THURSDAY, APRIL 26, 1883

SCIENTIFIC WORTHIES

XXI.—WILLIAM SPOTTISWOODE

WILLIAM SPOTTISWOODE, President of the Royal Society, was born in London, Jan. 11, 1825. He belongs to an ancient Scottish family, many members of which have risen to distinction in Scotland and also in the New World.[1] He was first sent to a private (we believe) school at Laleham under Mr. Buckland, brother of Dean Buckland. Here, we read, "the discipline was of a severity unknown at the present day." Thence he was removed to Eton, where however his stay was short. The poet writes, "the child is father of the man"; but science in those days did not hold the place it does now in the scholastic curriculum, and so the future President, venturing to make some researches into the effects produced by the combination of various detonants, came into collision with the "powers that be";[2] the upshot of this *contretemps* was that the brothers Spottiswoode were transferred to Harrow, then under the rule of the present Bishop of Lincoln. His house tutor was Mr. Harris, of the Park.[3] On entrance he was placed in the upper shell, a high form in those days for a newcomer: here he was a very studious, quiet, and thoughtful boy, not much given to athletic games. He remained at Harrow three years, and in 1842 obtained a Lyon Scholarship.[4] In this same year he entered Balliol College, Oxford, and had the present Bishop of Exeter for his mathematical tutor; subsequently, in 1845, the last year of his residence as an undergraduate, he read with the Rev. Bartholomew Price, of Pembroke College. This gentleman writes: "He showed extraordinary liking for, and great skill in, what I may call the morphology of mathematics, such as the theory of simultaneous equations and the results deducible from the *form* of these equations, a department in which he has since shown great ability. He had, I think, greater taste for these branches in their algebraical and geometrical developments than for any other. His power of work was very great and his industry equally so; he read a great deal outside the usual range." In 1845 he took a first class in mathematics, and he afterwards won the Junior (1846) and Senior (1847) University Mathematical Scholarships. He returned to Oxford for a term or two, and gave a course of lectures in Balliol College on Geometry of Three Dimensions—a favourite subject of his. He was Examiner in the Mathematical Schools in 1857-58.[5] On leaving Oxford, he immediately, we believe, took an active part in the working management of the business of the Queen's printers, about this time resigned to him by his father, Andrew Spottiswoode, brother of the Laird of Spottiswoode. The business has largely developed under his hands.

Other subjects than mathematics have occupied his attention: at an early age he studied languages, as well Oriental as European; of his acquaintance with these ample evidence is furnished by his contributions more particularly referred to below.

In 1856 Mr. Spottiswoode made a journey through Eastern Russia; of this he has published a graphic and, in parts, very lively account in his book entitled "A Tarantasse Journey through Eastern Russia in the Autumn of 1856" (Longmans, 1857). "I neither made the journey, nor do I now write, with any political object, but simply as a traveller to whom every square mile of the earth's surface is interesting, and the more so in proportion as it is less known."[1]

In 1860 the brothers Spottiswoode, accompanied by a sister, went through Croatia and Hungary.[2] In 1861 Mr. Spottiswoode married the eldest daughter of the late William Urquhart Arbuthnot, a distinguished member of the Indian Council. His exceptional qualifications as an organiser have not only served to advance his business in the way we have mentioned above, but these same qualifications, together with the broad and liberal education on which they were based, have combined to raise him to his present high position in science. As Treasurer and President he has been continuously on the Council of the Royal Society for a great many years, and through his exceptional gifts as an administrator he has rendered it invaluable services. He has rendered similar services to the British Association, to the London Mathematical Society, and to the Royal Institution.[3] We have permission to make the following extract from a letter written by a friend of many years standing: "In the councils (of the various societies) he has always been distinguished by his sound judgment and his deep sympathy with their purest and highest aims. There never was a trace of partisanship in his action, or of narrowness in his sympathies. On the contrary, every one engaged in thoroughly scientific work has felt that he had a warm supporter in Spottiswoode, on whose opportune aid he might surely count. The same breadth of sympathy and generosity of sentiment has marked also his relations to those more entirely dependent upon him. The workmen in his large establishment all feel that they have in him a true and trustworthy friend. He has always identified himself with their educational and social well-being."[4] We give here a list of some of the offices Mr. Spottiswoode has held, and of the honours that have been bestowed upon him: Treasurer of the British Association from 1861 to 1874, of the Royal Institution from 1865 to 1873, and of the Royal Society from 1871 to 1878. In 1871 he succeeded Dr. Bence

[1] John Spottiswoode, born 1565, Archbishop of St. Andrews, "had few equals, and was excelled by none"; another John (1616) was "a youth of extraordinary parts"; and Sir Robert Spottiswoode, second son of the Archbishop, was "a man of extraordinary parts, learning, and merit." ("Genealogy of the Spotswood Family in Scotland and Virginia," by C. Campbell. Albany, 1868.)

[2] "The feeling and opinion" at Harrow "were that no blame whatever attached to them."

[3] One who knew Mr. Spottiswoode in his earliest days says: "Our numbers at the school were comparatively very small, but I remember well the great ease with which he did all his school work. I knew him well at Oxford, and he several times lent me his horse—a sturdy, Roman-nosed animal of great courage and strength—for a day's hunting. He rode but little himself, and did not read much in an orderly way." He also gives other particulars of interest, which we forbear to give here.

[4] A son of Bishop Colenso also obtained a scholarship in the same year. The mathematical prizes of the present day were not then founded, so that the name of Spottiswoode does not occur among the prizemen of that time.

[5] He also acted as an Examiner in the Civil Service Commission in its first year of operation, and subsequently for the Society of Arts, and also for the Cowper Street Middle-Class Schools.

[1] The hotel accommodation was of the scantiest (p. 93); the description of the vehicles is pleasanter to read than to realise. The only peculiarly personal statement is that the writer was a non-smoker. There are several illustrations by the author, and a route map of Russia.

[2] For a description, see a paper by Mr. G. A. Spottiswoode in Galton's "Vacation Tourist in 1860."

[3] He has, we believe, also rendered valuable services to the Astronomical and Geographical Societies.

[4] This last statement we have corroborated from other sources. "Spottiswoode's people" have "many institutions for healthful recreation as well as mental improvement, such as library, rowing and cricket clubs, a choral society, and a volunteer corps."

Jones as Honorary Secretary to the Royal Institution. *President* of Section A, 1865; of the British Association, 1878; of the London Mathematical Society, 1870 to 1872; of the Royal Society, 1879, which office he still holds. Correspondent of the Institut (Académie des Sciences), March 27, 1876. He is also LL.D. of the Universities of Cambridge, Dublin, and Edinburgh, D.C.L. of Oxford, and F.R.A.S., F.R.G.S., F.R.S.E. In addition to these honours he has many other literary and scientific distinctions.

Of Mr. Spottiswoode's willingness to communicate from his stores of knowledge many have had frequent proof. We are breaking no faith, we believe, when we mention that it was his wish to purchase the late Prof. De Morgan's valuable library to present it to the Mathematical Society, of which that distinguished mathematician had been the first President.

Few students of the present day are acquainted with Mr. Spottiswoode's earliest work which appeared in the shape of five quarto pamphlets (136 pp. in all) with the title, "Meditationes Analyticæ" (London, 1847). The author's dedication runs thus: "To those who love to wander on the shore till the day when their eyes shall be opened and they shall see clearly the works of God in the unfathomed ocean of truth, these papers are inscribed;" and in his preface he says, "The following papers have been written at various periods, as the subjects presented themselves to notice from time to time. If leisure had been afforded, an attempt would have been made to draw some of them up into a distinct treatise; but it was thought that even in their present form they might interest some of those who take pleasure in the pursuit of mathematical science. Some of the papers are entirely original." The papers are entitled, "Symmetrical Investigations of Formulæ relative to Plane Triangles," "On some Theorems relative to Sections of Surfaces of the Second Order," "On the Reduction of the General Equation of the Second Order," "On the Partial Differential Equations of certain Classes of Surfaces," "On some Theorems relating to the Curvature of Surfaces," "On certain Formulæ for the Transformation of Coordinates," "On the Principle of Virtual Velocities," "On Infinitesimal Analysis," "Examples of the Application of the Infinitesimal Calculus," "On certain Formulæ made use of in Physical Astronomy," "On the Calculus of Variations," "Problems in the Calculus of Variations," and "Note on Lagrange's Condition for Maxima and Minima of Two Variables"—a fair epitome of his subsequent mathematical labours. The treatment calls for no special comment, except that we may note that "in the form of the equations symmetry has been preserved wherever the circumstances of the case would permit."

At a slightly later date (1851) appeared, of a uniform appearance with the "Meditationes," a much more notable pamphlet (63 and viii. pp.), "Elementary Theorems relating to Determinants," of which a writer remarks, "full of interest for the mathematician, but terrible to the unmathematical vision." A second edition of this, rewritten and much enlarged, was published in *Crelle's Journal* (vol. li. 1856, occupying pp. 209–271, 328–381).[1] This was the earliest elementary treatise on a subject which has since risen to such importance, and contains a good sketch of what had previously been done in the same direction. The friend, some of whose words we have already cited, remarks, "that Spottiswoode should have devoted himself at an early period to its cultivation is to me perfectly natural, for the prevailing character of all his mathematical work is *symmetry* (one might generalise still further indeed and say that it, combined with graceful elegance, is the salient feature of all his activity, mathematical, physical, and literary). Bertrand once said of Serret that he was '*un artiste en formules*,' and in a far more general sense one might say that Spottiswoode is the 'incarnation of symmetry.'" To go back to the criticism just now quoted, Mr. Spottiswoode is indeed a leviathan in symbols, and he takes his pastime amongst them: the "gay determinant" is a familiar form nowadays, and "Hamilton's weird delta turned" (the *Nabla* of Clerk Maxwell) is conspicuous on many a page devoted to physics, but in some of the papers we are about to describe there are not only inverted deltas, but Nablas turned to the right and to the left run riot on the pages.

It is since 1870 that Mr. Spottiswoode has more especially divided his attention between physics and mathematics. "His nearest friends," we are informed, "induced him to take up the less abstract one of these two branches of science in order that the general public might have better opportunities of appreciating his abilities. His work in the new field has been of the same character as in the former one. It aims less perhaps at exhaustive treatment than at a study of subtle and beautiful phenomena."

An early consequence of his new study was the publication in 1874, in the NATURE Series, of his "Polarisation of Light." This contains a popular exposition of the subject, and its pages "constitute a talk" with his workpeople "rather than a treatise" on "this beautiful branch of optics."[1]

Before we give a list of the several papers which, of course, do not admit of quotation and passing over, as still within the recollection of most of our readers, the most admirable address delivered before the British Association at Dublin in 1878[2]—though one finds it hard to pass over the many brilliant passages, of more special interest however to the mathematician, who alone can be supposed to care for any other than the ordinary space of three dimensions—we must trespass to the extent of taking the following passage from the earlier address to Section A in 1865. This address, in the words of Prof. Sylvester, is a combined history of the progress of mathematics and physics, and of it Clerk Maxwell said he had endeavoured to follow Mr. Spottiswoode, "as with far-reaching vision he distinguishes the systems of science into which phenomena, our knowledge of which is still in the nebulous stage, are growing."

"A detailed summary of recent progress in pure mathematics would probably prove either interesting to the mathematician or unintelligible to the general hearer;

[1] "On the request of the editor of this *Journal* to reproduce it he (Mr. Spottiswoode) requested permission to revise the work. The subject had, however, been so extensively developed in the interim, that it proved necessary not merely to revise but entirely to rewrite the work. The result is given in the following pages."

[1] He has also contributed a lecture on the same subject to the "Science Lectures at South Kensington" Series.

[2] See NATURE, vol. xviii. pp. 404-415.

with a view to sparing the patience of both, I shall restrict myself to a few general remarks. In both the great branches of mathematics, viz. geometry and algebra, new schools have arisen within the last few years. In its primary aspect the movement has tended to separate the two; geometry has become more purely geometrical in its conceptions and methods, algebra more independent of geometrical considerations. The geometry of to-day is more like the Greek than was that of fifty years ago; and yet at the same time they have not only many principles really in common, but many methods which, although independent, are strictly analogous. Geometry regards its figures, algebra its forms, not as isolated individuals, but as associated with others (concomitants, as they are called) whose properties characterise those of their primitives. The principles of both may be regarded as the same, but dual in their application. Geometry, again, is dual within itself: points and lines may be so viewed that theorems concerning the one give rise to analogies concerning the other; the principle the same, but dual in its manifestation. In this way we seem to be rising to laws which transcend the distinctions between the two parts of geometry—between geometry and algebra.

"Descending a little further into particulars, in another way again we seem to be gaining some steps—but as yet only a few steps—towards a higher scheme both of geometry and algebra. There are a few certain relations so elementary in their conception, yet so universal in their application, that they seem capable of forming the basis of extensive theories: such, for example, in geometry, is that of Anharmonic Ratio—a particular kind of ratio applicable alike to points and rays, to lines and to angles, on which M. Chasles has founded his new and classical work on Conic Sections. Such, again, in algebra, are those of homogeneity and of symmetry, which prove to be not merely improvements in form, but actually new powers for progress in the hands of the mathematician. The calculus of homogeneous forms has marked a new era in the history of algebra; the theory of equations has been transfigured in its light; mechanics, both ordinary and molecular, have been elucidated by it; and the remote applications of the integral calculus have felt its ever-extending influence. Under these, as it were, new fundamental conceptions, whole theories may be co-ordinated, and of these, again, perhaps some coordination may one day be contemplated. As another instance of this generalisation of principles and of this dual aspect of the principles so generalised within almost the present generation, it has been discovered, or at all events been duly realised, that symbols of operation combine according to definite laws, comprising as a particular case those of ordinary number. This fertile idea has, year by year, been receiving fuller developments, till it has at last assumed the form of a complete calculus."

We, too, must join our apologies with those of the learned speaker for lingering so long upon a favourite subject.

The following is as complete a list of Mr. Spottiswoode's papers as we have been able to make:[1] they are grouped, not according to subjects nor in order of time, but as they occur in the several journals in which they originally appeared:—

Phil. Magazine.—(1) On the Equation $Q=q\ (\omega, x, y, z)$ $=w+ix+jy+kz$ (vol. xxxvi. 1850); this is a theorem of considerable importance in the calculus of quaternions, and indeed essential for the application of that method to geometrical and physical problems. (2) On the Quaternion Expressions of Coplanarity and Homoconicism (*ib.*). (3) On the Geometrical Interpretation of Quaternions (vol. xxxvii. 1850), the working out on other lines of results stated in a previous volume by Prof. Donkin. (31) On a Geometrical Theorem (*ib.*, 1850), viz. if three cones of the second order, having a common vortex, intersect one another two and two, the nine lines of intersection (three being selected from each pair of cones) will lie on a cone of the fourth order. (7) On a Problem in Combinational Analysis (vol. iii. 1852) connected with the 15-girl Problem and a more general form of it, the solution of which turns upon certain determinants. (41) On some Experiments on Successive Polarisation of Light made by Sir C. Wheatstone (vol. xli. 1871); the introduction of instrumental means for converting the plane of polarisation of the ordinary apparatus into successive, or, as it is more commonly called, circular polarisation, and the explanation of the phenomena thence arising, constitutes the main purpose of the communication. See also *Proc. of R. Inst.*, vol. vi. 1872. 1875 (*a*) on a Revolving Polariscope; 1882 (*b*) on a Separator and Shunt for Alternate Currents.

