school is not, as might be judged from its title, a dual institution like the Austro-Hungarian monarchy; but it has grown out of the growth, development, and eventual coalescence of two perfectly distinct and independent organisations, which have at different times, and quite independently of one another been set on foot by the Government of this country for the purpose of giving science—by which I mean physical science—that influence upon the industries and arts of the country which, as every one now recognises, is absolutely essential to their sound and rapid progress. The Royal School of Mines was practically established, or rather the foundations of it were laid, so far back as the year 1851, at which time a very staunch and kind friend of mine, at a time when friends were not quite so plentiful as they are now, the late Sir Henry De la Beche, one of the most sagacious and able men it was ever my good fortune to meet with, having set agoing, chiefly by his own energy, the Geological Survey of Great Britain, obtained the attachment to that service, und to the Museum of Practical Geology, which was connected with it, of an institution which I think may be described as the first technical school which was ever established in this country by the influence of Government; I do not know if private enterprise had done anything of the kind before. This institution was termed "the Government School of Mines, and of Science applied to the Arts"; and you will observe, and I call your attention to the fact, that in that title there is a duality of precisely the same nature as that which exists in our present name. No doubt one of the objects most dear to Sir Henry de la Beche and his associates, was the establishment of a technical school for those branches of science of which the applications are more or less direct to mining and metallurgy; and no doubt a considerable proportion of the influence which was brought to bear in establishing the school arose from the fact that the mining and metallurgical industries of the country were largely interested in it. But you will also observe that the school took upon itself the teaching of "science applied to the arts," and we had therein a germ, for it was no more than a germ, of what may be termed a general technical school.

Now it was about the same time that the Great Exhibition of 1851 directed the attention of people in this country, far more strongly than it had been directed before, to the extreme importance of giving our industries some better foundation than the mere rule of thumb, which up to that time had too largely obtained. That movement grew and became more important until it resulted in the creation of the Science and Art Department, the effects of which upon the art side, are unmistakeable, for you have them in this vast museum in which you now meet, which I believe is without its parallel in the civilised world. That side of the activity of the Science and Art Department grew rapidly; but the other side of it, the development of the technical application of science, was indeed attempted, but got very little further than the attempt. That attempt was made in this wise: the course of instruction in the Government School of Mines and Science applied to the Arts, then lodged in Jermyn Street, was enlarged so as to include an addition to its mining and metallurgical division, which was called a general division—a general training in physical science—and a technical division, that is to say, what we now understand as a technical school. Moreover, the Royal College of Chemistry was combined with the School of Mines; and in order, as it were, to emphasise the development of the general technical school side of the institution, its title was altered into that of the "Metropolitan School of Science applied to Mining and the Arts." That was in the year 1853, very nearly thirty years ago—a generation of men; and I have no hesitation in saying that if the idea which at that time obtained in the minds of the heads of the Department of Science and Art had been developed and carried out, it would not have been left for this generation to make the efforts which it now seems prepared to make in various ways for the establishment of a thorough and effectual system of technical education throughout the country. Whether it was that the time was not ripe for such an effort, or from what other cause, it is not worth while to inquire; but this course of development was more or less nipped in the bud. The instruction in Jermyn Street narrowed instead of widening; the general and technical divisions were gradually abolished, and the institution restricted itself as far as it could, to being a school of mining and metallurgy, pure and simple; with this difference, however, that the very large and efficient organisation for teaching chemistry under Prof. Hofmann, which existed at that time, retained a certain amount of *quasi* autonomy, and did specially profess to teach the applications of chemistry to industry. The change of policy was signalised in the year 1859 by another change of name; the institution was then called the "Government School of Mines," and so it remained for a few years, until in 1863 the title was altered once more, by way of giving the institution extra dignity, to the "Royal School of Mines," which title it has retained ever since.

I had the honour to be appointed one of the professors of the School of Mines in the year 1854. I have now, therefore, completed twenty-eight years' connection with it. I estimate that connection as one of the happiest and most honourable events of my life, having always been associated with colleagues with whom any man might have been proud to act. Moreover, let me say, in respect of such change of policy as has taken place, I am just as much responsible as anybody else, so that you must not think that I have the smallest intention of saying a word which could militate against the estimation which the School of Mines, I am happy to say, always has held, and which I profoundly trust it always will hold, if I point out to you that there were, from the very beginning, certain extremely grave defects in its constitution. I cannot say that they arose from the fault of any body concerned, but from the fact that the necessities of scientific training were understood a quarter of a century ago in a totally different way to that in which they are now understood. The only provision which was made for that practical instruction, which is the heart and soul of all efficient scientific education, in the original School of Mines, consisted in the laboratories for chemistry and for metallurgy. For no other branch of science was there any efficient practical teaching provided, and even the accommodation for chemistry and metallurgy was so imperfect, that within a very few years after the foundation of the school, laboratories for these purposes had to be sought elsewhere. For eighteen years I did my duty as well as I could towards that institution, lecturing about natural history, and I am sorry to say, all the time, with the more or less definite consciousness, that I was an involuntary impostor, and that it was not possible for me to teach in any genuine fashion, because I had no room in which practical instruction could be given. I do not know whether my colleagues would be inclined to make the same confession, but the same want must have been felt in the teaching of physics, and in the other kinds of instruction given in the school. Moreover, we had no mathematical instruction, and, in spite of our repeated representations, it was not provided.

Now that state of things obtained up to the year 1872. By that time some of us had got extremely tired of it, and I was one of those who were so tired, my chemical colleague was another, my colleague the Professor of Physics was a third, and we got up a sort of little pronunciamento to say that we really could not go on teaching in that way any longer; that at South Kensington there was a large building which was standing perfectly empty, and might we be allowed to do our business in a more efficient way by being transferred to this empty building? With the assent and consent of our colleagues, and with the sanction of the Department of Science and Art, the desired transference took place, and the result of that was, that all the professors who were moved were able at once to institute a more or less adequate system of practical instruction, and to make the teaching in the school in their own departments something like what it ought to be. Subsequently the Professors of Geology and Metallurgy and Applied Mechanics were similarly moved, until now only the Professor of Mining remains in Jermyn Street, simply because he has there the admirable collection of models which are so important for his work.

That, Sir, is the history so far as it can be told, in a few words, of the origin and growth of the Royal School of Mines. The only change that has taken place in consequence of the new organisation in that institution is that it has been made more efficient. Mathematical instruction has been added; practical teaching has been supplied in all branches of science which the Associates of the Royal School of Mines are required to study, and I cannot doubt, seeing the respect which has for many years been paid to the title of Associate of the Royal School of Mines, that that respect will simply grow and increase with the knowledge of the public, that the only alteration which has taken place here of late years is to make the title represent a very much larger value than hitherto it has been possible it should represent.