Camb. and Dub. Math. Journal.—(4) On certain Geometrical Theorems (vol. vi. 1851). This is an anonymous article which gives simple algebraical demonstrations of certain of Steiner's Theorems in the *Systematische Entwickelung*, and also of some relations given by M. Chasles in his "Aperçu." (9) On Certain Theorems in the Calculus of Operations (vol. viii. 1853); an extension of theorems by Boole (*Phil. Trans.*, 1844), relating to the operation symbol $D=x\frac{d}{dx}$, and by Carmichael relating to the symbol $\nabla = x_1\frac{d}{dx_1} + x_2\frac{d}{dx_2}$ . . . to the cases (1) in which the order of the Variables by which the Symbols of Differentiation are Multiplied is not the same as that of the Variables with respect to which the Differentiations are to be performed; (2) in which the Variables by which the Symbols of Differentiation are Multiplied are any linear Function of the Given Variables; (10) on Certain Geometrical Theorems (*ib.* 1853); two Elementary Theorems in anharmonics proved by aid of determinants. (11) On the Curvature of Curves in Space (vol. ix. 1854); on this M. Chasles ("Rapports," p. 162) remarks: "M. W. Spottiswoode est parvenu à la même expression dans une Note . . . " *i.e.* to the expression—

$$\frac{1}{\rho} = \operatorname{cosec}\phi\left\{\frac{1}{\rho^2}+\frac{1}{\rho_1{}^2}-\frac{2\cos\phi}{\rho\rho_1}\right\}^{\frac{1}{2}}.$$

Quarterly Journal of Mathematics.—(15) Note on Axes of Equilibrium (vol. i. 1857). The axes (Möbius, "Statik") possess the property of allowing the body to be turned about them, the forces retaining their directions in space without a disturbance of equilibrium. The paper is an application of formulæ given by Rodrigues to a proof of the property. (16) On a Theorem in Statics (*ib.* 1857) is a proof of the following, due to Möbius ("Statik"): "If there be any forces in equilibrium, and a series of pyramids be constructed having for one edge a common line, and for their opposite edges the lines which represent the forces, in both magnitude and direction, respectively, the algebraical sum of the volumes of the pyramids will vanish. It is of this M. Chasles ("Rapport," p. 59) writes: "M. W. Spottiswoode, à qui toutes les ressources des nouvelles théories de l'analyse sont si familières, s'est plu à les appliquer à la démonstration de cette proposition (*i.e.* Möbius's) et d'un autre passage du traité de statique de Möbius, sur les axes de l'équilibre." (23) On Petzval's Asymptotic Method of Solving Differential Equations (vol. v. 1862). Also in a somewhat different form in *Brit. Assoc. Report* (part ii.), 1861. (29)

[1] We trust our readers will pardon our imperfect treatment of these papers: we had formed quite a mass of notes—a "rudis indigestaque moles"—but we have had, through circumstances over which we had no control, an utterly inadequate period in which to prune them and shape them into comely form. The prefixed numbers are those of the "Royal Society's Catalogue," and the notes are in most cases derived from the papers themselves. In our haste we have preferred to insert notes to the less familiar papers; the papers read before the Royal and Mathematical Societies are without doubt those by which Mr. Spottiswoode's rank as a mathematician has been determined, but these are just the ones that are most familiar to students.

On Differential Resolvents (vol. vi. 1863). A subject first brought into notice by Mr. J. Cockle, subsequently discussed by Rev. R. Harley. The functions considered are derived from equations in a factorial form; see also *Manch. Phil. Soc. Memoirs*, ii. 1865. [In the *R. S. Catalogue* these are also numbered (33)]. (37) Note on the Contact of Curves (vol. vii. 1866). "In my former paper" (*Phil. Trans.* 1862, see *infra*) "one set of expressions is unsymmetrical with respect to the variables; the other, although symmetrical, involves certain arbitrary quantities which remain to be eliminated by special methods in the course of the developments"—the object of the note is to establish general expressions which are both symmetrical and free from arbitrary quantities. (38) Note on the Resolution of a Ternary Cubic into Linear Factors (*ib.* 1866) is in effect a note on a paper by Mr. J. J. Walker in the previous volume, entitled "On the Resolution of Composite Quantities into Linear Factors."

Crelle's Journal.—(5) Mémoires sur les points singuliers d'une courbe à double courbure (vol. xlii. 1852). (6) Mémoire sur quelques formules relatives aux surfaces du second ordre (*ib.* 1852). (12) Correspondence between Prof. Donkin and Mr. Spottiswoode (vol. xlvii. 1854); extracts from letters (one from each), on a Method for Determining Two Cyclic Sections of a Surface of the Second Order. (14) The Memoir on Determinants (vol li. 1856). (25) Sur quelques formules générales dans le calcul des opérations (vol. lix. 1861), connected with a *Phil. Trans.* paper (17). In this he shows the method by which he obtained the formulæ in (17). (32) Note sur la transformation de la cubique temaire en sa forme canonique (vol. lxiii. 1864).

Tortolini Annali di Scienze.—(8) Sulla trasformazione delle equazioni differenziali lineari dell' ordine secondo (vol. iii. 1852).

R. Soc. Proc.[1]—(13) Researches on the Theory of Invariants (vol. vii. 1854). "The view of invariants here taken has suggested a series of other functions of which invariants form the last term. These functions I propose to call *variants*. With the exact relation between these functions and covariants I am not at present acquainted." (17) On an Extended Form of the Index Symbol in the Calculus of Operations (vol. x. 1859, *Phil. Trans.* 1860). A more detailed form of (9). (20) On the Calculus of Functions (vol. xi. 1861). (21) On Internal and External Division in the Calculus of Symbols (*ib.*). Connected with a paper by Mr. W. H. L. Russell (*Phil. Trans.* 1861), a generalisation and an extension. (30) On the Equations of Rotation of a Solid Body about a Fixed Point (vol. xiii. 1863). In treating the equations of rotation of a solid body about a fixed point it is usual to employ principal axes of the body as the moving system of coordinates. Cases, however, occur in which it is advisable to employ other systems. The object of the paper is to develop the fundamental formulæ of transformation and integration for any system. [This is also given as (34) in the *R. S. Cat.*]. (35) On the Sextactic Points of a Plane Curve (vol. xiv. 1865; *Phil. Trans.* 1865). (40) On the Contact of Conics with Surfaces (vol. xviii. 1870; *Phil. Trans.* 1870). (43) On the Contact of Surfaces (vol. xx. 1872; *Phil. Trans.* 1872). (45) On the Rings Produced by Crystals when Submitted to Circularly Polarised Light (vol. xx. 1872); 1874 (*a*) On Combinations of Colour by Polarised Light; 1874-5 (*b*) On Stratified Discharges through Rarefied Gases; 1875-6 (*c*) On Multiple Contact of Surfaces; (*d*) An Experiment in Electromagnetic Rotation; 1876-7 (*e*) On Stratified Discharges (ii.); Observations with a Revolving Mirror (iii.); (*f*) On a Rapid Contact Breaker and the Phenomena of the Flow; 1877 (*g*) On Hyperjacobian Surfaces and Curves; (*h*) Stratified Discharges (iv.): Stratified and Unstratified Forms of the Jar-Discharge; (*i*) Photographic Image of the Stratified Discharge; 1878 (*j*) Stratified Discharge (v.); Discharge from a Condenser of Large Capacity; 1879 (*k*) On the Sensitive State of Electrical Discharges through Rarefied Gases [with J. F. Moulton], *Phil. Trans.*; 1879-80 (*l*) On some of the Effects Produced by an Induction Coil with a De Meriten's Magneto Electric Machine; (*m*) On the Sensitive State (ii.) (with J. F. M.), *Phil. Trans.*; 1880-1 (*n*) On the 48 Coordinates of a Cubic Curve in Space (*Phil. Trans.*); 1881 (*o*) On Stratified Discharges (vi.), Shadows of Striæ (with J. F. M.); and (*p*) Multiple Radiations from Negative Terminal; 1881-2 (*q*) Note on Mr. Russell's Paper on Definite Integrals; (*r*) Note on Mr. Russell's Paper on Certain Geometrical Theorems; (*s*) On the Movement of Gas in Vacuum Discharges (with J. F. M.).[1]

R. Asiatic Soc. Journal.—(18) Note on the supposed Discovery of the Principle of the Differential Calculus by an Indian Astronomer (vol. xvii. 1860). While not granting that Bhóskarácharya had discovered the principle, "it must be admitted that the penetration shown by him in his analysis is in the highest degree remarkable, and that the formula which he establishes and his method of establishing it bear more than a mere resemblance—they bear a strong analogy—to the corresponding process in modern astronomy." (28) On the "Súrya Siddhánta" and the Hindoo Method of calculating Eclipses (vol. xx. 1863). It had been suggested that Mr. Spottiswoode should undertake an edition of the above work. For reasons stated, the attempt was not made; but the object of this paper is the translation into modern mathematical language and formulæ of the rules of the work in question.

R. Geog. Soc. Proc.—(19) On Typical Mountain Ranges: an application of the Calculus of Probability to Physical Geography (vol. iv. 1861; *Journal*, vol. xxxi. 1861).

R. Astron. Soc. Memoirs.—(22) On a Method for determining Longitude by Means of Observations on the Moon's greatest Altitude (vol. xxix. 1861; also in *Geog. Soc. Proc.* vol. v. 1861).

British Assoc. Report.—(24) On the Reduction of the Decadic Binary Quantic to its Canonical Form (1861, part 2); (36) Address to Section A (1865); (*a*) Address to the Association (1878).

Phil. Trans.—(26) On the Contact of Curves (1862); (27) On the Calculus of Symbols (1862); 1874 (*a*) On the Contact of Quadrics with other Surfaces. See also above under *R. Soc. Proc.*

Comptes Rendus.—(39) Note sur l'équilibre des forces dans l'espace (vol. lxvi. 1868); (48) Note sur la représentation algébrique des lignes droites dans l'espace (vol. lxxvi. 1873); (49) Sur les plans tangents triples à une surface (vol. lxxvii. 1873); 1874 (*a*) Sur les surfaces osculatrices; 1875 (*b*) Sur la représentation des figures de géométrie à *n* dimensions par les figures corrélatives de géométrie ordinaire; 1876 (*c*) Sur le contact d'une courbe avec un faisceau de courbes doublement infini.

R. Inst. Proc.—(44) On Optical Phenomena produced by Crystals submitted to Circularly Polarised Light (vol. vii. 1872. See also *Phil. Mag.* vol. xliv. 1872); (46) On the Old and New Laboratories at the Royal Institution (vol. vii. 1873); (47) On Spectra of Polarised Light (*ib.* 1873); 1874 (*a*) On Combinations of Colour by Polarised Light; 1878 (*b*) A Nocturne in Black and Yellow; (*c*) Quartz: an old chapter rewritten; 1880 (*d*) Electricity in Transitu; 1882 (*e*) Matter and Magnetoelectric Action.

Musical Society Proc.—1879 (*a*) Lecture on Beats and Combination Tones.

Royal Society.—Presidential Addresses for the Years 1879, 1880, 1881, 1882.

[1] When there is a paper in the *Phil. Trans.* as well, the reference is also given under this head.

[1] For analyses of the papers on "Sensitive Discharges," &c., consult vol. ii. of "A Physical Treatise on Electricity and Magnetism," by J. E. H. Gordon, 1880 (see pp. 47-50, 71-81, 88-111).

L. Math. Soc. Proc.—1866 (*a*) A Problem in Probabilities connected with Parliamentary Elections; 1868 (*b*) Equilibrium of Forces in Space; 1871 (*c*) Question in the Mathematical Theory of Vibrating Strings; 1872 (*d*) On some recent Generalisations in Algebra (Presidential Address); 1874 (*e*) On the Contact of Quadrics with other Surfaces; 1876 (*f*) On Determinants of Alternate Numbers; (*g*) On Curves having Four-point Contact with a Triply-infinite Pencil of Curves; 1879 (*h*) On the Twenty-one Coordinates of a Conic in Space; (*i*) On Clifford's Graphs; 1881 (*j*) On the Polar Planes of Four Quadrics; 1882 (*k*) On Quartic Curves in Space.

"A MANUAL OF THE INFUSORIA"

A Manual of the Infusoria; Including a Description of all known Flagellate, Ciliate, and Tentaculiferous Protozoa. By W. Saville Kent, F.L.S., F.Z.S. (London: David Bogue, 1882.)

THE *Philosophical Transactions of the Royal Society of London* for the year 1677 contain the first published account of the minute organisms to which the term "Infusoria" is now very generally applied. The account is by "Mr. Antony van Leeuwenhoek," who, taking up the line of study so successfully pursued by his compatriot, Swammerdam, was the first to apply the microscope to the investigation of the otherwise invisible fauna and flora which teem in inconceivable abundance in the waters of ponds, rivers, and seas, in the infusions of organic substances prepared by man's agency, and in even the minutest drops of moisture which accumulate on the surfaces of natural objects.

Henry Baker (1742), O. F. Müller (1773), and other names are connected with the history of this field of investigation in the period antecedent to Ehrenberg, who in 1836 gave a new aspect to the subject by his descriptions and figures of a great number of forms and of their intimate organisation. The minute creatures at one time spoken of as "animalculæ," and later as "Infusoria," are now known to comprise many very diverse series of organisms—unicellular plants, variously organised unicellular animals, as well as animals of multicellular structure and high organisation, although of minute size. The improvement of the microscope within the last forty years and the studies of a host of observers, among whom are Dujardin (1841), von Siebold (1845), Stein (1854), Claparède and Lachmann (1858), Max Schultze (1860), and more recently of Haeckel, Engelmann, and Bütschli —have gradually resulted in the recognition of a series of minute animals included amongst the "animalculæ" and "Infusoria" of earlier writers, which are characterised by having their living substance in the form of one single nucleated corpuscle or "cell," whilst nevertheless exhibiting a considerable degree of organisation, possessing a mouth into which solid particles of food are taken, pulsating spaces within the protoplasm of the cell, special organs of locomotion, prehension, and protection. These are the mouth-bearing Protozoa, distinguished as such from the other unicellular animals which have not a special orifice for the ingestion of food and constitute the mouthless Protozoa.

It is to these mouth-bearing Protozoa and a few allied mouthless forms that Mr. Saville Kent restricts (as is not unusual) the old term Infusoria. Among them the most numerous and highly organised are the Ciliata; far less abundant and varied are the Tentaculifera (Acinetæ), whilst the Flagellata have, on account of their excessive minuteness, not been properly understood (and were for the most part altogether unknown) until very recently, some important features in their organisation having been first made known by the author of the book which forms the text of this article.

Mr. Kent's "Manual of the Infusoria" consists of two large volumes and an atlas of fifty-one plates. The first volume contains chapters on the history, the organisation, the affinities, and the classification of the Infusoria. Then the three classes, Flagellata, Ciliata, and Tentaculifera, are taken up one by one and systematically divided into orders and families, genera and species—a diagnosis and usually a figure being given of every species. The systematic treatment of the Ciliata and Tentaculifera occupies the second volume. Altogether Mr. Kent describes 900 species of Infusoria, arranged in 300 genera and 80 families. To go over this ground in any case involves a vast amount of labour and perseverance. To do so in the thorough and conscientious manner which distinguishes Mr. Kent's work requires special capacity. Mr. Kent has spared no pains to make his work a trustworthy source of information on all points relating to the group with which it deals; the most comprehensive as well as the smallest and most obscure of recent publications relating to the organisation or to particular species of Infusoria have their contents duly set forth in the proper place in Mr. Kent's work. So far as a frequent reference to these volumes enables one to come to a conclusion, little if anything of importance, whether published in English, French, German, or Italian, has been overlooked by our author. Even the quite recent observations of Foettinger on the parasitic *Benedenia* found in Cephalopoda, and of Joseph Leidy on the parasitic Ciliata occurring in the Termites, are incorporated, as well as the observations of Cunningham on *Protomyxomyces*, little more than a year old.

This is by no means the only merit of Mr. Kent's work. He might have contented himself with recasting the materials to be found in the three great volumes published by Stein, in Claparède and Lachmann, and in Pritchard's "Infusoria" (a valuable book in its day), and have simply incorporated with these the results scattered through the various English and foreign journals and transactions of the past twenty-five years. Mr. Kent has duly done all this, but he has done more, since he has himself made a very careful and prolonged study of a large number of Infusoria. Accordingly we find throughout the present work original observations brought forward for the first time. These include a number of new species and genera, especially among the Flagellate and Tentaculiferous forms. The beautiful cup-forming monads mounted on branching stalks like a colony of Vorticellæ were first brought prominently into notice by that keen observer, the late Prof. James-Clark of Boston, and Mr. Kent has followed up the study of these beautiful forms in a very thorough manner. On the whole, it may be said that the portion of Mr. Kent's work devoted to the Flagellata will have, for those naturalists who have not very closely followed the periodical literature of the subject, the charm of complete novelty, for very many of these forms were completely unknown or misunderstood

till within the last ten years, and have not found their way into general treatises and text-books before the present occasion.

With Mr. Kent's views as to the affinities of the different classes of Infusoria it is not necessary to agree in order to appreciate the value of his work in general. The view is maintained in the "Manual" that the Sponges are genetically related to the Flagellata, whilst an opinion is quoted to the effect that the Ciliata are related to the Turbellaria. Without discussing the grounds for either of these views, we must simply express our entire disagreement with Mr. Kent, who is not (it seems to us) so happy in these speculations as in the more substantial portion of his work. The woodcut on p. 477, vol. ii., comparing the disposition of the ciliated bands of various Infusoria with that of the similar ciliated bands of various larvæ of higher animals, is exceedingly instructive and useful. It serves to point out the close similarity in form and disposition which such ciliated bands may assume in organisms totally unrelated to one another in the genealogical sense. Mr. Kent, however, takes the view, which we think will not be shared by many zoologists, that there is a deeper significance in the occurrence of these similar modifications of similar structures in forms so widely apart as unicellular Protozoa and multicellular Molluscan, Polyzoan, and Echinoderm larvæ; according to Mr. Kent they indicate "affinity," "phylogenetic connection," and "biogenetic relationship." In every direction Mr. Kent detects possible instances of such affinity, which he sets forth in a tabular form on p. 479; but it is not always quite obvious what Mr. Kent means when he speaks of certain Infusoria as "prototypes of" and as "foreshadowing" higher organisms. Had he confined himself to drawing attention to the remarkable parallelism or homoplasy presented by Infusoria on the one hand, and certain higher organisms on the other, we could have appreciated his capacity for detecting structural coincidences. But it appears to be Mr. Kent's opinion that the Holotrichous Ciliata are the forefathers of the Annelida, which are *also* traced by him to the Peritricha. The latter have (according to Mr. Kent) given rise to the Polyzoa, Mollusca, and Echinoderms; the Hypotricha are the ancestors of the Rotifera and of the Arthropoda! whilst the Tentaculifera are the progenitors of the Cœlenterata and the Choano-flagellata of the Sponges.

Mr. Saville Kent is no doubt entitled to hold and to promulgate an opinion on these matters, but we regret, inasmuch as his opinion is a very singular one, that he should have allowed it to take a prominent position in this "Manual."

Upon the question of spontaneous generation Mr. Kent is in accord with the prevalent doctrine, and gives a clear exposition of the history of the discussion of the subject, and so exhibits the importance of the researches carried on by Messrs. Dallinger and Drysdale upon the reproductive process in certain flagellate Infusoria, and the power of the ultra-minute germs of these Flagellata to resist the destructive influence of high temperatures.

With regard to the normal generation of Infusoria Mr. Kent is not so satisfactory. He distinguishes Fission, Gemmation, Sporular Multiplication, and "Genetic" Reproduction—the latter term being, without explanation, applied to sexual reproduction. Our author clearly has not—amongst his numerous and widespread researches upon the Infusoria—devoted any time to a personal investigation of the phenomena of conjugation and rejuvenescence amongst the Ciliata. The account which he gives of the work of Engelmann and Bütschli is meagre in comparison with the space which he has devoted to speculative digressions, and we find no figures illustrative of the exceedingly important results attained by those authors. In view of the great biological interest of the phenomena of conjugation in unicellular organisms generally, this is a serious omission. It is a mistake to have introduced the bygone error of attributing sexual reproduction to the Infusoria into this work at all, as Mr. Kent has done by the heading of his paragraph. Fission, gemmation, and possibly spore-formation preceded at a certain period in the family history by conjugation, constitute all that is *known* to occur in Infusoria. Mr. Kent makes too much of the isolated cases of spore-formation among Ciliata which stand upon good evidence. Admitting them as cases of spore-formation (that is of multiple fission), it is not possible to use them in support of the exploded view as to the production of embryos in the Ciliata by the breaking up of the nucleus after conjugation. Mr. Kent still clings to this notion of a special and peculiar formation of embryos within the parent ciliate Infusorian after, and as the immediate result of, conjugation, but he does not adduce any new fact in support of it. There is no reason adduced by Mr. Kent for regarding the nucleus of Infusoria as anything more than a cell-nucleus, and one is surprised to find that he should express so strong a disagreement with Bütschli as to the fate of the cast-out fragments of the nuclei of conjugated Ciliata, when he does not detail to us any original observations made by him upon the process in question. The cast-out fragments of the nucleus of the conjugated Ciliate possibly have the same significance (Mr. Kent calls it an "unprofitable destiny," p. 98) as the cast-out præseminal apoblasts or "directive corpuscles" of an ordinary egg-cell.

Undoubtedly the best part of Mr. Kent's book, and one which will prove of constant value to that large body of working naturalists who are scattered throughout English-speaking lands, who delight to follow with care and accuracy, by the aid of the microscope, the forms and life-histories of the minute beings first made known by Mr. Antony van Leeuwenhoek, is that which contains the systematic description of every known species of Infusoria.

Accuracy is one of the first requisites in any attempt at scientific work, and Mr. Kent's descriptions and figures will enable numberless good observers in country places and small towns where there are no libraries containing the big books of Stein and Ehrenberg to *accurately* identify the organisms which they observe. By familiarity with Mr. Kent's book such an observer will be able to tell whether he has observed a new species or a new fact about a known species, and he will rise at once from the position of an isolated spectator of the curiosities of microscopic life to that of a possible contributor to the world's knowledge of animal structure, a fellow-worker with all the naturalists of civilised humanity. It is an excellent thing for the cause of science in England, and an excellent thing for other good causes too, that there

are so many unprofessional naturalists in all classes of the community and in all parts of the kingdom. Our dilettanti naturalists not only pursue their favourite study with a devotion and energy which Englishmen always exhibit in regard to a "hobby," but they assist in all quarters in gaining for science true appreciation and popularity. Not merely so, but from their ranks many honoured leaders have sprung. It is chiefly for the service which he has rendered to this class of students that we consider Mr. Saville Kent is entitled to thanks, as was Andrew Pritchard and his editors in a past generation.

In conclusion we may briefly epitomise the classification of the Infusoria followed by Mr. Kent. He regards the Infusoria as a legion or section of the Protozoa or unicellular animals characterised by having appendages which are *not* pseudopodia, lobose, or radiate (Rhizopoda), but are either flagelliform, cilia, or tentaculiform. The character of possessing a distinct mouth or mouths cannot be strictly applied to the whole group, since some few flagellate forms have not even a localised ingestive area. The classes and orders and families recognised in this legion are as follows :—

CLASS I.—FLAGELLATA.

Order 1. TRYPANOSOMATA (Trypanosoma).

Order 2. RHIZOFLAGELLATA (Mastigamœba).

Order 3. RADIOFLAGELLATA.

Family 1. Actinomonadidæ ; 2. Euchitonidæ.

Order 4. PANTOSTOMATA.

Family 1. Monadidæ ; 2. Pleuromonadidæ ; 3. Cercomonadidæ ; 4. Codonœcidæ ; 5. Dendromonadidæ ; 6. Bikœcidæ ; 7. Amphimonadidæ ; 8. Spongomonadidæ ; 9. Heteromitidæ ; 10. Trepomonadidæ ; 11. Polytomidæ ; 12. Pseudosporidæ ; 13. Spumellidæ ; 14. Trimastigidæ ; 15. Tetramitidæ ; 16. Hexamitidæ ; 17. Lophomonadidæ ; 18. Catallactidæ.

Order 5. CHOANOFLAGELLATA or DISCOSTOMATA.

Section I. Gymnozoida.

Family 1. Codonosigidæ ; 2. Salpingœcidæ ; 3. Phalansteriidæ.

Section II. Sarcocrypta (*The Sponges*).

Order 6. EUSTOMATA.

Family 1. Paramonadidæ ; 2. Astasiadæ ; 3. Euglenidæ ; 4. Noctilucidæ ; 5. Chrysomonadidæ ; 6. Zygoselmidæ ; 7. Chilomonadidæ ; 8. Anisonemidæ ; 9. Sphenomonadidæ.

Order 7. CILIOFLAGELLATA.

Family 1. Peridiniidæ ; 2. Heteromastigidæ ; 3. Mallomonadidæ ; 4. Stephanomonadidæ ; 5. Trichonemidæ.

CLASS II.—CILIATA.

Order 1. HOLOTRICHA.

Family 1. Paramœcidæ ; 2. Prorodontidæ ; 3. Trachelophyllidæ ; 4. Colepidæ ; 5. Euchelyidæ ; 6. Trachelocercidæ ; 7. Tracheliidæ ; 8. Ichthyophthiriidæ ; 9. Ophryoglenidæ ; 10. Pleuronemidæ ; 11. Lembidæ ; 12. Trichonymphidæ ; 13. Opalinidæ.

Order 2. HETEROTRICHA.

Family 1. Bursariidæ ; 2. Spirostomidæ ; 3. Stentoridæ ; 4. Tintinnodæ ; 5. Trichodinopsidæ ; 6. Codonellidæ ; 7. Calceolidæ.

Order 3. PERITRICHA.

Family 1. Torquatellidæ ; 3. Dictyocystidæ ; 3. Actinobolidæ ; 4. Halteriidæ ; 5. Gyrocoridæ ; 6. Urceolariidæ ; 7. Ophryoscolecidæ ; 8. Vorticellidæ.

Order 4. HYPOTRICHA.

Family 1. Litonotidæ ; 2. Chlamydodontidæ ; 3. Dysteriidæ ; 4. Peritromidæ ; 5. Oxytrichidæ ; 6. Euplotidæ.

CLASS III.—TENTACULIFERA.

Order 1. SUCTORIA.

Family 1. Rhynchetidæ ; 2. Acinetidæ ; 3. Dendrocometidæ ; 4. Dendrosomidæ.

Order 2. ACTINARIA.

Family 1. Ephelotidæ ; 2. Ophryodendridæ.

The only feature in the above classification upon which it occurs to us to offer a remark is the limitation assigned to the class Flagellata. Putting aside the author's speciality as to the inclusion of the Sponges in that group, it seems that he has drawn up a very neat and, on the whole, satisfactory classification of the group. But on the one hand exception may be taken to the inclusion amongst the Flagellata of such forms as Mastigamœba and Euchitonia, whilst, on the other hand, those who follow Stein will ask why such forms as Volvox and Chlamydomonas are excluded. Further we cannot accept as satisfactory the subordinate position assigned to Noctiluca, the proboscis of which is no ordinary flagellum, but of so special a character as to entitle its owner to a distinct order or even a class. The fact is that it is excessively difficult to say what monadiform or flagellate unicellular organisms should be associated with forms such as the Choanoflagellata and Eustomata which undoubtedly are rightly placed in one legion with the Ciliata, and what should be left among lower plants, or again in association with the pseudopodic Rhizopods. A flagellate condition in the early stages of development (a "monad form") is common to a vast number of Protozoa and Thallophyta, and the mere flagellate character is not a sufficient basis for the construction of a natural group. Mr. Kent very properly proposes to separate as plants those flagellate forms which do not ingest solid particles of nutriment ; but he is no doubt aware of the difficulty of observation in this matter, and of the statement (probably an erroneous one) by Stein, that certain Volvocineæ actually possess a cell-mouth and gullet.

The true limitations of the natural group of the Flagellate Infusoria will probably be ultimately found in the characters afforded by the series of events constituting the life-history of the various flagellate organisms which at first sight may appear to have a claim to be placed in that group. E. RAY LANKESTER

OUR BOOK SHELF

The Micrographic Dictionary. By J. W. Griffith, M.D., and A. Henfrey. Fourth Edition, Edited by J. W. Griffith, M D. (London : Van Voorst, 1883.)

THE interval of eight years since the publication of the third edition of the "Micrographic Dictionary" has been marked by substantial progress, not only in the microscope itself, but also in our knowledge of the structure of various classes of organisms included in the subjects specially treated. In the former of these two departments the present edition may be regarded as fairly keeping pace with the advance of science ; and the introduction forms a very useful treatise on the structure and use of the microscope and of the various appliances

and reagents which the microscopist should have at his command, as well as of the mode of examination of microscopic objects. In the second department the editor has been again assisted by the Rev. M. J. Berkeley in the cryptogamic articles, and by Prof. Rupert Jones in those on Geology and on Foraminifera, as well as by other specialists. To put new wine into old wine-skins is proverbially an unsatisfactory proceeding; and we do not know that it has been more successful here than elsewhere. We are far from saying that the syndicate who have assisted the editor have not contributed much from their vast stores to bring down the work to the date which it now bears on its title-page; but in some of the articles which we have had occasion to consult for work that we have happened to have in hand, the most recent observations are certainly not alluded to, and the system of classification is not the best or newest. But granting these defects, the work is one which no practical microscopist can afford to be without, and which must always lie on his table for ready reference. The present edition is enriched by five new plates, and some new woodcuts.

A. W. B.

LETTERS TO THE EDITOR

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

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

Speke and Grant's Zebra

In or about 1882 a zebra was presented to the French Government by King Menelik of Shoa (which is in lat. 10° N., south-east of Abyssinia). It differed in certain respects from zebras hitherto supposed to have been described, and being regarded therefore as a new species or variety was named by Mr. Milne Edwards *Equus Grevyi*, after the President of the French Republic.

The species of zebra hitherto known were *E. quagga*, *E. Burchelli*, and *E. zebra*. The new one recently received in Paris apparently approximates to *E. zebra*, but the arrangement of the stripes, which are more numerous and more closely set, especially on the haunches, as well as its geographical distribution, seem to give sufficiently distinctive characters to entitle it to rank as a new species or variety.[1]

In a recent communication to the Zoological Society of London, Col. A. Grant, C.B., F.R.S., has called attention to the fact that the late Capt. Speke and he observed, hunted, and shot zebras during their expedition (chiefly in the lake regions of Equatorial Africa) in 1860–63, which from his description are either identical with the zebra from Shoa, or, if not, are entitled to be considered as a new species or variety.

Col. Grant has described the animal both in his notes written during the expedition and also in a paper to the Geographical Society in 1872, of which extracts are subjoined.