Now, sir, I turn to the Normal School of Mines, about which my task will be easier, because Col. Donnelly has said something about it. I have spoken of my respect and affection for the older institution, the Royal School of Mines, with which I have been so long connected, but I am not quite sure that, looking at the matter from a broad and general point of view with reference to the influence of our school upon the country, that I may not have taken an even greater interest in the series of steps which have led to the organisation of the Normal School of Science. It is very hard for those whom I address, and who have not the advantage or disadvantage of being as old as I am, to believe that there was a time, hardly more than a score of years ago, when it was almost impossible for any one who was not connected either with the universities, with the medical schools, with the School of Mines, or with one or two institutions in London, to obtain the slightest tincture of practical scientific instruction in this country. When, therefore, those conferences and deliberations, to which Col. Donnelly referred just now, came to my knowledge in the year 1859, I felt profoundly interested, and I thought the plan proposed extremely well devised, and that it was the only one, whatever its imperfections may be, which at that time was adapted to meet the wants of the time. I confess that when I heard of the establishment of these science classes, I made the same sort of reflection as the man who said let him make the songs, and he did not mind who made the laws. I said to myself, I do not care in the slightest degree from this time forth what the universities, or what the public schools may do in the way of teaching science to the non-professional classes; they are bound now *se soumettre ou se demettre;* either they will follow in the wake of this movement towards general scientific education of the country, or they will pass out of the stream of progress of modern culture. You may think that was a very large anticipation to base upon a small foundation, and undoubtedly it was; but the immense development of this system of scientific teaching has, I think, entirely verified my anticipation, and I am happy to say that the public schools and the Universities have followed suit, until now it is as easy to obtain a fair general scientific training in this country, as a quarter of a century ago it was difficult.

Well then, this system of science classes having spread over the country, it soon became apparent that the greatest obstacle to its efficiency lay in the want of knowledge of proper modes of teaching on the part of teachers. It is lamentable how much the ordinary mode of education in what is often called literature, but commonly is not, tends not only not to help a man to become a learner or a teacher of physical science, but rather to impede his becoming one. Nothing is more surprising to me than to find a number of instructed persons coming up here for scientific education, and to discover that they cannot observe. They have been so accustomed to take statements on credit from books and word of mouth that they have almost lost the faculty of seeing things for themselves. I remember after having given a lecture, accompanied in my ordinary way by drawings on the blackboard, that I went to look through the microscope, and see what one of the students who had heard this lecture was drawing. To my astonishment, I saw that his drawing was the thing I had drawn on the blackboard, not the thing under the microscope. I said to him, What is this? this is not at all like what is under the microscope. No, he said, that is what was on the blackboard. He did not believe nature, he believed me; and the great lesson I have tried to teach, which is the fundamental basis of scientific teaching is, do not put too much faith in your teacher, but do believe nature. The only way of remedying this evil habit of taking science on trust, is to give the science teachers the opportunity of obtaining a discipline in the methods and a practical acquaintance with the most important facts of the particular branches of science which they profess to teach. That has been done partly by bringing up teachers from the country for short courses such as are now going on, or will shortly be going on in this institution, and partly by giving them the opportunity individually of attending the courses of the Royal School of Mines during its separate existence. What happened last year was that this system of bringing up teachers for scientific training, for training, that is to say, in special branches of science, was made systematic and thorough. By adding to the staff of the Royal School of Mines a chair of Mathematics and Mechanics, a lectureship on Astronomy, a lectureship on Agriculture, in addition to lectureships on some other subjects, and by providing full means of practical instruction, the institution is now able to provide for a tolerably efficient training, extending over a considerable number of months, of teachers of the science classes in those matters of elementary science which it is needful for them to understand thoroughly in order to teach properly.

Having been practically interested in the administration of the great measure of education for the masses of the people, which was set on foot a dozen years ago, it is particularly gratifying to me to see this last step taken, because it appears to me that so far as science is concerned, it is the crowning of all the organisations which a Government may and should undertake in regard to the education of the masses of the population. The result is this: At this present time, if there be anybody in the remotest district of England in which these science classes are established, if there be any child who has a faculty for science, which is a thing inborn, and as much a genius as the faculty for art; that child, boy or girl, as the case may be, has open to him or her the means of instruction in one of the science classes. To those who have not any special faculty, science certainly will not do any more harm than learning anything else that they learn without understanding, as most boys do learn so many things at all schools. But if the scholar possesses this scientific faculty which I just now spoke of, it is open to him to distinguish himself at the May examinations. If he distinguishes himself at the May examinations, scholarships are open to him at various institutions, among the rest in this Normal School. If under the instruction which is offered to him, he shows a higher kind of scientific capacity, I do not know that there is any limit to the point which he may eventually reach. If he has in him the making of a Davy or a Faraday—and once in thirty or forty years men of that kind are born in the most out of the way and unlikely places—if he have that faculty, there is no longer a need that he should hopelessly struggle with adverse obstacles, but the path to reach that position in which he may serve his country most effectually is laid open to him by the organisation which I have described. And in order to make that organisation complete, we are endeavouring to give such instruction to the teachers as will enable them to aid in this business of picking out from the mass of youth under instruction those who are most likely to attain scientific distinction, and to train and inform those who are likely to profit by scientific instruction.

I am sorry, Sir, that I have detained you so long. It now only remains for me to report to you that, at present, the number of students in the Institution amounts to 198. I may say, that in only one or two classes is there a slight falling off in numbers. In several the numbers are enlarged, particularly in the metallurgical class, and in the geological class, in which latter the demand for a system of instruction which has been established here by my colleague, Prof. Judd, has been so considerable, that several have had to be turned away for want of accommodation. You will be glad to know that this system is so thorough and so efficient, that from abroad men are sent to study its working. The whole school is at present in a very healthy condition. Some little difficulties attended its birth, as is very often the case with strong and lusty infants; but I think our infantile complaints have all now subsided, and I hope that the institution may look forward to a vigorous manhood.

General Martin was then called upon to read the names of the successful students. He said: The ceremony to-day of necessity came so closely on to the heels of the examinations, that the general lists could not possibly be made up. Only those awards, therefore, would appear to-day which could be ascertained in time. For this same reason we may hope that some other gentlemen, in addition to those who receive the Associateship to-day, will be found to be qualified, and receive it hereafter.

The following names were then read, and the certificates and prizes were delivered by the Chairman:—

List of Students who are to receive Associateships, June, 1882

A. W. Day	1st Class	Mining
F. W. Harbord	1st Class	Metallurgy
G. Kamensky	1st Class	,,
F. L. Cepero	2nd Class	Mining
G. Ross Divett	1st Class	,,
J. E. Green	2nd Class	Metallurgy
J. P. Walton	1st Class	,,
F. L. I'Anson	2nd Class	Mining
M. Staniland	1st Class	Metallurgy
	2nd Class	Mining
F. T. Barnett	1st Class	Metallurgy
J. H. White	1st Class	,,

Award of Prizes, Scholarships, &c., June, 1882

2nd Year's Scholarships	H. F. Collins
	R. T. Bodey
1st Year's Scholarships	A. Sutton
	H. W. Hughes
	T. Mather
	H. G. Graves

Medals, &c.