Should further examination and comparison show that the zebra described by Grant in 1861, and again in 1872, is identical with the Paris animal, it would seem that priority of discovery, although hitherto unclaimed, is due in title, as it is in fact, to Speke and Grant. If, on the other hand, the animal described by them should turn out to be distinct from any other form yet described, it would appear to have a claim to be named after these discoverers.[2]

The following extracts from Col. Grant's notes and papers addressed to the Geographical Society—written many years ago—appear to substantiate Speke and Grant's claim to the discovery and description of a new variety of zebra:—

[1] It should be added that *E. Burchelli* is the only zebra known to occur *north* of the equator, and that *E. zebra* has not been seen for many years. (Refer to figure in *Proc. Zool. Soc.* 1882, iv. p. 721, published April 1, 1883.)

[2] It is possible that it may be a local variety of *E. zebra*, hitherto found much further south.

Speke and Grant's Expedition of 1860-63, *from Journal of Royal Geographical Society of London*, 1872

"*Equus zebra* (?), *Native name* '*Phoonda*.'—This animal was frequent in Ugogo, Unyamezi, and north of Uganda. He differs from the *Equus Burchelli* of Regent's Park Gardens in being larger and differently striped. The stripes of our zebra were black upon white (not yellow) ground, and extended to the hoofs, whereas *Burchelli* has broader stripes, yellow ground, and the stripes on the legs are few. However, a sketch of an old mare shot by me shows the same black muzzle and hog mane as *Burchelli*, and Mr. Blyth says my sketch is of this last species."[1]

From Notes of Expedition

"Oct. 25, 1860.—Zebra shot through chest, shape superb, scarcely any pile, thickly striped over every inch of it, feet, legs, and all; fine hoofs, immense intestines. Flesh had quite the look of prime beef, ears rounded like deer's; a mare. A second zebra brought in by Ruyter. This was at Zungomero.

"Dec. 18.—Halt, in lat. 6° 22′ S., long. 30° 50′ E., altitude 2500 feet to 3329 feet. Zebra spoor again. . . . Shot another zebra.

"Dec. 21.—Again got zebras! . . .

"Dec. 22.—Do. do. . . .

"Jan. 2, 1861.—Eight to ten zebras.

"Jan. 6.—Zebras came among camp donkeys." . . .

Recent Note by Col. Grant, C.B., F.R.S.

"When we were shooting these zebras in Africa, we thought we were shooting the zebra which is common to Africa; but after our return, on my seeing Burchell's at the Zoological Gardens, I felt convinced we had never seen a Burchell's zebra; I said so to Blyth, who looked at my sketch, but who never saw Speke's specimens, and he seems to have called our zebras *Burchelli*. As soon as I saw Speke's specimens in 1873, and on hearing Prof. Flower describe by drawings the various zebras, I brought forward the matter, and got Speke's specimens up from Speke's brother. My journal notices *the stripes to be an inch apart all over the body, and extended to the hoofs;* but it says nothing of the marks on the haunches, though I believe that in our zebras, as well as in all other species, the haunch stripes are farther than an inch apart."

"The twelve zebras which were shot by the Speke and Grant expedition in 1861-3, were found at the undermentioned places in Africa:—

Places.	Lat.	Long.	Alt. above Sea. Feet.
Zungomero ...	7 27 S. ...	37 36 E. ...	516
Jiwe la M'koa	6 0 S. ...	34 0 E. ...	4690
Rubuga ...	5 0 S. ...	33 0 E. ...	3402
Usui District ...	2 49 S. ...	32 0 E. ...	About 4000
Uganda District	0 52 N. ...	32 30 E. ...	About 4000

"The zebras pasture in the forest and also in open country which is covered with bushy jungle, or where granite crops up, as this bears the richest grass, whilst hills with running water are always within their access."

However the zebras in question may be named, it seems right that the facts connected with Speke and Grant's discovery should be known.

J. Fayrer

April 17

Leaves and their Environment

I am taking steps to have some analyses instituted, by a highly qualified authority, of the atmosphere (or water) in the natural environment of certain typical plants, in order, if possible, to produce experimental evidence upon the points impugned by Prof. Thiselton Dyer. The results of such (necessarily very inconclusive) evidence I shall publish in Nature, if the Editor will grant me space, whether they are favourable or otherwise to my own allegations.

Meanwhile, as Prof. Dyer has himself relied upon purely *a priori* considerations, may I urge (1) that in the papers themselves I did not overlook the other factors of the problem to which he alludes; (2) that in woods, hedgerows, and thickets, the air is generally very still; (3) that the layer of air from time to time in actual contact with the surface of plants must always be in course of being deprived of its carbonic acid; and (4) that

[1] Evidently Blyth was mistaken, as the zebra was thickly striped on the legs, which is not the case with *E. Burchelli*.

wherever plants get free access to the open air above, it was one of my own assertions that they must necessarily obtain carbonic acid in abundance. It seems to me difficult to understand how in a still place, where many plants at once are engaged in deoxidising a compound which only normally forms 0·03 per cent. of the atmosphere, there can always be as much of it left as any of them can possibly want. I do not presume to argue with Prof. Dyer upon the subject; but as far as my own comprehension goes, he has not made this point clear to me.

May I venture also to suggest that perhaps another danger surrounds biology, and especially botany—the danger of becoming too technical and too academic? Now that perfect instruments, immense collections, and a long technical training are necessary in order to do anything in biology by the regular road, does not the science run just a little risk of falling into a groove? And is it not well from this point of view that there should be an outside body of amateurs, who will take occasionally a fresh non professional view of the subject, handling their own problems in their own way, and publishing their own little guesses or glimpses for what they may be worth? No doubt they will often go demonstrably wrong; no doubt the masters of the science will usually find numerous blunders of detail in their work, and may often see reason to disagree with them altogether; and in that case the amateurs ought to receive their corrections with all humility; but is it not a healthy thing after all that the amateurs should do their best, and try to follow out their own lights to their own conclusions? GRANT ALLEN

Forms of Leaves

YOU have recently inserted several letters from Mr. Grant Allen on the forms of leaves, a question in which I have myself been working lately. Mr. Grant Allen's letters open up a number of interesting questions, but for the moment I will only refer to his suggestion with reference to the reason why water plants so often have their leaves cut up into fine filaments. He tells us that this is because the proportion of carbonic acid held in solution by water is very small, and that therefore for this amount there is a great competition among the various aquatic plants.

The question has already been asked on what grounds Mr. Allen makes this statement with reference to the proportionate amount of carbonic acid. Without entering on this point, I would, however, venture to suggest that the reason for this tendency in the leaves of water plants is mechanical rather than chemical.

It is, of course, important for all leaves to present a large surface for the purposes of absorption with as little expenditure of material for purposes of support as possible. Now delicate filaments such as those of water plants present a very large area of surface in proportion to their mass. On the other hand, they are unsuited to terrestrial plants, because they are deficient in strength and unable to support themselves in air. Take, for instance, a handful of the submerged leaves of an aquatic ranunculus out of the water, and, as every one knows, the filaments collapse. This seems to me the real reason why this form of leaves is an advantage to water plants. It is perhaps for the same reason that low-growing herbs, which are thus protected from the wind so often have much divided leaves.

April JOHN LUBBOCK

The Föhn

MAY I be allowed the space of a few lines to point out a defect in the account of the Föhn, given by Mr. Scott in his recent work on "Meteorology," and quoted in the review of that work which appeared in NATURE, vol. xxvii. p. 575. This phenomenon has been fully and clearly explained by Dr. J. Hann in a paper entitled "Einfährung in die Meteorologie der Alpen," published under the auspices of the *D. und O. Alpenverein*. Mr. Scott's account of the Föhn attributes rightly the dryness and the cooling of the wind at high altitudes to expansion; but he appears to entirely overlook the *heating effect due to condensation of moisture* during the ascent of the wind.

From observations made in Switzerland, where the Föhn is chiefly felt, Hann has established the following rule: the Föhn is as many half degrees C. warmer at any place in its descent, than it is at an equal altitude during its previous ascent on the other side, as the place is hundreds of metres below the mountain ridge. This he explains by the fact that compression during the descent of the Föhn reverses the loss of temperature due to rarefaction during its previous ascent; while the wind brings with it over the mountain ridge the heat gained by the liberation of latent heat in the condensation of moisture. This latter amounts at 15° C. to about half a degree C. for each ascent of 100 metres for saturated air. "Therein," says Hann, "lies the explanation of the heat of the Föhn." A. IRVING

Wellington College, Berks, April 21

The Zodiacal Light (?)

THE same "peculiar appearance in the western sky" as that described by your correspondent, "J. W. B.," was observed here by me on the same evening, April 6. At 7h. 0m. G.M.T., or fifteen minutes after sunset, I noticed a bright, golden-coloured column of light, well defined, about 4° in length and slightly more than 1° in width, and inclined towards the south. "J. W. B." says it "rose vertically from near the horizon" at his station, Bath. Here it was decidedly inclined to an angle of about 15° towards the south. At 7h. 20m. no traces of it were visible. I have not seen any similar appearance since.

W. H. ROBINSON

N.B.—In the observer's book this observation is entered as "Bright zodiacal light (?), seen at 7h. 0m." E. J. STONE

Radcliffe Observatory, Oxford, April 20

REFERRING to the letter of your correspondent, "J. W. B.," Bath, in your last issue (p. 580), allow me to say that this peculiar ray of brilliant light was seen here by myself and many other people at about 6.40 p.m. on Friday, April 6. The sunset was brilliant and cloudless, but from the horizon to about 25° in height immediately above the spot where the sun had disappeared there appeared a ray of light of great beauty and extreme brilliancy; its centre, a delicate rose colour, graduating to the edges into the purest gold. This single ray was perpendicular, and appeared to be little, if at all affected, in its brilliancy by the approaching dusk of evening, but continued to exhibit itself with little-diminished brilliancy for nearly half an hour, finally disappearing with the twilight.

ROBERT DWARRIS GIBNEY

Glan-y-dwr, Crickhowell, South Wales, April 21

WHAT your correspondent, "J. W. B.," saw after sunset was not the zodiacal light, which is easily distinguishable by its great extent of area, lenticular shape, and invisibility during strong twilight, but it may be not incorrectly termed a sun column. I find the following entry in an old journal, of a similar appearance:—"1868, April 17.—Sun column, continuing half an hour after sunset, which was perfectly bright, without clouds." Perhaps some of your readers may be able to explain the cause of it. E. BROWN

Further Barton, Cirencester, April 21

THE phenomenon observed on the evening of Friday, the 6th inst., in Bath, by your correspondent J. W. B. (vol. xxvii. p. 580) was seen at Dolgelly by the writer when on a tour through Wales. On his pointing it out to a companion and some of the townsfolk, all agreed it was quite unique in their experience.

A bright, slender pillar of light, hazy toward the edges, rose majestically from the western horizon, in a cloudless sky, and so continued for about three-quarters of an hour after the sun had set. To one long habituated in meteorological observation it was of a character differing *toto cœlo* from the path of sunbeams through a cloud-rift, which is invariably divergent in appearance, as if from a focus. The "pillar" was uniform in width, perfectly vertical, and straight, the centre line alone brilliant. The height was, however, greater than your correspondent indicates.

Having fortunately with me a pocket-compass, with plumb-bob for "dip" measurements, I determined (1) the light-pillar was exactly vertical; (2) the height, which scarcely varied during visibility, was 20°, dying out faintly at that elevation; (3) the azimuth 25° north of west. By terrestrial bearings there was an appearance or a slight movement northward, but smallness of the compass dial (1 inch diameter) precluded any reliable angular determination of azimuthal change.

Further, the evening was very cold, and a continuous easterly wind had during the day obscured the hills, which still showed many unmelted snowdrifts upon their summits and flanks. First observed at 7 p.m., the strange appearance faded out at 7.30 p.m.

From the verticality, linear form, and condition of atmosphere I was led to remark at the time to my companion that the phenomenon appeared more of the nature of parhelia than referable to the zodiacal light. An intensely cold easterly wind encountering ocean-warmed airs to the westward would not improbably lead to the ice-molecule condition of atmosphere now assumed to be associated with the occurrence of parhelia.

It may be added (though of little probable significance) that the time corresponded roughly with the time of high water along that coast.

D. J. ROWAN

Kingstown, April 24

On the Value of the "Neoarctic" as one of the Primary Zoological Regions

PERMIT me to make a few remarks relative to Mr. Wallace's criticisms (NATURE, vol. xxvii. p. 482) of my paper on "The Value of the Neoarctic as one of the Primary Zoological Regions." Briefly stated, it is maintained in the early portion of this paper (1) that the Neoarctic[1] and Palæarctic faunas taken individually exhibit, in comparison with the other regional faunas (at least the Neotropical, Ethiopian, and Australian), a marked absence of *positive* distinguishing characters, a deficiency which in the mammalia extends to families, genera, and species, and one which, in the case of the Neoarctic region, also equally (or nearly so) distinguishes the reptilian and amphibian faunas; (2) that this deficiency is principally due to the circumstance that many groups of animals which would otherwise be peculiar to, or very characteristic of, one or other of the regions, are prevented from being such by reason of their being held in common by the two regions; and (3) that the Neoarctic and Palæarctic faunas taken collectively are more clearly defined from any or all of the other faunas than either the Neoarctic or Palæarctic taken individually.

In reference to these points Mr. Wallace, while not denying the facts, remarks: "The best division of the earth into zoological regions is a question not to be settled by looking at it from one point of view alone; and Prof. Heilprin entirely omits two considerations—peculiarity due to the absence of widespread groups and geographical individuality." Numerous families and genera from the classes of mammals and birds are then cited as being entirely wanting in the western hemisphere, and which—in many cases almost sufficient to "characterise the Old World as compared with the New"—"must surely be allowed to have great weight in determining this question." No one can deny that the absence from a given region of certain widespread groups of animals is a factor of very considerable importance in determining the zoological relationship of that region, and one that is not likely to be overlooked by any fair-minded investigator of the subject. But the value of this *negative* character afforded by the absence of certain animal groups as distinguishing a given fauna, is in great measure proportional to the extent of the positive character—that furnished by the presence of peculiar groups—and indeed may be said to be entirely dependent on it. No region can be said to be satisfactorily distinguished from another without its possessing both positive and negative distinguishing characters. Mr. Wallace has in his several publications laid considerable stress upon the negative features of the Neoarctic fauna as separating it from the Palæarctic or from any other, but he has not, it appears to me, sufficiently emphasised the great lack, *when compared to the other faunas*, of the positive element, the consideration of which is the point aimed at in the first portion of my paper, and which has led to the conclusions already stated, that only by uniting the Neoarctic and Palæarctic regions do we produce a collective fauna which is broadly distinguished by both positive and negative characters from that of any other region. If, as Mr. Wallace seems to argue, the absence from North America of the "families of hedgehogs, swine, and dormice, and of the genera *Meles*, *Equus*, *Bos*, *Gazella*, *Mus*, *Cricetus*, *Meriones*, *Dipus*, and *Hystrix*" be sufficient, as far as the mammalian fauna is concerned, to separate that region from the Palæarctic, could not on nearly equally strong grounds a separation be effected in the Palæarctic region itself? Thus, if were to consider the western division of the Palæarctic region, or what corresponds to the continent of Europe of geographers, as constituting an independent region of its own, it would be distinguished from the remainder of what now belongs to the Palæarctic region by negative characters probably fully as important as those indicated by Mr. Wallace as separating the Neoarctic from the Palæarctic region. The European mammalian fauna would be wholly deficient, or nearly so, in the genera *Equus*, *Moschus*, *Camelus*, *Poephagus*, *Gazella*, *Oryx*, *Addox*, *Saiga*, *Ovis*, *Lagomys*, *Tamias*, in several of the larger *Felidæ*, as the tiger and leopard, and in a host of other forms. A similar selection could be made from the class of birds (among the most striking of these the *Phasianidæ* and *Struthionidæ*), but it is scarcely necessary in this place to enter upon an enumeration of characteristic forms. Divisions of this kind, to be characterised principally or largely by negative faunal features, could be effected in all the regions, and in some instances with probably more reason than in the case under discussion.

But the question suggests itself, What amount of characters, whether positive or negative, or both, is sufficient to distinguish one regional fauna from another? Mr. Wallace states: "There runs through Prof. Heilprin's paper a tacit assumption that there should be an equivalence, if not an absolute equality, in the zoological characteristics and peculiarities of all the regions." Is it to be inferred from this quotation that Mr. Wallace recognises no such general equivalence? Is a region holding in its fauna, say, from 15 to 20 per cent. of peculiar or highly characteristic forms to be considered equivalent in value to one where the faunal peculiarity amounts to 60 to 80 per cent? If there be no equivalence of any kind required, why not give to many of the subregions, as now recognised, the full value of region?

Surely, on this method of looking at the question, a province could readily be raised to the rank of a full region. In the matter of geographical individuality little need be said, as the circumstance, whether it be or be not so, that the "temperate and cold parts of the globe are necessarily less marked by highly peculiar groups than the tropical areas, because they have been recently subjected to great extremes of climate," does not affect the present issue, seeing that the peculiarity is greatly increased by uniting the two regions in question; nor does it directly affect the question of the Neoarctic-Palæarctic relationship.

The second part of my paper deals with the examination of the reptilian and amphibian faunas, and the general conclusion arrived at is: "that by the community of its mammalian, batrachian, and reptilian characters, the Neoarctic fauna (excluding therefrom the local faunas of the Sonoran and Lower Californian subregions, which are Neotropical) is shown to be of a distinctively Old World type, and to be indissolubly linked to the Palæarctic (of which it forms only a lateral extension)." Towards this conclusion, which, it is claimed, is also borne out by the land and freshwater mollusca and the butterflies among insects, I am now happy to add the further testimony of Mr. Wallace (overlooked when preparing my article respecting the *Coleoptera* ("Distribution," "Encycl. Britann." 9th ed. vii. p. 274).

As regards the name "Triarctic," by which I intended to designate the combined Neoarctic and Palæarctic regions, and which may or may not be "somewhat awkward," I beg to state that, at the suggestion of Prof. Alfred Newton (who, as he informs me, has arrived from a study of the bird faunas at conclusions approximately identical with my own), it has been replaced by "Holarctic." In conclusion, I would say that, while the views enunciated in my paper may not meet with general acceptance at the hands of naturalists, it is to be hoped that they will not be rejected because they may "open up questions as regards the remaining regions which it will not be easy to set at rest."

ANGELO HEILPRIN

Academy of Natural Sciences, Philadelphia, April 6

[1] In the paper under consideration I have given what appear to me satisfactory reasons for detaching certain portions of the South-western United States from the Neoarctic (my Triarctic), and uniting them with the Neotropical region.

Mock Moons

A LITTLE before midnight on Monday, the 16th inst., the moon, being nine days old and about 30° above the western horizon, was surrounded by an unusual halo. Its radius was certainly more than the normal 22°. By careful estimation I judged it to be about 30°, the lower edge resting on the horizon. On the right and left limbs of the ring were very distinct bright patches, rather broader than the ring itself, and slightly elongated outwards. The right-hand patch appeared to be in its normal position on a line passing through the moon, parallel with the horizon, but the left-hand patch was distinctly elevated

above this line, and seemed to be unaccountably out of place. As, however, the moon was little past the first quarter, and the terminator nearly a straight line, and only slightly inclined from the vertical, a line drawn perpendicular to it would have passed through the left-hand patch, and I imagine that its position was due to this inequality in shape of the two sides of the visible moon. The atmosphere was hazy, the moon though clearly visible appearing as in a slight fog. No colours were distinguishable at any part of the halo. F. T. MOTT

Birstal Hill, Leicester, April 17

Benevolence in Animals

TWO or three years ago Dr. Allen Thomson gave me an instance of benevolence in a cat which is so closely similar to one communicated to you by Mr. Oswald Fitch that for the sake of corroboration I may state it.

The cat belonged to Dr. Thomson, and one day came into the kitchen, pulled the cook by the dress, and otherwise made signs showing a persistent desire to attract attention. Eventually the cat led the cook out of doors and showed her a famishing stranger cat. The cook thereupon gave the stranger some food, and while this was being discussed, Dr. Thomson's cat paraded round and round her companion, purring loudly with a satisfied sense of well-doing. GEORGE J. ROMANES

"Medioscribed Circle"

IN this week's NATURE (p. 595) the use of the *medioscribed* circle is suggested in place of the well-known "nine-point" circle. If a change is desirable, would not "mid-point" circle be equally expressive? R. T.

April 20

AGRICULTURE IN MADRAS[1]

THE Government establishment at Saidápet has now been in existence about twelve years. It consists in part of an experimental farm, and in part of an educational establishment, in which, at the date of the last report, forty-one native students were receiving instruction in the science and practice of agriculture. The whole is under the superintendence of Mr. W. R. Robertson. The object in view is to improve the condition of agriculture in the Presidency. This is indeed urgently needed. With a large and increasing population, the soil is in general wretchedly cultivated, and reduced to a low state of fertility. The farm at Saidápet is the centre of many useful agencies. Here new crops, new breeds of cattle, and improved implements are carefully tried. Here the teaching of European science is reduced to practice, and methods of cultivation suitable to the conditions of Indian agriculture are perfected. While by means of the educational department, by tours in the country, distributions of seed, ploughing competitions with different implements, and various other agencies, the endeavour is made to bring these improved methods into use by the native farmers.

The meteorological records kept at the farm exhibit in a striking manner the difficulties under which Indian agriculture must be pursued. Thus in the season 1880-81 the rainfall in September was 10·9, in October 10·7, and in November 19·6 inches, while during the whole six months from January to June only 2·35 inches were recorded. Long-continued heat and drought are thus followed, on the arrival of the monsoon, by a deluge of rain. It is pleasing to notice that the director of the farm is quite abreast of the latest scientific teaching respecting the best mode of meeting the difficulty in question. It is plain that in the rainy season the land will be washed clear of all soluble plant-food; all nitrates formed in the soil during the hot season will thus be lost, unless they have been already assimilated by a crop. Mr. Robertson recommends that, whenever possible, advantage should be taken of the first commencement of rain in June or July to sow the land with a green leguminous crop (horse-gram). In most years there will be enough rain to maintain such a crop in growth during the summer months. This crop will collect and assimilate a great part of the nitrates in the soil. At the commencement of the wet season the green crop is to be ploughed into the soil, and forms an excellent manure for the principal crop of the year, which is then sown. Mr. Robertson refers apparently to the experiments at Rothamsted when speaking of the quantity of nitrates annually formed in a soil; the amount he mentions (40 lbs. of nitrates[1] per acre) is, however, far below the truth. The quantity of nitrates found in five successive years in the drainage water from uncropped and unmanured land at Rothamsted amounts, indeed, on an average, to nearly 3 cwts. of Indian saltpetre per acre per annum.

In India agriculture depends much for its success and permanence on irrigation, and vast sums have been, and will be, expended on irrigation works. Here again, however, the question of the presence or absence of nitrates is an important factor, which has been almost entirely overlooked, engineering rather than chemical skill having been employed in the direction of the work. It should always be borne in mind that a water containing nitrates supplies not only water but *manure*. The native farmers are generally quite aware of the difference in value of different water-supplies, and reckon the water from the village well as worth far more than that procured from the Government canal. To the engineer it appears a ridiculous waste of power to lift water from a well when a water-supply is available at the level of the land. But the native is right; his well-water is rich in nitrates, and for the farmer's purpose far more valuable than the purer water of surface drainage found in rivers and canals. It should always be borne in mind in plans for irrigation, that the drainage from arable land, and from inhabited districts will always yield the best irrigation water. By restoring to land in time of drought the plant-food lost in time of flood we are pursuing a truly scientific economy.

R. W.

[1] Annual Reports on Government Agricultural Operations in the Madras Presidency, 1880-81 and 1881-82.

[1] Possibly in Mr. Robertson's Report "nitrates" is here a misprint for "nitrogen."

ANTHROPOLOGICAL NOTES IN THE SOLOMON ISLANDS

WITHOUT going into the general question as to the position which these islanders hold to the other Pacific races, I will briefly state the results of numerous measurements and observations which I made during my visit to these islands in 1882. As the surveying work of this ship was confined for the most part to the large island of St. Christoval and the adjacent small islands, my remarks will refer more particularly to the natives of this part of the group.

The average height of a man of St. Christoval is about 5 feet 3 inches or 5 feet 4 inches, whilst the span of the arms generally exceeds the length of the body by from 4 to 5 inches. Both men and women are usually of a good physique, robust and well-proportioned; but one may find in the same village community weak, puny, thin-limbed individuals associated with others of a strong muscular frame, with well-rounded limbs and a good carriage.

The colour of the skin varies considerably in shade from a very dark brown, approaching black, to a dark copper hue. The elderly adults are as a rule more dark-skinned than those of younger years, the difference in shade being attributable partly to a longer exposure by reason of their age to the influence of sun and weather, and partly to those structural changes in the skin which accompany advancing years. Not unfrequently, amongst a group of dark-skinned natives a man may be observed whose skin is of a pale sickly hue, and who at the first glance may be thought to afford an example of recent

intermingling between the Melanesian and Polynesian races. On a closer examination I always found that such men were covered from head to foot with an inveterate form of body ringworm—a scaly skin-eruption, which affects in a greater or less degree quite two-fifths of the natives of this part of the group—and that in all their other physical characters they belonged to the Melanesian type. In its most aggravated and chronic condition this parasitical disease implicates the skin to such a degree that the rapid desiccation and desquamation of the epidermal cells lead to a partial decoloration of the deeper parts of the cuticle, as though the rate of the production of pigment was less rapid than the rate of its removal in the desquamative process.

The hair of the head is generally black, frizzly, and bushy; more particularly amongst the younger adults of both sexes this last character prevails. Amongst middle-aged men I have sometimes observed that the hair arranges itself into entangled corkscrew-like spirals,

FIG. 1.—Native of Santa Anna (an island off the east extremity of St. Christoval). The round disk of wood in the lobe of the ear should be quite white, the dark spots being due to the imperfections of the dry plate. The faint linear markings on the cheek due to a form of tattoo are rarely well marked.

the whole head of hair having much the appearance of a mop placed erect on its handle. Now and then, though rarely, the hair shows a tendency to become straight; I met with one such native near Cape Keibeck, on the north coast of St. Christoval; and I am informed that straight-haired varieties do exist among the hill-tribes in the interior of the island. With regard to the amount of hair on the face, limbs, and body, great diversity is observed amongst natives of the same village. Epilation is commonly employed, but there can be no doubt that the development of hair varies quite independently of such a custom. Out of ten men taken promiscuously from any village, perhaps five would have smooth faces, three would possess a small growth of hair on the chin and upper lip, the ninth would wear a beard, a moustache, and whiskers of moderate growth, whilst the tenth would present a shaggy beard and a hairy visage. The surfaces of the body and limbs are as a rule comparatively free from hair; but hairy men are to be met with in most villages; and on one occasion when in the vicinity of Cape Surville—the eastern extremity of St. Christoval—I visited a village where the proportion of hairy-bodied, hairy-visaged men was in excess of the smooth-skinned element.

From my measurements the form of the skull would appear to be mesocephalic: the cephalic indices ranged between 73 and 82—the greater number of them being included between 74 and 77. The facial angle varied in amount between 85° and 90°. The nose is generally straight, coarse, and somewhat short, the nostrils wide, and the bridge depressed in some instances. Not uncommonly the nose is arched or aquiline; out of fifty natives amongst whom I took especial notice of this feature, I found that ten possessed an aquiline nose. The countenances of the younger of both sexes are often prepossessing, and amongst the adults I have frequently met with men of some intellectual expression.

Such are some of the leading physical characters of the natives of this part of the Solomon group. To the inhabitants of the small island of Santa Anna, which lies off the east extremity of St. Christoval, the same description will apply; but we find in the still smaller adjacent island of Santa Catalina a subvariety of the Melanesian type characterised by a lighter colour and probably a greater height, although I made no measurements there. The few natives which I saw belonging to the large island of Malayta, which we did not visit, resembled in appearance those of St. Christoval; and from a few measurements and observations which I made in the Florida subgroup, where the St. Christoval type prevails, it was evident that thus far to the westward the same description of a native of the Solomon Islands was equally applicable. The large neighbouring island of Guadalcanar I had no opportunity of visiting. In the small island of Simbo, further to the west, I found no important difference in the physical characters of the natives except perhaps a rather darker shade of colour. Proceeding westward as far as Treasury Island, our furthest point in that direction, we for the first time came upon a distinct variation in the type of native—a difference which has been a subject for remark even by such usually unobservant people as the masters of trading ships. In their greater height and in the almost black colour of the skin, the natives of Treasury Island are at once distinguished from the prevailing native type to the eastward. Their features are more finely cut, and the form of the skull, as shown by the cephalic indices, is more brachycephalic—the range of seven measurements being 78 to 84, and the mean cephalic index 81. In some individuals the cheekbones were prominent and the foreheads retreating. As a race the Treasury Islanders are said to evince a fiercer disposition than do the natives in the eastern islands of the Solomon group. The natives of the large adjacent island of Bougainville have the reputation of being amongst the most daring and warlike of the inhabitants of this archipelago; and probably the examination of their physical characters will exhibit them as a more pronounced type of the Treasury Islanders.

H. B. GUPPY

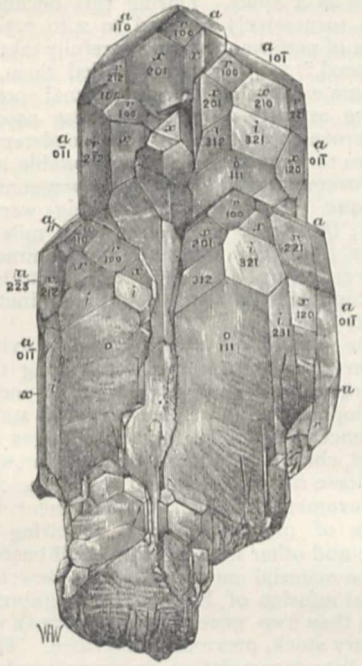
H.M.S. *Lark*, Auckland, N.Z., February 27

ON A FINE SPECIMEN OF APATITE FROM TYROL, LATELY IN THE POSSESSION OF MR. SAMUEL HENSON

THE specimen of apatite represented in the diagram was submitted to my inspection by Mr. Henson last November, and is the most beautiful specimen of this mineral which I have seen. The faces observed were not, however, determined on the specimen itself, but from a plaster cast and a smaller specimen with which Mr. Henson supplied me. From these latter approximate measurements of some of the more prominent angles were obtained by means of a contact-goniometer, which,

on comparison with the table of angles given in Miller's "Mineralogy," rendered the identification of the more conspicuous planes easy. The remaining planes were then easily determined from the relation which connects three planes lying in a zone. The forms present are : $o\{111\}$, $a\{10\bar{1}\}$, $r_1\{100\}$, $r_1\{22\bar{1}\}$, $x\{210\}$, $i\{321\}$, $u\pi\{4\bar{1}0\}$, $u_1\pi\{2\bar{2}3\}$.