"Forbes"	C. J. Gahan
"Murchison"	H. F. Collins
"Tyndall"	W. T. Burgess
"De la Beche"	C. H. Powell
"Bessemer"	J. J. Hood (1880–81)
	F. W. Harbord
Chemistry Prize, "Hodgkinson"	C. A. White

The Chairman:—Mr. Dean, ladies and gentlemen, in the discharge of the duties of my office I have seldom had to perform a more interesting duty than the one I have just fulfilled, of distributing the awards to the successful students on this occasion. I am not going to detain you at this hour with a speech, especially as you have had a most excellent address from that master of science and oratory, the Dean of our Normal School. It would not only be bad taste, but it would be a great indiscretion on my part, if surrounded by men so eminent in science, I ventured to talk to this audience on any scientific question. All I have to express is my great gratification in being in the humblest degree instrumental in bringing the Normal School to its last phase, and to its present position. I am sorry that my noble friend, the Lord President of the Council, who is at this moment discharging also the arduous duties of Lord Lieutenant of Ireland, is not here to day to preside over this interesting ceremony, for he took the greatest possible interest in the reorganisation of the school, and of bringing it into the position which fulfils so admirably the conditions of usefulness which Prof. Huxley has so well described to you.

We have all felt in the words which fell from Col. Donnelly how much science and art in this country and in this place owe to the late Sir Henry Cole, and I should not feel satisfied to address this audience without expressing my own deep conviction of the great service which he rendered to his country, services which will endure for generations and centuries, the value of which we only yet very imperfectly realise. Prof. Huxley pointed out how slow the growth of science teaching in this country had been as compared with the success of art-teaching. It is hardly to be wondered at how much more easy it is to appreciate beauty and art as applied to industry than to see at once the advantages which science confers on industry. Even the most superficial of us who have lived for the last thirty years cannot walk through the streets of London, cannot look into any ordinary shop, or look into a shop window, without being struck with the marvellous change which has come over the textile and metallic productions of this country in the way of their artistic character. There is nothing so remarkable as the change which has taken place in our curtains, or carpets, or hangings, or furniture, or decorations, in everything admitting of the application of art to our common life. There is nothing more charming or more agreeable to realise, but it is not so easy to understand the enormous value and importance of scientific instruction, as it is to appreciate at once the advantages of art training. The influence which art has had on the industry of this country through the instrumentality, I think, in the first instance, of the late Prince Consort, and the men who surrounded him thirty years ago at the exhibition of 1851—that influence is something incalculable, I believe, not only in its advantages to those of us who enjoy the pleasure of these more interesting surroundings, but also in the industry of the country, and in the extent of its employment and manufacture, and the hundreds and thousands of people who are benefited by an increase of our export trade. But we have, and I am glad to know that the manufacturers of this country are beginning to realise it, been far behind in science-teaching. We have been behind our neighbours in France and Germany, and other countries. They have within the last twenty or thirty years made prodigious efforts, and are still making prodigious efforts to apply science to individual industry, and to avail themselves of the resources of science in order to improve their manufactures and to develop the resources of their country in order that they may successfully compete with us in the markets of the world. I know nothing so astonishing as the lavish expenditure and the prodigious efforts that France and Germany have made within the last ten years to increase science teaching in those countries. However, if we have been slow in our growth, I am not at all disheartened, because I believe it has been sure, and, as Prof. Huxley has told you, it is better fitted to the circumstances and wants of our country, probably, than the Government-created institutions which have prevailed abroad. I do not want for one moment to anticipate the report of the Royal Commission on technical education which is now pursuing its investigations. I am quite sure that Commission will lay before Parliament and the country not only a most interesting, but a most startling report; but at the same time I am not at all afraid that we are so behind that we cannot adapt ourselves to the circumstances of the case, and that we shall not continue to hold our own in the industrial progress of the future as we have in the past.

Prof. Huxley told you that, twenty-five years ago, in our provincial towns, and even in London, there was hardly any opportunity for scientific instruction. I know in my own early days the only opportunity an inquiring young man had was to be found in the classes of Mechanics' Institutions, where some amateur student of science was willing to convey to his fellows some share of the little knowledge which he himself possessed. But anything like systematic scientific instruction was utterly unknown in the great centre of industries of this kingdom thirty years ago. To-day, in connection with the Science and Art Department, there are 1760 teachers, at least, principal teachers, I am excluding assistants. There are 60,000 students in schools receiving grants from the Government, in connection with the Science and Art Department. There are about 200 students that we have here in this institution, 50 of whom are in training as teachers, and there are 200 science teachers who come from the provinces ever year to receive short courses of instruction, with their travelling expenses paid, and an allowance made to them whilst they are pursuing their studies in this institution. We have also twelve exhibitions of 50*l*., four of 15*l*., and two of 25*l*., which are awarded annually by the Government. These are only the nucleus, so to speak, of numbers of exhibitions which are given in various localities, and that bring to this institution for training, the men who have the faculty for science teaching, and who will be the future teachers for science in this country. I am sure no one can have been present to-day, and have seen those young men advance to the table, and have seen them receive their certificates of associateship, and their honourable awards for their successful studies, without feeling that those men are going to carry to all the centres of industry an amount of light and knowledge which will be of immense advantage, not only to themselves, but to the industry with which they are associated. In every part of England there is a demand for technical instruction, and that demand is very much groping in the dark, for our people hardly understand what they mean by it yet. It means they want to know the *rationale* of the work which they are doing. They are tired of working by rule of thumb, that when, as I have heard a Dyer explain how he got certain results, he tried his alkalies and acids by dipping his thumb into them and tasting them, and when he found the components for some particular dye, he took a shovelful of this and a shovelful of the other, and so arrived at certain results which he could rarely arrive at with precision again, but which was mere guesswork, rule of thumb, chance, and accident; all that is passing away, and I believe, as the result of the good work that is doing in this institution. I am sure you will all join with me in expressing the hope that our Dean, who holds that title for the first time during the last year, will long remain at the head of this institution, to carry it to that success to which he aspires, and which he has done his utmost, by his noble effort and by his constant and eloquent advocacy, to secure.

DUNSINK OBSERVATORY[1]

MR. DREYER, having been appointed to succeed the late Dr. T. Romney Robinson as director of the Armagh Observatory, will vacate his post here next September. An advertisement has been inserted in NATURE inviting applications for the post of assistant. I have received a number of replies, but I am not yet in a position to make a definite recommendation. I do not like to allow Mr. Dreyer's resignation to pass without expressing the high opinion I have of the manner in which his duties here were discharged.

The meridian circle has been as before in the entire charge of Mr. Dreyer. During the past year Part IV. of the Dunsink Observations and Researches has been issued, in which is contained an account of the meridian circle and a catalogue of the red stars whose places have been determined. In July and August many nights were spent observing the two bright comets, but the weather was so unsettled that only four observations of Comet III. and two of Comet IV. could be secured on the meridian.

In September a series of observations of stars between $-2°$ and $-23°$ declination were commenced. In all there have been made 713 observations of transits, and 582 observations of declination; the reductions to apparent place are completed for R.A. up to December 11, and for decl. up to March 10.

The meantime clock service has been continued throughout the year. The circuit has been tested on 349 days—from July 1 up to June 14—with the following results:—

265 days' error not greater than 1 sec.
56 „ between 1 sec. and 2 secs.
28 „ greater than 2 secs.

I referred in my last report to the chronograph which Mr. Grubb has had in hand. From a great press of other work, the instrument has not yet been quite finished, but I think we may now regard the chief difficulties as conquered, and I look forward very shortly to having a chronograph which will enable us to do real justice to the meridian circle.