I had no intention of describing the specimen at the time it was shown me, and did not pay enough attention to the physical characters of the faces to be able to recall them. The specimen was for the most part remarkably limpid, with a pale mauve tint in its purest portions. It was in part penetrated by fine delicate needles of epidote,



ao	90°	0′
io	157	05
xo	139	47
xa	130	13
ro	124	20
aa′	120	0
ra	135	39
rr	131	14

as is shown in the very excellent diagram attached, which gives a very clear and accurate idea of the specimen. A remarkably large crystal from the same locality has recently been added to the mineral collection of the Natural History Museum, Cromwell Road. It is of a much deeper mauve colour than Mr. Henson's specimen ; it shows the same general forms, the planes *o* and *a* are bright and even, but the small planes, *r*, *x*, *i*, are somewhat rough. These same characters are also those observed on the faces of such smaller specimens as I have examined. W. J. L.

THE EVOLUTION OF THE AMERICAN TROTTING-HORSE.[1]

THE American trotting-horse is an example of a new breed of animals in process of formation. As yet it can hardly be called a definite breed in which the special and distinctive character is either fully developed in quality or satisfactorily fixed by heredity. Great progress has, however, been made, many individual animals have attained great speed, and all the better ones have derived their trotting excellence in part, at least, through heredity.

The origin of most breeds is involved in considerable obscurity, as to how much they are due to conscious and how much to unconscious selection, what motives led to this selection, how far the enhancement of the special qualities have been due to physical environment, and how far to education, training, nourishment, or cultivation.

[1] By Wm. H. Brewer, from the *American Journal of Science*.

The formation of this new breed is so recent, the development of a special quality has been so marked, there is such an abundant literature pertaining to its history, the system of sporting "records" is so carefully planned and comprehensively conducted, and withal has become so extensive, that we have the data for a reasonably accurate determination of the influences at work which led to this new breed being made, the materials of which it is made, and the rate of progress of the special evolution.

It is as an implement of gambling and sport that the trotter has his chief value to the biological student. Sporting events are published or recorded as the mere everyday use of animals is not, and the records of races give numerical data by which to measure the rate of progress. Similar data do not exist for the study of the evolution of any other breed.

Incidental to the preparation of a paper pertaining to this matter for farmers and breeders, I have compiled and collated certain data which have a scientific as well as economic value, the more interesting portion of which I condense for this paper.

The horse has several gaits which he uses naturally, that is, instinctively. And besides those which are natural, he has been taught several artificial ones, some of which have been much used, particularly in the middle ages. But to trot fast was not natural to horses ; when urged to speed they never assumed it, and until within a century the gait was neither cultivated nor wanted by any class of horsemen. A breed of fast trotters, had it been miraculously created, would doubtless soon have perished in that it would have had no use, satisfied no fancy, and found no place in either the social or industrial world as it then was.

Before the present century the chief and almost sole uses of the horse were as an implement of war, an instrument of sport and ceremony, an index of rank and wealth, and an article of luxury.

For all these uses, as then pursued, a fast trotter was not suited, nor was he better adapted to the heavy coaches over rough roads, or the slow waggon-trains of armies. The horse best adapted to all these, however much he may have varied as to size, strength, and fleetness, was one whose fast gait was the gallop or run rather than the trot. For leisurely horseback travelling the ambling gait (or *pacing* gait as it came to be called in America) was preferred. With increasing use of horses for draft, certain heavy but slow breeds were developed in the Old World, of which the Dutch, Clydesdale, and Norman breeds are examples.

The causes which led to the cultivation of the trotting gait in this country, and the evolution of a breed with which it should be instinctively the fast gait, were various, and the separate value of each as a factor in the problem would be very differently estimated by different persons studying the subject from different points of view. Now that he is so valuable and plays such a part as a horse of use, it is easy to see why a breed of trotting roadsters should be produced to meet certain important demands of our modern civilisation. But this does not explain how the process actually began.

Reasoning *a priori*, the trotter, as a horse of use, should have originated in western Europe ; as a matter of fact, he not only did not begin there, but he was unpopular there until well developed here. Locomotives began to draw armies to the battle-field, the war-horse declined in actual as well as relative importance, the modern, light, steel-spring, one-horse, convenient business waggon as well as the modern buggy came into common use after trotting as a sport was established, and after the gait had been extensively cultivated and bred to. The trotting-horse is specially adapted to various modern uses, but these uses followed his development, rather than led it, although in later days this factor has been an important one in the rate of progress.

The influences which originally led to the starting of the breed were more social than economical; a similar fact a century earlier marked the founding of that famous running breed, the English thoroughbred. The origin of the trotter, however, was not so simple as that, and several diverse social factors were involved, only the chief of which will here be noticed.

From early colonial times horses have been more generally owned by the masses of the people here than in any country of western Europe. They have had a more general use in agriculture and in business, their ownership or possession has had less social significance, and they have had less importance as instruments of gambling. The colonists who settled north of Delaware Bay, although of various nationalities, were largely those whose religious prejudices and social education was opposed to horse-racing. With the great majority of them it was considered a sort of aristocratic sport, and at best led to unthrifty ways, even if not open to the objection of positive immorality. Consequently but few race-horses were imported into this region in colonial times. The original horse stock of the northern colonies came from several European sources. England, Holland, France, and Spain certainly, and Sweden, Denmark, Germany, Ireland, and Italy probably, contributed to it. The blood from this variety of sources, variously mingled, formed the mongrel stock of the country. This was further modified by local conditions and local breeding assuming different characters in different places, and the hardships of horse life incident to a new country, with strange forage and a rough climate, caused deterioration in size and form. Early writers are unanimous on this point, but many add that what was lost in size and beauty was gained in hardiness and other useful qualities.

After the war of independence there was an improvement in the live stock of the country. English thoroughbred horses were imported both for sporting and to improve the horse stock of the country, and horse-racing rapidly grew in favour as wealth and leisure increased. The export trade in horses to the West Indies increased, particularly from New England. Pacers were most sought for this trade, but sometimes trotters were advertised for.

As horse-racing increased in the last years of the last century the opposition to it revived, and in the earlier years of the present century this became ascendant, and stringent laws forbidding the sport were passed in most of the northern States. The prohibition was sweeping and the penalties severe.

Horse-racing was then a contest between running-horses, and during this repression of racing, trotting as a sport began, at first in a very unostentatious, irregular, and innocent sort of way. Probably no people or class of people have ever bred good horses which they prized and were proud of, who did not find pleasure in seeing them compete in speed or show their fleetness in some way, and during the repression of racing (which meant running), trotting came in as a substitute, poor though it was at first. It had a sort of encouragement from very many thrifty people who were not sportsmen, and was in a measure considered a sort of democratic sport in which even plough-horses could take part. Racing of any kind in those days was a strife between two or more things, as it still is in most countries; no one thought that a single horse could run a race alone, but the instinctive inclination to see a spirited horse in action could be mildly gratified by letting him trot, even if single and alone, and testing by the watch how quickly a given distance could be covered. So "timing" animals came to be practised. We hear of it on the Harlem racecourse in 1806, four years after the laws forbidding horse-racing had been enacted, and again, a little later, near Boston, and it was reputed that certain horses could trot a mile in three minutes. This speed seemed so extraordinary that in 1818 a bet of a thousand dollars was staked (and lost) that no horse could be found that could trot a mile in three minutes. Some authorities date the beginning of trotting as a sport with this event. It is said that in the betting the odds against the successful performance of the feat were great, which shows, strikingly, the enormous progress since made in developing speed at this gait.

In 1821, certain persons on Long Island were allowed by special statute to train, trot, etc., horses on a certain track, under certain restrictions, exempt from the penalties against horse-racing. Other organisations followed, and by 1830 the "training" of trotters was going on at several points, and trotting may be said to have become established as a sport. During this decade the record had been successively lowered to 2.40, 2.34, and 2.32. The times of performance were carefully taken at these "trials of speed," as the statute called them, and "records" became established by more formal sporting codes.

The ostensible object of these associations was the "improvement of the breed of roadsters;" driving single horses to waggons became fashionable, and this led to the improvement of light one-horse waggons for business and pleasure. Those with steel springs were rare luxuries in 1830; by 1843, when the record of mile heats dropped to below 2.30, they were already common. During this thirteen years, the record had been lowered only half a second on mile heats, but three-minute horses were no longer rare.

The fashion of wealthy men driving a single fast trotter for pleasure was for a long time a peculiarly American one, and played an important part in the development of this breed. But, as stated earlier, many influences have contributed: changes in the modes of travel, changes in the methods of war, sentiments regarding horse-racing, the incentives of the course, the general improvement of roads, improvement in carriages, the needs of modern business requiring quick roadsters, these and other influences have all been at work.[1]

The material out of which this new breed is made is a liberal infusion of English thoroughbred blood (usually more than two generations removed), with the mongrel country stock, previously described. There is a voluminous literature relating to special pedigrees, and much speculation as to the comparative merits of the several ingredients of this composite blood.

Regarding the ideal trotter there is as yet a difference of opinion as to what the form should be, and it is too early to decide from actual results. That the gait is now hereditary, that it is the instinctive fast gait with some animals is certain, but whether this is due to inherited habit, inherited training, or to mere adventitious variation and selection, I will not discuss.

The gain in speed is given in the following table, which is the best records at mile heats, omitting the names of the special performers:

Date.	Best Record.	Date.	Best Record.
1818,	3	1865,	2.18¼
1824,	2.40	1866,	2.18
,,	2.34	1867,	2.17¼
1830,	2.32	1871,	2.17
1834,	2.31½	1872,	2.16¾
1843,	2.28	1874,	2.14
1844,	2.26½	1878,	2.13¼
1852,	2.26	1879,	2.12¾
1853,	2.25½	1880,	2.10¾
1856,	2.24½	1881,	2.10¼
1859,	2.19¾		

A sporting paper published in 1873 a list of three hundred and twenty-three horses, with their best records, down to the close of the preceding year. This first list

[1] For more details regarding the history of this development and the factors involved, see the paper already cited, *Rep. Conn. Bd. Agr.* for 1882, p. 215.

of the kind known to me was very imperfect in its details; it was revised for the next year, and since that time many lists, in one form or another, have been published. The figures for the animals with records of 2.25, or better, are reasonably accurate; for the others there is much discrepancy. In the following table the numbers are my own, counting down to 1872, inclusive; the numbers after that date are derived from various lists published since that time in the sporting and breeding periodicals. From the very nature of the case, the table cannot be accurate in the larger numbers, but the numbers do not lose their value for comparison with each other from such faults as to the details of the larger numbers, and, as such, it is undoubtedly the most significant series of numbers ever compiled to show progress in evolution, whether of a breed or species. The number of horses with records of 2.40, or better, is now stated to be over five thousand.

I leave it to mathematicians to plot the curves which immediately suggest themselves, and determine how fast horses will ultimately trot, and when this maximum will be reached.

Table showing the numbers of Horses under the respective Records.

	2.30 or better.	2.27 or better.	2.25 or better.	2.23 or better.	2.21 or better.	2.19 or better.	2.17 or better.	2.15 or better.	2.13 or better.	2.11 or better.
1843	1									
1844	2	1								
1849	7	2								
1852	10	3								
1853	14	5								
1854	16	6								
1855	19	6								
1856	24	7	1							
1857	26	7	2							
1858	30	7	2							
1859	32	9	2	1	1					
1860	40	11	4	2	1					
1861	48	14	4	2	1					
1862	54	17	7	4	1					
1863	59	19	9	4	1					
1864	66	22	12	4	1					
1865	84	29	15	5	2	1				
1866	101	32	17	6	3	1				
1867	124	42	21	9	5	2				
1868	146	52	28	13	6	2				
1869	171	63	34	15	10	4				
1870	194	72	35	16	11	5				
1871	233	99	40	17	12	6	1			
1872	323	—	—	—	—	—	—			
1873	376	—	74	28	15	5	2			
1874	500	—	98	40	16	11	5	1		
1875	—	—	134	61	30	13	5	2		
1876	794	—	165	81	39	16	6	2		
1877	836	—	214	105	51	19	8	2		
1878	1,025	—	270	129	68	24	9	4		
1879	1,142	—	325	164	88	33	11	5	1	
1880	1,210	—	366	192	106	41	14	6	2	1
1881	1,532	—	419	227	126	49	15	7	2	1
1882	1,684	—	495	275	156	60	18	8	2	1

INSTITUTION OF MECHANICAL ENGINEERS

THIS Institution held their usual Spring meeting at the Institution of Civil Engineers, 25, Great George Street, on April 11 and 12, the president, Mr. Percy G. B. Westmacott, in the chair. Three papers were read, and discussed at length; a fourth, by Mr. A. C. Bagot, on "The Application of Electricity to Coal Mines," was postponed for want of time.

The first paper was by Prof. A. G. Greenhill, of Woolwich Arsenal, and dealt with the strength of shafting when exposed both to torsion and end-thrust. He has worked out for this case, by a complete mathematical investigation to be published in the *Proceedings*, the following formula:—

$$\frac{\pi^2}{l^2} = \frac{P}{EI} + \frac{T^2}{4E^2I^2}$$

where P = end-thrust, T = twisting moment, I = moment of inertia of cross-section, E = modulus of elasticity, l = maximum distance between bearings, which will allow a shaft to be stable.

When there is no twisting moment, as in a long column, the second part of the right-hand expression vanishes, and we have the ordinary formula of Euler. If there be no end-thrust, as in ordinary mill shafting, the first part vanishes. The special case where both occur together is that of the screw-shaft of a steamer; but here, it appears, on working the figures out with ordinary dimensions, that the second part is small in comparison with the first, and may be neglected. Hence a screw-shaft may so far be treated as if it were a long column only; and it follows at once that the numerous bearings interposed between the engines and propeller (say, about every 25 feet) are quite unnecessary so far as stiffness is concerned. If retained, as seems desirable, simply to support the weight of the shaft, they might at least be made in some way elastic, so as to enable the shaft to accommodate itself to the sagging and straining of the vessel. It was, in fact, admitted on all hands that screw-shafts never give way from twist or thrust, but always by cross-breaking through strains induced by the unequal movements of the ship; and if so, there seems every reason for taking some steps at least in the direction which Prof. Greenhill indicates.

Another point which the paper touched upon was the question of hollow *versus* solid shafts. Now that shafts can be conveniently cast out of ingot steel, they are frequently made hollow, with the obvious advantage of increasing the stiffness as compared with the weight. Thus, in the case of the screw-shaft of the *City of Rome*, which is 25 inches diameter, with an internal hole of 14 inches diameter, it appears that the moment of inertia is 0·9 of that of an equal solid shaft, while the weight of the latter would be 1·45 that of the former. Again, if a solid shaft were used of the same weight as the hollow shaft, or 20·7 inches diameter, its moment of inertia, and therefore its stiffness, would be barely half that of the latter. Even if a transverse crack, 1 inch deep, were to occur in the hollow shaft (which it might be urged would place it at a serious disadvantage) the loss of stiffness comes out to be 6 per cent., whereas in a solid shaft of equal diameter the corresponding loss would be 5 per cent.; so that even here the advantage on the side of solidity is only 1 per cent.