The South Equatorial has, as before, been chiefly employed by myself in the observations of stars for annual parallax. The number of the observations made altogether amount to 186. This number is less than that in former years, because several series of observations have been brought to a close during the present year, and the results have been discussed and prepared for publication. I now submit the manuscript which is ready for the press as Part V. of our publications. The work will be considerably larger than the parts formerly issued, and will contain 200 pages or somewhat more. It consists entirely of the parallax researches made by myself at the South Equatorial in the last four years, and brief abstracts have occasionally appeared elsewhere. I now only glance at the portions completed since the last visitation.

In my last report I stated that the measures of the position angle of $+50°$, 1724, from Groombridge, 1618, required further discussion: that discussion they have since received, and the result is very satisfactory. From the distances I had obtained from Gr. 1618 a parallax of

$$0''\cdot334 \pm \cdot036.$$

From the position angles the discussion now submitted gives a parallax of

$$0''\cdot314 \pm \cdot031.$$

By combining these results, we find as the result of 106 nights of observation the mean value

$$0''\cdot322 \pm \cdot0''028.$$

Considering the smallness of the probable error, it can hardly be doubted that this object has a parallax of a third of a second.

I also submit the completely discussed observations of 368 stars which have been examined in the manner already described as reconnoitring for annual parallax. In the great majority of cases the results are negative, yet even in these cases I believe the work is of value as a part of the general survey of the heavens. It is also, I believe, the only systematic effort which has yet been made to search for the nearest neighbours of the sun.

I am, however, glad to say that all the results of this work are not purely negative, but that certainly in one instance, and probably in others, results of considerable interest have arisen. At the present moment I am only in a position to speak definitely as to one object, viz. the star 6 Cygni B = Σ2486.

My attention was directed to this star from the circumstance that the reconnoitring observations indicated a probable parallax, and I determined to observe it systematically. The observations were made on 33 nights, the first being November 30, 1879, and the last being December 22, 1881, observations of the distance and of the position angle now submitted. The mean value of the parallax from the distances is—

$$+\ 0''\cdot504 \pm \cdot060,$$

and from the positions

$$+\ 0''\cdot383 \pm \cdot130,$$

the mean being

$$+\ 0''\cdot482 \pm 0''\cdot054.$$

It is a matter of considerable interest to observe that this is about the same parallax as that of 61 Cygni, another object in the same constellation, and a double of the same character.

The proposed part v. will consist of five papers, as follows:—(1) Reconnoitring observations of 368 stars, with a view of finding whether they have a large parallax; (2) on the annual parallax of Groombridge 1618; (3) further researches on the annual parallax of 61 Cygni; (4) on the annual parallax of P. III., 242; (5) on the annual parallax of 6 Cygni B.

Brief accounts of the results of 2, 3, 4 have already appeared in the *Proceedings* of the Royal Irish Academy or in the special astronomical journals. It is now proposed that they shall be issued fully and with all the information necessary to enable astronomers to judge them adequately.

Besides this work, which I now submit as completed, there is a large mass of other work which is in a partially completed state. The red star Sch 249 (*a*) seems to have a parallax, and I have completed two sets of observations thereon. These have indeed been finished for some time, but I have not yet been able to complete the discussion, and further observations will probably be necessary. I have also completed two sets which will give four independent determinations of the parallax of μ Cephei. There are also some hundreds of the reconnoitring observations in a half-completed condition, most of which I hope to observe during the autumn.

Up to the present I have almost entirely confined my work with the South Equatorial to the researches on annual parallax with which Dunsink is historically associated. I have, however, after some hesitation, decided to co-operate in the proposal of Mr. Gill, her Majesty's Astronomer at the Cape, to determine

[1] Report on the Work of the Dunsink Observatory between July 6, 1881, and June 26, 1882, made to the Board of Trinity College, Dublin, at the Annual Visitation on June 27, 1882. By Prof. Robert S. Ball, LL.D., F.R.S., Royal Astronomer of Ireland.

the sun's parallax by observation of Victoria and Sappho. I have already commenced the preliminary work, and I anticipate that much time will be devoted thereto in the ensuing autumn.

ROBERT S. BALL

SCIENCE IN BOHEMIA

A CORRESPONDENT, who was present at the recent meeting of the Bohemian Naturalists, sends us the following brief report:—

The second meeting of Bohemian Naturalists and Physicians was held during May 24–30 in Prague (NATURE, vol. xxvi. p. 66). This meeting, in which over 600 members (some of them coming from Poland) took part, seems to have proved sufficiently that the above-named Slavic tribe (counting only something over six millions of souls) is not less successful in cultivating and promoting science in its own language, than other small nations (Dutch, Swedes, &c.).

In the two general meetings the following addresses were given:—By Dr. Schafarik, Professor in the Bohemian University, on the aims of chemical investigation, in which the subject was treated from an unusually deep and philosophic point of view; and by Dr. Holub, on the importance of the medical profession in transatlantic countries. In this address the essayist pointed out that the great power which had been obtained by the English in transatlantic countries is especially due to the investigations made by them from the scientific, commercial, economical, and strategical point of view. Dr. Holub further referred to other experiences of that kind, which he made in his travels in South Africa, already known to the readers of NATURE (vol. xxiv. pp. 35–38).

In the Section for Medicine, papers were read by the following gentlemen:—Doctors Eiselt, Janovsky, Maixner, Drozda, Thomayer, Chodounsky, Hlava, Wiktor, Zahor, Pelc, Böhm, Belohradsky, Ehrmann, Carda, Krasinski, Chudoba, Mayzel, Steffal, Wach.

In the Section for Surgery, papers were read by Doctors Schoebel, Obtulowicz, Janovsky, Janda, Kuniewicz, Michl, Medal, Talko, Weiss, Bastyr, Jerzykowski, Ostrcil, Carda, Michl, Matlakowski, Spott, Maixner, Skalicka.

In the Section for Pharmacy, papers were read by Doctors Belohoubek, Jandous, Fragner, and Stepanek.

In the Section for Mathematics and Physics, Dr. E. Weyr read a paper on the construction of a hyperboloid of osculation; J. Vanecek, on general inversion; V. Jaeger, on the solution of equations of 4th degree; K. V. Zenger, on a dispersive parallelopipedon, and on microscopes with endomersic lenses; Dr. Doubrava, on sensitive flames; Dr. Becka, on comets; F. Machovec, on the construction of certain curves; Dr. Weyr, on the construction of rational curves in space, of third, fourth, fifth, and sixth degrees; B. Prochazka, generalisation of stereographic sections of planes of second degree; A. Sucharda, on movements of curved planes; F. Toms, construction of section lines of two conic sections; F. Cechac, contributions to electrotechnics; Dr. A. Seydler, on the use of quaternions for the solution of a certain mechanical problem; Dr. V. Strouhal, on the peculiarities of magnetic and galvanic steel; E. Dziewulski, electric conductivity of mixtures of alcohol and water.

In the Section for Natural Science, papers were read by Dr. Celakovsky, on the sympodial constitution of vine-branches; J. Szyszylowicz, on the influence of light upon the transformation of matter in plants; F. Bayer, on the asymmetry in the shoulder-blade circle of frogs and some birds; V. T. Velenovsky, on the flora of Bohemian chalk-formation; Dr. Palacky, on the relations of the American and Bohemian flora; F. Sitensky, on the turfs from the giant mountains; K. Cermak, on the stratification of the alluvium and diluvium in certain parts of Bohemia, the fauna of these strata, and their deposition over older formations; Dr. Mayzl, on the division of cells; Dr. Fric, on the Sauria found in the permic formation of Bohemia; F. Safranek, on a new rock found near Tabor (Bohemia); J. Korensky, on the diluvial fauna from the rock-cave near Tetin; J. Kafka, on Bohemian bryozoa; Dr. Woldrich, on the diluvial system of Central Europe; G. Ossowski, geology of Wolonia; Dr. Novak, contributions to the fauna of Bohemian Siluric formation; J. Fric, contribution to the ontogeny of Copepoda; Dr. Kamienski, contribution to the morphology of the urticularii; J. Ssyszylowicz, conservation of spores of plants during the winter; K. Taranek, on rhizopoda and diatomacæa of South Bohemian turfs; S. Klnava, criteria of modern petrology; Dr. Celakovsky, comparison of indusia of ferns and oval integumenta; F. Safranek, on a new find of opals and chalcedons near Tabor; Dr. Vejdovsky, on the male of *Lernæpoda selachiorum*, and on Bohemian Planariæ; Dr. Hansgirg, on Bohemian Algæ, and on the movements of Oscillariæ; J. Ulicny, on Moravian Molusca; Dr. Zulinski, on mineralogical symbolics; Dr. Palacky, on the flora in the Bohemian chalk formation; C. Zahalka, geological map of the environments of Jicin; Dr. Kamienski, growth of plants in an atmosphere not containing carbon dioxide; F. Posepny, on the disintegration of rocks; Dr. Rostafinski, on the distribution of Galician fishes, and on the formation of hormogonia.

In the Chemical Section papers were read by Prof. Butleroff, on the oxidation of isodibutylene by potassium permanganate (presented); Dr. Radziszewski, on physiological oxidation; F. Stolba, application of aluminium-metal in laboratories; A. Belohoubek, on crystallised hydrates of potassium; Dr. B. Brauner (Manchester), on the atomic weight of didymium and other researches, regarding the chemistry of rare earth-metals (presented); F. Chodounsky, on fermentation; Prof. Preis, on sodium sulfarsenite; Dr. Janecek, on the electrolysis of saline solutions; Dr. Wasowicz, on crotaconic acid; Farsky, on superphosphates; K. Kruis, fermentation in spirit-refineries; M. Fischer, on the decomposition of collagenous substances; J. Stoklasa, on the geochemical conditions of Bohemian chalk-formation; Jal, on the estimation of hypophosphorous acid; J. Wiesner, on potassium-uranic chromates; K. Sykora, on certain coloured clays found in Bohemia, B. Rayman, on a new synthesis of methyl-phenyles; Farsky, chlorine as a nutriment of plants.

In the Section for Archæology and Anthropology, papers were read by Dr. Woldrich, on the skulls of prehistoric domestic dogs; J. Ossowski, on the objects found in caves near Cracow; Dr. Berger, on fibulæ found in Bohemia; Dr. Kopernicki, on the trepanation of prehistoric skulls in Bohemia; B. Jelinek, on the environments of Plesivec.

In the Section for Pædagogy the following papers were read or subjects discussed:—Dr. Hejzlar, how to teach physics and astronomy; F. Nekut, how to teach mineralogy; J. Mrazik, on the services rendered to pædagogy by medicine and natural science; J. Vanecek, necessity of teaching new geometry in middle schools; Dr. Kotal, on the treatises of natural science used in middle schools; J. Klika, how to popularise natural science; Pokorny, on teaching of gymnastics.

In an exhibition connected with the meeting many interesting objects touching upon Medicine and Natural Science were exhibited. From the scientific excursions by which the meeting was concluded only that into the well-known mine of Pribram, under the direction of Prof. Krejci, may be mentioned.

Only within recent years Natural Science began to be cultivated in Bohemia in the Slav language, and this is especially due to the establishment of a Bohemian Polytechnic School and recently of a corresponding division in the University of Prague though the last-named high school was founded already in 1348.

INDIA-RUBBER PLANTS

MR. W. T. THISELTON DYER brought before the Linnean Society, June 15, an important communication on the caoutchouc-yielding Apocynaceæ of Malaya and Tropical Africa. After giving a general sketch of the structural and physiological conditions of the occurrence of caoutchouc in plants, the author pointed out that the plants which appeared to yield it in commercial quantity in three widely-separated regions all belonged to one tribe of Apocynaceæ, the *Carisseæ*. In the East Indies the "gutta singgarip" of the Malay Peninsula, the "gutta soosoo" of Borneo, was the produce of a new species *Willughbeia*, *W. Burbidgei*. Many other species of this and allied genera also seemed to produce caoutchouc in quantity, worth collection. In Central Africa *Landolphia*, which was closely allied to *Willughbeia*, but differed in possessing terminal instead of axillary flowers, was the most important source. On the East Coast caoutchouc was yielded by *L. owariensis* and *L. florida*, the latter a very ornamental plant. As the rubber exuded from the cut stems, it was plastered by the collectors on the breast and arms, and the thick layer, when peeled off and cut up into squares, was called "thimble rubber." On the west coast the most important species was *L. Kirkii*, the rubber of which could be wound off into balls or small rolls from the cut stems, like silk from a cocoon; this species was called "Matere." *L. florida* also occurred, and was called "m'bunga"; its rubber was worked up into balls, but was inferior in value. The rubber of *L. Petersiana* was of little importance. In South America *Hancornia speciosa* yielded what was called "mangabeira rubber."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

AT the summer commencements of the University of Dublin, held on June 29 last, the degree of LL.D. Honoris causâ was conferred on Dr. Siemens and on Mr. Alfred Russel Wallace.

At a special meeting of the Council of the University of Dublin, held on June 30, Mr. Robert Crauford was nominated for the important post of Professor of Engineering in the University. Mr. Craufurd is well known for his many fine engineering works successfully carried out in North and South America, and in Europe.

UNIVERSITY COLLEGE, BRISTOL.—The new wing of the permanent buildings of University College, Bristol, is now rising rapidly. The portion devoted to physical and engineering laboratories and lecture-rooms will be ready for occupancy in October; the new chemical laboratories and lecture-rooms will be completed before Christmas. This greatly-needed extension will not, however, meet all the requirements of the growing institution, and additional buildings to accommodate the medical faculty are greatly wanted. One of the laboratories of the Physical Department is to be fitted up as an electrical laboratory. Prof. Thompson is actively endeavouring to raise funds for its complete outfit. Mr. C. C. Starling has been appointed Demonstrator in Physics.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 15.—"On the Specific Heat, and Heat of Transformation, of the Iodide of Silver, AgI, and of the Alloys $Cu_2I_2.AgI$; $Cu_2I_2.2AgI$; $Cu_2I_2.3AgI$; $Cu_2I_2.4AgI$; $Cu_2I_2.12AgI$; $PbI_2.AgI$." By Sigr. Manfredo Bellati and Dr. R. Romanese, Professors in the University of Padua.