These figures might seem to be conclusive, yet the solid shaft has its defenders. Mr. Edward Reynolds, of Messrs. Vickers and Co., stated roundly that the history of hollow screw-shafts was a mere history of disaster (which, however, was denied by a subsequent speaker); and he quoted some experiments of his own on shafts one-fourth the size of that in the *City of Rome*, where, tested under a 1-ton weight falling from about 20 feet, the hollow shaft was rapidly destroyed, while the solid shaft remained uninjured. This occurred even when great care was taken to prevent the hollow shaft from getting flattened during the process. His explanation was that the comparatively unstrained fibres towards the centre of the section came in to support and relieve the exterior parts, whenever, by cracks or otherwise, these became unduly loaded. Prof. Kennedy, who followed, seemed to lean to the same view, and quoted the increase of strength observable in the metal between the holes of a drilled plate, as being due, in some unexplained manner, to the influence of the unstrained metal behind the holes. A very satisfactory explanation of this fact was, however, given by Mr. Wrightson at the last meeting of the British

Association. The real question to which Mr. Reynolds's tests point is probably how far theories which rest on the hypothesis that elasticity is perfect can properly be applied to cases where the breaking point has been nearly reached; and this is a question on which more light is very urgently needed, especially with reference to such cases as screw-shafts, where fractures, as a matter of fact, do very commonly occur.

The second paper, by Mr. W. Ford Smith, dealt with twist drills, milling machines, and other methods for the cutting and dressing of metal surfaces, which have been introduced within the last few years; and was almost entirely of a practical character. The third paper, by Mr. John Jameson, was on "Improvements in the Manufacture of Coke," and dealt with a new method, invented by the author, for recovering the gas, gas-tar, and ammoniacal liquor, which are separated from coking coal during the process of carbonisation. As the paper points out, these products are not originally present in the coal. There is, for instance, no ammonia in coal; but there are combinations containing nitrogen and hydrogen, and in almost any process of distillation parts of the evolved nitrogen and hydrogen unite, under very obscure conditions, to form ammonia, which, however, is not stable, but readily decomposes in the presence *e.g.* of oxygen. Every process of distillation, in fact (but some much more than others), favours the formation of gas on the one hand and of condensable hydrocarbons on the other. With regard to the former, its value in the neighbourhood of coke-ovens is not usually high, and it is a question whether it may not best be burnt in the oven itself, to furnish the heat required in any case for the distilling process; but the value of tar and ammonia is great, and would probably not fall very low, even if the production were largely increased. At the same time, as a fuel they are not even equal to the same weight of pure carbon. It will be seen, therefore, that there is ample room for a process which will enable us to separate and utilise these by-products, instead of simply using them as fuel, or, which is far worse, discharging them unburnt to poison the air and destroy vegetation. Mr. Jameson's method of effecting this end is very simple. He takes an ordinary "beehive" coke-oven, makes it tolerably airtight by letting tar soak into the brickwork, and covers the floor with an impervious substance, in which are inserted some large bricks or quarls, pierced with holes. Below these is a chamber connected with a pipe, which leads, through any convenient form of condenser, to a small exhausting fan. The oven is now charged and lighted from the top, to which alone air is admitted. The heat of combustion, penetrating downwards, gradually distils the pitch and gases out of the coal, and the fan being set to work, these products, instead of passing upwards to the fire, are sucked downwards through the holes in the floor, and afterwards separated, the tar being left in one condenser, the ammoniacal liquor in another, and the gas either used at once for steam-raising, &c., or stored in a gas-holder till required.

In the discussion which followed, the advantage of saving the waste products was fully admitted, though some rather startling estimates of the author (who had assumed that 75,000,000*l.* per annum was practically wasted under our present system of coal consumption) were sharply criticised. But by the ironmasters who were present it was strongly laid down that the first duty of a coke-oven was to make good coke—such coke as would give the best results in a blast-furnace; and that to this duty all consideration of by-products must give way. It was further suggested that pitch was a valuable ingredient in coke, and that this pitch was left in it by the present system, but withdrawn on the new one. This idea, however, seems to be founded on a misapprehension. Mr. Jameson and others were able to state positively that the coke made by his process could not be distinguished in quality from the product of the old beehive oven; that the quantity per ton of coal was the same; and that the by-products, though differing very greatly in quantity according to the character of the coal, method of condensation, &c., were almost always sufficient to repay, within a few months or even weeks, the 10*l.* or 15*l.* required to adapt an existing oven to the new arrangement. If these results are confirmed by more extended trials in different localities, the process seems likely, as one speaker phrased it, "to take a pretty prominent position among the great inventions of the present day."

CORONERS' SCIENCE IN CHINA

WHETHER Chinamen are or are not believers in the principle that it is better that nine guilty persons should escape rather than that one innocent person should suffer, they do at all events, by their manner of conducting inquests, leave open a wide door for the escape of murderers. A deeply-rooted repugnance to dissection of the human body and a consequently slight acquaintance with anatomy, coupled with an entire ignorance of the action of poisons, deprive coroners of every means of arriving at decisions except those furnished by outward symptoms and appearances. From early times, however, the importance attaching to human life has been recognised by the custom of holding inquests in cases of sudden death, and various works have been published embodying all the knowledge available on the subject to assist coroners in their duty of investigation. The best-known of these was the *Se yuen luh*, or "Record of the washing away of wrongs," which was given to the world in the thirteenth century, and which, under the same title, subsequently received the *imprimatur* of the officers of the Board of Punishments, who, in the exercise of their legislative function, issued it as a manual for coroners. In this work is expounded the whole system of Chinese medical jurisprudence, of which the following is a slight sketch.

One of the first directions given to coroners reminds one of Mrs. Glasse's celebrated dictum, and is to the effect that before issuing a warrant for an inquest they should be quite sure that there really is a corpse. This admonition is no less curious than the reason which makes it necessary. It appears to be not uncommon for unscrupulous swindlers to demand inquests on imaginary corpses for the purpose of extorting money from the wealthy owners of the houses where the bodies are said to be, who, rather than fall into the clutches of the law, generally pay the sum demanded on condition that all proceedings are stayed. But being well assured of the existence of a corpse, the coroner should proceed to the spot well provided with onions, red pepper, salt, white prunes, and vinegar with the lees. If death has just taken place, he should examine the top of the head, back of the ears, throat, and any other vital part where a sharp-pointed instrument may have been inserted. In case of his failing to find any such cause of death, he should interrogate the friends and neighbours, and then proceed to examine any wounds there may be on any other part of the person.

An infallible guide to the date of a wound is found in the colour of the bone affected. If it is a recent one or of a slight nature, the bone will be red, but if old and severe, the bone will be of a dark blue colour. Particular care should, however, be taken to ascertain that these colours are genuine, and not manufactured to agree with the story told by the relatives. A red tint may be given to the bone by painting it with an ointment of genuine safflover, sapanwood, black plums, and alum, with the addition of boiling vinegar. On the other hand, green alum or nutgalls, mixed with vinegar, impart a dark blue or black hue. These counterfeit colours may, however, be distinguished by their want of brightness. Again, not uncommonly a fictitious wound is made after death by

burning the spot with lighted strips of bamboo, but such a wound will be level with the surrounding flesh and be soft to the touch. If willow bark has been used for the same purpose, the flesh will be rotten and black, livid all round, and free from hardness. A lighted paper placed inside a cup and applied to the flesh makes a wound which resembles the result of a blow with the fist ; but it will be observed that all round there is a red, scorched mark, that the flesh inside is yellow, and that although it swells, it does not become hard. On the other hand, a genuine wound can be distinguished by the well-defined colours of the surrounding flesh. At the extremity of the wound there should be "a halo-like appearance, like rain seen from a distance, or like fleecy clouds, vague and indistinct."

Murders, it is held, are seldom the result of premeditation, but are in a great majority of cases to be traced to drunken brawls ; and further, coroners should remember that the relatives of a wounded man, unless their ties be of the closest, desire his death that they may extort money from his slayer. It becomes their duty, therefore, on hearing of a fray in which any one has been seriously wounded, to see that the injured man be carefully tended and provided for. If death ensues, a careful examination of the corpse should be made, beginning from the head downwards, and in doing so, should it be suspected that tattoo-marks on his cheeks or elsewhere have been obliterated, such parts should be tapped with a slip of bamboo, which will have the effect of making the marks reappear. Attention should be given to see if the ears have been bitten or torn, whether the nostrils have been wounded, and whether the lips are open or closed. The teeth should be counted, the jaws examined, and the limbs carefully scrutinised down to the finger- and toe-nails. If the body bears marks of corporal chastisement, it should be noted, and any scars there may be, both on the inside and outside of the ankle-bones, may be safely set down to torture. When the mark of a wound which is known to have been inflicted cannot be traced, vinegar with the lees should be poured on the spot, and a transparent piece of oilcloth be held between the sun and part to be observed. On a dull day live charcoal must take the place of the sun. If the result be not satisfactory, spread powdered white prunes, with more vinegar and lees, and examine closely. Should this also prove unsatisfactory, then a cake composed of the flesh of white prunes, red pepper, onions, salt, and lees should be made very hot over a fire and applied to the parts, when the wound will appear.

In the same way, when violence is suspected, but no injury is at first sight apparent, it is directed that vinegar with the lees should be poured on the body, over which the clothes of the deceased saturated again with hot vinegar should be laid, and, covering all, mats spread to keep the steam in. The temperature of the vinegar should be regulated by the season of the year, and in very cold weather, when the vinegar, however hot, is insufficient to relax the rigidity, the corpse should be laid in a hole in the ground, in which a roaring fire has been subdued by copious sprinklings of vinegar. The fumes of steam which will then arise may be expected to accomplish the object. A careful examination should then be made, and if the marks of a wound or wounds are observed on the skin, their size, shape, and position are to be carefully noted, and death attributed to the one on the most vulnerable part. One of the most curiously perverted pieces of coroners' science is contained in the assertion that, if death has arisen from a blow on the lower part of the abdomen, the injury is discoverable by the condition of the roots of either the top or bottom teeth in the case of men, and in that of women by the appearance of the gums.

If the services of the coroner should not be called in until the body is in so advanced a stage of decomposition that the condition of the bones is the only test left him, he should choose a bright day, and having steamed them in the fumes of hot vinegar he should examine them under a red oilcloth umbrella. The blood having soaked into the injured parts, these will at once become visible, and will leave clearly-defined red, dark blue, or black marks. A long-shaped, dark-coloured mark so discovered points to a wound inflicted by a weapon, a round one to a blow of the fist, a large one to a butt of the head, and a small one to a kick. The fact of saturation of blood in the bone is evidence that the wound was inflicted before death. Should there be any doubt as to the identification of the bones, it is only necessary for a child or grandchild of the deceased to cut himself and herself with a knife, so that the blood may drip upon the bones, when, if they be really those of the parent, the blood will soak into them, otherwise it will not. In connection with this test it is curious to find stated the old-world belief that the blood of relations, if dripped into a basin, will mix, and not in the case of others. This test would appear to be often appealed to, since coroners—though it is difficult to see what it has to do with coroners—are warned to see that those interested in proving a relationship do not smear the basin with salt or vinegar, under the influence of either of which any bloods will mix.

Observations have shown, so coroners are told, that a man who has been killed with a knife dies with his mouth and eyes open and his hands clenched. The skin and flesh about the wounds will be shrunken, and in case of a limb having been cut off the bone will be protruding. Where decapitation has taken place, the muscles will have shrunk backwards, the skin will have curled over, and the shoulders will be shrugged up. These appearances will be wanting if the wounds have been made after death has taken place. It is necessary to be particular on these points, we are told, as murderers constantly endeavour to mislead coroners by inflicting wounds after death in such a way as to lend a colour to vamped-up stories of suicide. The exact frame of mind in which a man was when committing suicide can be readily discovered by the features of the corpse. If the teeth are firmly set, the eyes slightly open and looking upwards, a fit of violent passion prompted the act ; if the eyes are closed, but not tightly, the mouth slightly open, and the teeth not shut, then it was due to an excess of pent-up rage ; if fear of punishment has driven him to it, his eyes and mouth will be placidly closed, "for he looks on death merely as a return home and a happy release from the responsibilities of life." The hands also furnish a test when there is a doubt whether the case of a man whose throat has been cut be one of murder or suicide. The hand with which a suicide commits the deed will remain soft for a time, and will curl up a day or two after death, neither of which symptoms will occur when death has been caused by another person.

Strangulation is one of the commonest means by which persons tired of life "shuffle off this mortal coil," and full directions are given as to the points to be observed when holding inquests on such cases. The exact position of the body, the kind of scar on the neck, the existence or absence of the mark of a knot, the expression of the face, and a thousand other matters are detailed at length, and are contrasted with similar appearances in the case of murders. One curious piece of superstition receives the sanction of the Board of Punishment in connection with suicide by hanging. Beneath the spot where the crime was committed, at the depth of three or more feet below the surface of the soil, there will be found a deposit of charcoal, and by this test, should any doubt exist as to the scene of the suicide, the matter may be settled. The directions given in the case of deaths by drowning are voluminous, and, speaking generally, accurate. The habit of generalising from insufficient data, which is so common with Chinamen, occasionally leads them astray here as elsewhere. It has been reserved for them, for example,

to discover the law that bodies take a longer time to float in winter and the beginning of spring than in the summer and end of autumn. That a drowned man floats on his face and a woman on her back is mentioned, and it is left to be implied that in case of bodies having been thrown into the water after death this does not hold good. With the same minuteness every possible circumstance connected with death by fire is gone into at length, the presence of traces of ashes in the mouth and nose being described as "a crucial test of death by burning."

The chapters on poison are, as might be expected in the absence of dissection, the most unsatisfactory in the book. Practically very little light is thrown on the distinguishing symptoms arising from the effects of different poisons. The common test applied to most is that of inserting a silver needle washed with a decoction of *Gleditschia sinensis*, into the mouth of the corpse. If, when after a time this is withdrawn, it should be stained a dark colour, and remain so stained after it has been again washed with the decoction, poison has been the cause of death. Another proof is furnished by the effect which a pellet of rice, after having been some time in the mouth of the corpse, has on poultry who can be induced to swallow it. The commonest poisons are said to be opium, arsenic, and certain noxious essences derived from herbs. But besides these, other things are taken by suicides and given by murderers to cause death. In some of the southern provinces there exists a particular kind of silkworm, known as the Golden Silkworm, which is reared by miscreants to serve either purpose as occasion may require. Quicksilver, which is also used with fatal effect, is either swallowed, or, like the "juice of cursed hebenon" which sent Hamlet's father to his account, is poured into the ear. The torture necessarily consequent on this last method of using it must be so excessive that it may safely be assumed that it finds favour only with murderers. Swallowing gold, on the other hand, seems to be the favourite way of seeking death with wealthy suicides. It has been held by some writers that the expression "swallowing gold" is but a metaphorical phrase meaning "swallowing poison," just as when a notable culprit is ordered to strangle himself he is said to have had "a silken cord" sent to him. But the "Coroners' Manual" puts it beyond question that gold is actually swallowed, and it prescribes the remedies which should be adopted to effect a cure. Gold not being a poison, death is the result either of suffocation or laceration of the intestines. When suffocation is imminent, draughts of strained rice-water, we are told, should be given to wash the gold downwards, and when this object has been attained, the flesh of partridges, among other things, should be eaten by the patient to "soften the gold" and thus prevent its doing injury. Silver is also taken in the same way. But though wealthy Chinamen thus find a pleasure in seeking extinction by means of the precious metals, they have never gone the length of pounding diamonds to get rid of either themselves or their enemies after the manner of Indian potentates.