The authors have determined the specific heat, and heat of transformation, of iodide of silver, and of five alloys or compounds of that substance with iodide of copper, and one with iodide of lead. The substances have already been studied by Mr. G. F. Rodwell as regards their expansion and contraction on heating, and the results communicated to the Royal Society; the same specimens were transmitted to Padua for the experiments of Prof. Bellati and Romanese. The following results were obtained. θ_1 and θ_2 are the temperatures at which change of molecular structure respectively commences and finishes; c the mean specific heat between t and T for temperatures below θ_1; c_1 specific heat for temperatures above θ_2; and λ the heat absorbed by the unit weight of the substance in consequence of change of structure.

Composition of the substance.	Percentage of AgI.	θ_1.	θ_2.	c.	c_1.	λ
		C.	C.			
AgI............	100·0	142°	156°·5	0·054389+0·0000372(T+t)	0·0577	6·25
$Cu_2I_2.12AgI$	88·1	95	228	0·05882 (from 16° to 89°)...	0·0580	8·31
$Cu_2I_2.4AgI$	71·2	180	282	0·056526+0·0000410(T+t)	0·0702	7·95
$Cu_2I_2.3AgI$	65·0	194	280	0·059624+0·0000280(T+t)	0·0726	7·74
$Cu_2I_2.2AgI$	55·3	221	298	0·061035+0·0000295(T+t)	...	7·88
$Cu_2I_2.AgI$...	38·2	256	324	0·063099+0·0000260(T+t)	...	8·67
$PbI_2.AgI$ ...	33·8	118	144	0·047458+0·0000026(T+t)	0·0567	2·556

The results are compared and discussed, and inferences are drawn therefrom as to the constitution of the bodies experimented upon.

Geological Society, June 7.—J. W. Hulke, F.R.S., president, in the chair.—Alfred Morris, C.E., and William Henry Watson were elected Fellows of the Society. Prof. Louis Lartet of Toulouse was proposed as a Foreign Correspondent of the Society. The following communications were read:—The President read the following note, forwarded by Don Manuel F. de Castro, Director of the Geological Survey of Spain:—"On the Discovery of Triassic fossils in the Sierra de Gador, Province of Almeria, Spain. The metalliferous limestone of the Sierra de Gador, owing to no fossil remains having been found prior to this occasion, has been a perfect puzzle to all geologists for the last fifty years. MM. Maestre, Amar de la Torre, Pernolet, Ansted, and Cooke considered these limestones to belong to the Transition series, the former taking it as a representative of the Mountain Limestones of other parts of Europe. M. Prado hinted that they might be Devonian; whilst M. Willkomm, in the geological map published to accompany his botanical researches in Spain, considered them Silurian. Lately MM. Botella and Vilanova, in their respective maps, have marked them as belonging to the Permian series, whilst M. de Verneuil, coming nearer to the truth, took the whole of the limestones to the south of Granada and the Sierra de Gador as Triassic, though in doubt ('Trias incertain') Under these circumstances I was commissioned by the Director of the Geological Survey of Spain to investigate the south-west portion of the Province of Almeria, which comprises the Sierra de Gador. In February last I had the good fortune of discovering abundant fossil remains in different parts of the Sierra de Gador, which perfectly fix the age of the metalliferous limestones of this part of Spain. The whole series of rocks forming this *sierra*, resting on the mica-schists and slates of the Sierra Nevada, is a succession of black, white, and purple talcose schists at the base, which alternate with some beds of yellowish and porous limestone, and which pass through a considerable thickness of grey limestones and slates, and precisely where the fossils have been found, to the metalliferous limestone of Sierra de Gador, which appears to form the top of this interesting formation. The fossils found belong to the following genera:—*Myophoria* (*M. lævigata* and *M. Goldfussi*), *Hinnites*, *Monotis*, *Avicula* (*A. Bronni*), *Myacites*, *Rissoa*, and many others difficult to determine. The places where the fossils have been found are the following:—On the southern slopes of the Sierra de Gador, in the Rambla del Cañuelo, midway on the road from Felix to Marchal, and in the place named La Solana del Fondon, to the left of the River Andarax, following the track between the mine Sebastopol and the town of El Fondon.—Joaquin Gonzalo y Xavier."—The Girvan Succession.—Part I. Stratigraphical, by Charles Lapworth, F.G.S., Professor of Geology in the Mason Science College, Birmingham. The Lower Palæozoic rocks of the neighbourhood of Girvan, in the south of Ayrshire, have long been famous for the remarkable variety of their petrological features and for the abundance and beauty of their organic remains; but the strata are so intermingled and confused by faults, folds, and inversions, that it has hitherto been found impossible to give a satisfactory account of the geological structure of the region. The most remarkable formation in this Girwan area is a massive boulder-conglomerate, several hundreds of feet in thickness, which forms the high ground of Benan Hill, and ranges throughout the district from end to end. Employing this formation as a definite horizon of reference, the author showed, by numerous plans and sections, that it was possible for the geologist to work out the natural order of the strata both above and below this horizon, and to construct a complete stratigraphical and palæontological scheme of the entire Girvan Succession. The development of the palæontological features of the several zones of life in this succession, and the demonstration of their correspondence with the zones already recognised in the synchronous Lower Palæozoic strata of Moffatt, the Lake District, Scandinavia, and elsewhere were reserved by the author for a second part of this memoir.—Notes on the *Annelida tubicola* of the Wenlock Shales, from the washings of Mr. George Maw, F.G.S., by Mr. George Vine. Communicated by Prof. P. Martin Duncan, M.B., F.R.S., V.P.G.S.—Description of part of the femur of *Nototherium Mitchelli*, by Prof. Owen, C.B., F.R.S., F.G.S. The specimen described consisted of the distal portion, probably about one-half, of a femur obtained from Darling Downs, Queensland, and received by the author from Dr. George Bennett. Its principal differences from *Diprotodon* are that it has no depression above the outer condyle, but in its place a rough longitudinal rising for the attachment of the same or of a homologous muscle; and the hinder surface of the condyle is transversely convex. The relative width of the post-condylar fossa resembles that in *Phascolomys*; and a further resemblance to the Wombats consists in the more equal prominence of the lateral boundaries of the rotular surface than in *Diprotodon* and *Macropus*. The bone differs from the corresponding part in the

Wombats by several subordinate characters, and the animal to which it belonged would seem to have been intermediate between *Phascolomys* and *Macropus*. From the size and characters of the bone, the author referred it to *Nototherium Mitchelli*; its breadth across the condyles is 5⅜ inches.—On *Helicopora latispiralis*, a new spiral Fenestellid from the Upper Silurian beds of Ohio, U.S., by Mr. E. W. Claypole, B.A., B.Sc. (Lond.), F.G.S.

Chemical Society, June 15.—Dr. Gilbert, president, in the chair.—The following papers were read :—Note on β naphthaquinone, by C. E. Groves. The author has repeated the experiments of Liebermann (*Ber.* xiv. 1310) as to the preparation of the above substance from β napthol-orange, and fully corroborates the results of that chemist, but disagrees with him as to the economical value of the process. He has somewhat improved Liebermann's method by using less stannous chloride, but finds that even then it is more troublesome and tedious than the conversion of β napthol into the amidonapthol through the nitroso-compound, &c. The cost of Liebermann's process is four times as great as the one originally proposed by Stenhouse and Groves. In preparing either α or β naphthaquinone from the corresponding amido-compounds, the author prefers to use ferric chloride as the oxidising agent.—On some new compounds of Brazilein and Hæmatein, by J. F. Hummel and A. G. Perkin. Extract of logwood is dissolved in hot water and when cool, ammonia is added in slight excess. This solution, by exposure to the air, deposits a dark purplish precipitate of hæmatein, which, on purification, gave numbers indicating the formula $C_{16}H_{12}O_6$; by the action of cold sulphuric acid, an orange crystalline substance, $C_{16}H_{12}O_6SO_3$ was obtained. By the action of hydrochloric acid in sealed tubes, hydroxyl is replaced by Cl : $C_{16}H_{11}O_5Cl$), a similar body is produced by hydrobromic acid. Brazilein was prepared in a similar way from Brazil extract. It forms compounds which resemble those of hæmatein.—On the determination of nitric acid as nitric oxide by means of its reaction with ferrous salts, Part II., by R. Warington. The method is founded on that proposed by Schlœsing, but the nitric oxide is collected and determined by gas analysis, the gas being absorbed by caustic potash after successive treatments with oxygen and pyrogallol ; great care was also taken to exclude all oxygen from the carbonic acid used.—On a new process of bleaching, by J. J. Dobbie and J. Hutcheson. The authors have investigated various methods of liberating chlorine by decomposing hydrochloric acid and chlorides with a weak electric current. The best results were obtained by moistening the goods with sea-water and passing them between two slowly-revolving carbon rollers, which were connected with opposite poles of a battery ; sodium hypochlorite was formed in the fabric, and on immersion in acid the bleaching was effected. Results were also obtained with dilute hydrochloric acid. Pure hydrofluoric acid also bleaches when thus decomposed.

Physical Society June 17.—The Physical Society met in Oxford by invitation of the president, and after luncheon in the hall of Merton College, by kind permission of the Warden and Fellows, the health of the Society was proposed by the president, and responded to by Lord Rayleigh. The usual meeting was then held in the Clarendon Laboratory, Prof. Clifton, president, in the chair.—Dr. W. H. Stone exhibited and described an electro-dynamometer specially designed for measuring the currents used in the medical applications of electricity (NATURE, vol. xxvi. p. 201). Mr. Varley, Prof. Perry, and others, offered some remarks.—Mr. Bosanquet then described his application of the Faure accumulator charged by a dynamo-electric generator to the working of laboratory apparatus instead of the usual Grove, or other battery. The net result of his experiments is that the accumulators charged for two hours have sufficient energy to keep the apparatus employed running for a week, and hence it is unnecessary for him, as heretofore, to put up thirty Grove cells each day. Prof. Perry observed that a well-made Faure cell, having the minium laid on in a uniform coat, does not lose its charge nor develop local action, as is done by those accumulators in which the minium is put into holes in the plates.—Prof. W. G. Adams then took the chair while Prof. Clifton described some ingenious devices adopted by him in lecture experiments on electrostatics. These consisted of insulating glass stems with glass cups to hold sulphuric acid formed on the stems ; also a form of key which, by rapidly succeeding contacts, brings the spot of light on the electrometer scale to rest without tedious swinging. He also described a form of lecture-galvanometer, sine or tangent, which could be readily shown in all its working to a large class, and exhibited a simple and inexpensive apparatus for measuring the focal length of a lens in six different ways, according to what is known about the lens. The results showed that the apparatus was very accurate in its indications.

SYDNEY, N.S.W.

Royal Society, May 3.—Annual Meeting.—The number of new members elected during the year is 46, making the total number of ordinary members upon the roll to date 475.—At the Council Meeting held on March 22 it was unanimously resolved to award the Clarke Memorial medal for the year 1882 to Prof. James Dwight Dana, LL.D., of Yale College, Newhaven, Conn., in recognition of his eminent work as a naturalist, and especially in reference to his geological and other labours in Australia, when with the United States Exploring Expedition round the world in 1836 to 1842.—During the year the Society has held eight meetings, at which thirteen papers were read, and three of the sections held regular monthly meetings.—At a meeting held by the Council on October 26, it was resolved that the Society should offer prizes of 25*l*. each for the best communication containing the results of original research or observation upon certain subjects to be set forth from time to time.—The Bill for incorporating the Society was approved by the Parliament of New South Wales on December 16, 1881.

BERLIN

Physiological Society, June 16.—Prof. Du Bois-Reymond in the chair.—Prof. Zuntz read a paper upon the value of amid bodies as animal nutriment, based on experiments which he made upon a number of rabbits. In each experiment he divided the animals that he was experimenting on, into two groups. One of these groups was fed with food-stuffs containing no nitrogen (starch and oil) and with various nutritive salts, while the other rabbits received, in addition to this food, a supply of amid bodies. The object of the experiments was to determine which, if any, of the amid bodies could replace the albumen of the food. Herr Zuntz managed to overcome the distaste of the animals for the monotonous, unstimulating diet (a difficulty which has often to be combated in a disagreeable manner in experiments of this kind), by also giving them small quantities of an alcoholic infusion of hay, and by giving the food that had been refused by the animal as pap or powder, in a firm friable form. The results of the experiments may be shortly summed up thus : Extract of meat, when added to the non-nitrogeneous food-stuffs, produced no effect upon the nutrition ; the animals died in exactly the same time as without the extract. Asparagine likewise could not take the place of the albumen of the food, but the loss of albumen was about 20 per cent. less in the animals that were fed with the asparagine, in addition to their other food, than in those who were fed on non-nitrogenous food alone. An addition of a mixture of asparagine and some other amid bodies, *i.e.* leucine, tyrosine, and others, of which one might have presumed that they would together form an albumin-material during the process of digestion, had, as a fact, the exactly opposite effect of producing a remarkably larger loss of albumen than the non-nitrogenous diet of the other group of animals that were kept for purposes of comparison. In the same way the addition of the crystallising decomposition-products of albumen which were got by the action of pepsin, had a prejudicial influence, producing a greater loss of albumen. Probably an ammoniate was the active principle in both cases, as it is known to work destructively in the body upon albumen ; but it is possible that the amid bodies themselves behaved like ammoniate. These experiments are to be pursued with other amid bodies and with decomposition-products of albumen.—Prof. du Bois-Reymond made some remarks upon Prof. Fritsch's late investigations as to the homology of the torpedo-electrical organ with muscles and mucous-cells, and on the development of the Torpedinea, the relative weights and the nerve-endings in the electric plates, and made some observations upon the question of the immunity of the electric fish against their own shocks. He especially drew attention to the fact that there are to be found in the intestines of electric fish, certain entozoa, which must either have an immunity against the shocks of their hosts, or, a question that has not yet been investigated, be altogether insensible to electricity.

Physical Society, June 23.—Prof. du Bois-Reymond in the chair.—Prof. Neesen showed a new mercury air-pump, made on the principle of the Topler air-pump, but with several alterations to facilitate the working.—Dr. Braun exhibited a somewhat modified Huyghens barometer, which had, both at the upper and at the lower meniscus of mercury, points for exact measurement, and which served to measure not only the variations, but also the amount of the air pressure.—Dr. Kaiser showed a moment-shutter for instantaneous photographs, in which, on pressing a small capsule with the hand, two pendant valves before the aperture are raised, and meet one over the other. The time during which the light can penetrate by the aperture into the apparatus, is 1-20th second. By a simple replacement in the apparatus, the mechanism can be so altered, that the light coming from above—that of the sky and clouds—acts a much shorter time than that from other objects, so that, with 1-20th second of illumination, the exposure for the sky is not excessive.—Prof. Neesen remarked, *à propos* of a former communication by Dr. Thiesen, on the deflection of projectiles, that in the case of the best German guns, this deflection amounts to one degree; thus, with a distance of 3000 metres, it is about 128 metres, a value which cannot be explained by the hypothesis of Dr. Thiesen.—The next meeting of the Society takes place after the holidays, on October 20.

VIENNA

Imperial Academy of Sciences, June 9.—E. Mach, on A. Guebhard's statement on equipotential curves.—L. Boltzmann, on the theory of gas-diffusion.—E. Heller and C. Della-Torre, on the distribution of the fauna in the high mountains of Tyrol.—E. Rathay, Researches on the spermagonia of the Æcidiomycetes.—R. Andreasch, on mixed alloxantins.—On cyamidomalonic acid, by the same.—On dimethylglyoxylcarbamide, a product of reduction of Cholestrophæne, by the same.—W. Pscheidl, on determination of the coefficient of elasticity by bending of a rod.—G. Schmidt, on analogies.—C. Braun, a sealed packet, with the inscription, some suggestions to the technics and praxis of astronomical instruments.—L. Psæczolka, a sealed packet with the inscription, on the action of silicon on carbonic oxide in the recarburation in the Siemens-Martin process.—C. Natterer, on monochloraldehyde.—E. Lecher, on the absorption of radiant heat by steam of water and carbonic acid.—V. Uhlig, on the cephalopoda fauna of the strata of Wernsdorf.—On the strata of Wernsdorf and their equivalents, by the same.

June 15.—K. Fulkowsky, on the constituents of corallin.—B. Brauner, contribution to the chemistry of the cerite metals.—E. v. Haerdtl, computation of the orbit of the planet Adria.

June 22.—Ph. Knoll, contributions to the theory of respiratory innervation (part 2); on respiration with artificial stimulation of the cervical part of vagus.—G. Stach, on the fossils collected in the Western Sahara, by O. Lenz during his journey to Timbuctu. They belong all to the carboniferous, and show analogies with the fossils of the Belgian limestone.—F. Steindachner, ichthyological contributions (part 12) on a new Ezemias species, *E. Holubi*, from the valley of the Limpopo River (Transvaal).—Th. Weinzweig, on the anatomy of laryngeal nerves.

PARIS

Academy of Sciences, June 26.—M. Jamin in the chair.—The president reported on the presentation of a commemoration medal to M. Pasteur on June 25, by a committee of friends and admirers. M. Dumas' address and M. Pasteur's reply are given in *Comptes rendus*.—A telegram from the Emperor of Brazil stated that comet Wells was visible on the 17th (June). On the 20th the tail measured 45°, and the nucleus was very bright.—On the reciprocal displacements of acids combined with oxide of mercury, by M. Berthelot.—Note on the preparatory works of the submarine railway between France and England, and on the geological conditions under which they are executed, by M. Daubrée.—On *débris* of mammoth found in the heart of Paris, by M. Gaudry. The locality is in the Rue Pagevin, the foundations of the new Hôtel des Postes. M. Gaudry showed a molar. Since Cuvier's time numerous remains of large quaternary mammals have been found in Paris, and human remains contemporary with the mammoth.—Mobile tableau of the different attitudes of the horse in any pace, by M. Marey. He describes a device of M. Cuyer, in which a jointed figure of a horse is fixed on a board; the hoofs are painted different colours; and placed on corresponding coloured and numbered spaces on sheets of paste-board, so that different phases of a pace can be represented. Direction is also given in placing the head, neck, body, and tail.—Action of low temperatures on the vitality of trichinæ in meat, by MM. Bouley and Gibier. Exposure of meat to a temperature of − 20° and even − 15° is sufficient to kill the trichinæ in it.—On the second comet of the year 1784, by M. Gyldén.—On the photographic spectrum of Comet I, 1882 (Wells), by Dr. Huggins.—On *Laminaritez Lagrangei*, Sap. and Mar., by M. de Saporta.—Experimental study of the conditions that allow of rendering usual the employment of the method of M. Toussaint for weakening the virus of charbon and vaccinating animal species subject to splenic fever, by M. Chauveau. Heating (according to certain rules) blood infected with bacteria, makes it a vaccinating liquid quite as sure as that of M. Pasteur. The temperature 43°-44° suffices. In an hour enough vaccine matter for 500 sheep can be prepared from one guinea-pig.—M. Lallemand was elected Correspondent in Physics in room of the late M. Billet.—On Eulerian integrals, by M. Tannery.—On Abelian functions, by M. Appell.—On the reduction of Abelian integrals to elliptic integrals, by M. Picard.—On the perforating machine of Col. Beaumont employed on the submarine railway, by M. Duval.—On the employment of zinc-carbon couples in electrolytes, by M. Tommasi. A reply to M. Berthelot.—On silicium, by MM. Schützenberger and Colson. Platinum plate or wire, heated to a white red within a thick layer of non-siliciferous lamp-black, gains weight, and has its fusibility increased, through fixation of silicium, which can only have come from the crucible. From various experiments, the authors infer that nitrogen, and probably also oxygen, have a *rôle* in the transport of silicium.—Action of bimolybdate of potash on some oxides; production of corundum and specular iron ore, by M. Parmentier.—Action of sulphuretted hydrogen on sulphate of nickel in acetic solution, by M. Baubigny.—On the supposed compound NH_2, by M. Combes. Having repeated M. Maumené's experiments, he gets only ammonia and carbonic acid.—On didymium, by M. Brauner.—Action of oxygenated water on the red colouring matter of blood and on hematosin, by M. Béchamp. Hemoglobin and hematosin behave, in contact with oxygenated water, as oxidable bodies. The blood contains two causes of decomposition as regards oxygenated water, viz. microzymas and hemoglobin.—On gastric juice, by M. Chapoteaut. Pepsine seems to him to be a combination of an albuminoid matter with an organic acid; (he hopes to prove this shortly).—On the differentiation of protoplasm in the nerve-fibres of Unionides, by M. Chatin.—On the sexual organs of *Ciona intestinalis*, by M. Roule.—The eye of *Proteus*, by M. Desfosses. It has retinal development, but no crystalline lens, nor any refractive organ; thus it cannot be compared with the eye of any vertebrate.—New example of alternating generations; œcidium of creeping Ranunculus [*Œc. Ranuncuacearum* (*pro parte*)] and Puccinia of roses (*Puccinia arundinacea*, Dc.), by M. Cornu.—On the disease of saffrons called "Death," by M. Prillieux.—On the petioles of Alethopteris, by M. Renault.—On the marine carboniferous of Upper Alsace; discovery of its relations with the culm or the plant carboniferous, by MM. Bleicher and Mieg.

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