ROBERT K. DOUGLAS

ZOOLOGY IN JAPAN

A CORRESPONDENT in Tokio sends us the following:—During the late summer and autumn some good work has been done in the ornithological way. Mr. P. L. Jouy, of the Smithsonian Institution, collected extensively in the region of Mount Fujiyama, at Chiu-senji Lake, near the celebrated shrines of Nikko, and on Tateyama Range, between the borders of the provinces of Shinshiu and Hida. A large number of beautifully prepared skins, with a good deal of information regarding the breeding habits of some of the rarer birds, is the result, which will be recorded in the February number of the *Chrysanthemum*, a magazine published at Yokohama, appearing in enlarged form with the commencement of this year. An article contributed by Capt. Blakiston in the January number, follows up those of his for September, October, and November, 1882, on ornithological work in Yezo during the past summer; in which is noticeable the occurrence of *Locustella certhiola* (Pall), and *Phylloscopus borealis* (Blasius) on that island; and the discovery of a new species of *Motacilla* (probably described by Seebohm in the *Ibis* for January, 1883), allied to *M. ocularis* (Swinhoe) and *M. amurensis* (Seebohm), which has hitherto somehow been mixed up with *M. lugens* of the "Fauna Japonica," which latter is now found to be —to quote Capt. Blakiston's words (*Chrysanthemum*, January, 1883, p. 31)—"a species unique in its genus, having in the adult state the same appearance winter and summer, and in which the young pass at once before their first winter into the adult dress."

Messrs. Owston, Snow, and Co.'s otter hunters at the Kuril Islands have also during the past season added some new localities for Japan birds. The specimens are in the hands of Capt. Blakiston, and will be duly mentioned in the following number of the *Chrysanthemum*, as additional notes to the "Birds of Japan," *Trans. As. Soc. Japan*, vol. x. part 1 (noticed in NATURE, vol. xxvi. p. 362).

In the way of *mammalia* late investigation points to the distinctness of Yezo from Japan proper. The Rev. Père Heude, who is now engaged upon a revision of the *Cervidæ* of Eastern Asia, has come to the conclusion that the common deer of Yezo is not *C. sika* of the "Fauna Japonica," but *C. manchuricus-minor*, or an undescribed species. Two parts are already published—very creditably got up at the Mission Press at Sikawei, near Shanghai—cf. "Mémoires concernant l'Histoire Naturelle de l'Empire Chinois," others being promised to follow.

NOTES

THE following is the list of fifteen candidates recommended for election by the Council of the Royal Society:—Surgeon-Major James Edward Tierney Aitchison, M.D., James Crichton Browne, M.D., LL.D., Surgeon-Major George Edward Dobson, M.B., James Matthews Duncan, M.D., Prof. George Francis Fitzgerald, M.A., Walter Flight, D.Sc., Rev. Percival Frost, M.A., David Gill, LL.D., Charles Edward Groves, F.C.S., Howard Grubb, F.R.A.S., John Newport Langley, M.A., Arnold William Reinold, M.A., Roland Trimen, F.L.S., F.Z.S., John Venn, M.A., John James Walker, M.A.

THE loss sustained by mathematical science in the premature death of Henry Stephen Smith is still fresh in the minds of our readers. They will find their best consolation in the fact that his successor in Oxford may possibly be Prof. Sylvester. Such an opportunity of recovering for England the services of one of her two greatest mathematicians is not likely to recur, and will, we doubt not, be eagerly turned to advantage. It has been a humiliating thought to many to whom the highest interest of science is dearer than the prosperity of mere mediocrity that, of the two greatest mathematicians that England has produced in the nineteenth century, one has altogether and another almost been obliged to seek for refuge in a foreign land.

UNIVERSAL regret will be felt at the sad intelligence which has just reached England by telegram, from Madeira, of the untimely death of Mr. William Alexander Forbes, B.A., Fellow of St. John's College, Cambridge, and Prosector to the Zoological Society of London. Mr. Forbes left England in July last, along with Mr. McIntosh and Mr. Ashbury, upon what was expected to be a three or four months' expedition in a steam-yacht up the river Niger. He died of dysentery at Shonga on January 14, aged 28.

THREE months ago Mr. Raphael Meldola, as retiring President of the Essex Field Club, gave an interesting address, which is now printed in a separate form, on "Darwin and Modern Evolution." It gives a clear and well-condensed account of Darwin's life and work. The following extract concerning the first publication of the theory of natural selection at the Linnean Society is of historical interest, and also, we think, of some instructive value:—"Mr. Wallace has narrated to me that one of his correspondents, a well-known entomologist, wrote to say that it was a general remark in natural history circles, with respect to the paper, that it was much to be regretted that the author had not more confined himself to statements of fact!" This shows that the naturalists of the Linnean Society at that time had the same intolerance of anything like speculative brain-spinning which still finds occasional expression. But to-day we have to thank the sagacity of the greatest of naturalists that, while cautious of speculation, he nevertheless courted it as a friend to the highest interests of science, while leaving "the well-known entomologists" to shun it as the worst of enemies. The truth is that in biology, as in all other branches of science, unless the only aim of a worker is to accumulate knowledge of details, he is bound to resort to hypotheses as feelers after principles. On the other hand, of course, speculation, like fire, while the most valuable of servants, may also be the most dangerous of masters. The truest scientific judgment, therefore, consists in using speculation as not abusing it; and if in particular cases it is asked how much latitude is thus to be allowed to speculative thinking, the answer must be that this is just the question which in all particular cases it requires the truest scientific judgment to decide. All that can be said, as a matter of general principle, is that quite as much and even more harm may arise from an over-nervousness of deductive method in biology, as may arise from an over-confidence in them; and also that the theory of evolution—at least in our opinion—is now sufficiently well established to admit of being used deductively in no stinted measure, without danger of violating the best methods of scientific procedure.

THE great and deserved success which has attended the Girls' Public Day School Company has now led to the formation of a similar company for establishing schools for boys. A meeting, under the presidency of Lord Aberdare, was held on the 24th inst. at the rooms of the Society of Arts, at which the objects of the company were explained. The basis of the new schools is that of a self-supporting company, independent alike of Government and charitable aid. It is stated that premises will shortly be secured in Kentish Town, where the first school will be opened in a few months.

CAPT. C. E. DUTTON, of the United States Geological Survey, who spent half of last year in Hawaii studying the volcanic phenomena there, and whose researches among the plateaux of Utah have brought to light so many interesting phases of volcanic action in that region, is about to undertake the exploration of a still more extensive volcanic region. He is organising his forces for a summer campaign in the Cascade Range, beginning at the southern end in California, among the volcanic piles of Mount Shasta, and working northwards across Oregon to the remote peaks of Mounts Hood and Rainier, in Washington Territory. In this way a preliminary survey of the region will this year be made, and the information will be gained that will serve as the basis for future more detailed exploration. That vast region contains possibly the most colossal outpouring of volcanic matter anywhere to be seen in the world. Geologists will rejoice that it is now to be systematically examined by one so competent as Capt. Dutton, who has specially trained himself for the task. The American Congress is to be congratulated on the enlightened spirit in which these surveys of the Western Territories are conceived and carried out.

THE Central Swedish Meteorological Observatory, in Stockholm, has issued a request, signed by Baron Nordenskjöld, calling upon those who may witness meteoric phenomena to send minute particulars of the same to him. He requests that the following details may be noted:—Time, duration, direction as well as height above horizon, whether the meteor had a tail, emitted smoke, burst, or simply disappeared from view, whether any sound and any fall of objects were observed. He also requests that a drawing of the phenomena may if possible be forwarded. In conclusion, he says: "There often appears a peculiar dry mist or 'sun-smoke' over extensive tracts of land in Sweden, sometimes accompanied by a remarkable smell extending for hundreds of square miles. The nature of this phenomenon has not yet been ascertained. As I am informed that it was recently noticed in certain parts of Norrland, I beg that any observer of the same will forward all particulars he may possess."

GEOLOGISTS will learn with regret that Mr. Alexander Murray, who has so long and so ably directed the Geological Survey of Newfoundland, feels himself compelled by advancing years and enfeebled health to retire from his duties. For many years he was one of the late Sir William Logan's chief officers in the Geological Survey of Canada, where he long ago gained his geological spurs. His iron constitution and indomitable enthusiasm have carried him through more hardships than have fallen to the lot of almost any living geological explorer, but they have been borne with a quiet courage and good-humoured indifference altogether admirable. May he find now the honourable rest and recognition to which his long devotion to the colony so justly entitles him. He will be succeeded by his present second in command, Mr. James P. Howley, in whose experienced hands the Surveying Department of Newfoundland will be excellently administered.

PROF. TYNDALL will on Thursday next, May 3, at the Royal Institution, give the first of a course of three lectures on "Count Rumford, Originator of the Royal Institution."

ALTHOUGH the circulation of books from Newcastle-upon-Tyne Free Library has not quite kept up this second year, yet the Report, with its account of the handsome new building, is a very satisfactory one. The carrying on of education in various ways, in combination with the Science and Art Department and with the City and Guilds of London Institute, by literary and commercial classes, including even a competition in oratory supported by a "Bequest," is valuable work that ought naturally to fall, as it has done here, into the same hands as control the library. The method of encouraging juvenile readers by permitting the use of the whole library to the more intelligent is good where these readers are sufficiently known to the librarian. There is no doubt that the true reason is given for the large increase in the issue of fiction, viz. that the committee have added to their stock in that class in a proportion twice as great as in any other class. "The love of" fiction "increases as much as the" fiction "itself increases."

THE Mitchell Library at Glasgow has taken the only method of repressing this circulation of fiction, viz. that of not buying the books! In this well-endowed and promising institution, only open five years, yet now containing 45,000 volumes, there are only 374 volumes of fiction; yet so great is the demand for this class of reading that every volume has been issued ninety-eight times, *i.e.* changed twice every week throughout the year! This library, however, supported mainly by the splendid bequest of 70,000*l.* left by Mr. Stephen Mitchell in 1874, has purposely relegated this department and that of branch libraries to the 1*d.* rate, able to produce in Glasgow 11,000*l.* a year, while itself takes the form of a great reference department, already the

largest free library in Scotland, and promising in a second five years to be among the most important collections of books in the kingdom. One of the best functions of a public library in any town is to become the centre to which will gravitate all publications of any local value or interest. For since every subject or author is naturally connected with some locality, if this were well carried out all over the kingdom, information would gradually be as well arranged and as readily accessible as in a cyclopædia. The collections undertaken by the Mitchell Library at Glasgow are (1) the works of Burns and other Scotch poets and verse writers, one object of which will be "to preserve local dialects, local customs, and local memories"; (2) all papers which in any way illustrate the city's growth and life; (3) specimens of early Glasgow printing. The Scotch Covenanters is another subject in which a collection of publications has been commenced. Still nearly one-fifth of the volumes in the Mitchell Library, and more than one-fifth of the volumes in circulation, belong to the department of Arts and Sciences. The attendance of readers has been quite as large as the present premises will accommodate.

THE Council of the Society of British Artists opened their gallery in Suffolk Street on Sunday last to the members of the Sunday Society. A similar privilege has been granted for Sunday next, the 29th inst., when the public will be admitted during the afternoon and evening by free tickets, to be had by all who apply, inclosing a stamped and addressed envelope, to the Honorary Secretary, 8, Park Place Villas, W. The eighth annual meeting of the Sunday Society will be held in the Princes' Hall, Piccadilly, on May 5, under the presidency of Sir Coutts Lindsay.

WE have received the Memorandum of Association of the National Smoke Abatement Institution, signed by the Dukes of Westminster and Northumberland, Lord Mount-Temple, Sir W. F. Pollock, Sir Lyon Playfair, Sir Hussey Vivian, and Mr. Ernest Hart. The objects of this institution are already well known to all our readers.

THE diplomas and scholarships of the Spring Session of the Royal Agricultural College, Cirencester, were conferred on the successful students on the 19th inst. Among those on whom the diplomas were conferred were Messrs. Sen and Hossein, the two Indian scholars first sent to the College by the Government of India. It is worthy of note that one of these gentlemen, Mr. Sen, obtained the highest number of marks ever reached for the diploma.

A LARGE collection of weapons and implements from the Stone Age in Japan has, we are informed, arrived in London. The collector, Herr von Siebold, is an official of the Austrian Embassy in Japan, and has resided for many years in the latter country. The collection embraces, we believe, a large number of flint arrowheads, cells, axes, as well as numerous specimens of pottery taken from shell-heaps in various parts of Japan. The well known *magatama* and *kudatama* ornaments are also well represented. Except a few in the Christy collection in the British Museum, and a small collection given by Herr von Siebold himself to the Copenhagen Museum, the Japanese Stone Age is not, we believe, fairly represented in any archæological museum in Europe.

MORE than 250 years ago the English residents in Japan were perplexing themselves, as they are to-day, on the subject of earthquakes. In the diary of Richard Cocks, just published for the Hakluyt Society by Mr. Maunde Thompson, we find, under date November 7, 1618, the following entry:—"And, as we retorned, about 10 a clock, hapned a greate earthquake, which caused many people to run out of their howses. And about the lyke howr the night following hapned an other, this cuntrey being much subject to them. And that which is comunely markd, they allwais hapen at a hie water (or full sea); so it is thought it chanseth per reason is much wind blowen into hollow caves under grownd at a loe water, and the sea flowing in after, and stoping the passage out, causeth these earthquakes, to fynd passage or vent for the wind shut up."

NEWS from Mr. Stanley dating down to the middle of December has just been received at Brussels. Stanley had reached the African coast, and, after having augmented his party by 223 natives from Zanzibar, under the leadership of the Belgian traveller, M. de Cambier, had started for Vivi, the first station established by the International African Society. At Vivi preparations were being made for the construction of a railway line to the landing-place on the river, but the work proceeded slowly, owing to the total absence of beasts of burden. Up to now seven stations have been established—Vivi, Isanghila, Manyangha, Lutété, Stanley Pool, Ibaka Nkoutou, and Bolobo; the latter is distant about 700 miles from the mouth of the Congo, and is the last one established. Of the four small steamers taken to Africa three had been launched, and the fourth was being transported from Manyangha to Leopoldsville. The seven stations already seem to become centres of civilisation, and exercise a beneficial influence upon the surrounding native tribes. Horned cattle had been introduced at Vivi, and at Leopoldsville agricultural work had begun, cabbage and lettuce thriving exceedingly in that locality. At Bolobo a fertile and well-populated country was reached, which extends far beyond the limits of De Brazza's journey. The progress of the latter was contemplated with equanimity, yet fears were entertained regarding the claims of the Portuguese Government, and also concerning the freedom of way and commerce.

SEVERAL Swedish officers have recently left Europe, being invited to join Mr. Stanley on the Congo.

THE Swedish Academy of Sciences has offered a reward to the vessel which first brings despatches, &c., to the meteorological observing party wintering at Spitzbergen.

THE despatch of the Swedish corvette *Vanadis* on a voyage round the world is contemplated. Several men of science will accompany her, among whom is Dr. Stolpe, the well-known ethnographist.

ON the 13th inst., between 8 and 9 a.m., a remarkable mirage was seen at Ölsta, in the parish of Sala, Sweden. It displayed distinctly a town in Eastern style situated by the sea, with temples and minarets, while to the left a forest of fine cypress trees was seen. In front was a train in motion, while a body of soldiers appeared marching along a road, with their bayonets flashing in the sun. The whole was visible for nearly an hour, when it gradually faded away.

THE French Academy of Sciences, at its meeting on Monday last, selected MM. Bonnet and Resal as candidates for filling the place vacated by the decease of M. Liouville, in the Bureau des Longitudes.

LAST week M. de Lesseps delivered several speeches at the Sorbonne and in other places, showing that the Roudaire Inland Sea will be useful and profitable, and the speaker met with very decided success. On Monday, M. Cosson, his usual antagonist, delivered a long speech, pointing out the danger of the operations, but the French Academy of Sciences took no notice of it, and no commission being appointed the matter dropped.

AT the March meeting of the Russian Physical Society, M. Sreznevsky read a communication on an instrument largely employed but the theory of which is from being established, namely, the hygrometer of Saussure. Its scale, usually traced by comparison with a psychrometer, varies with the month when

the comparison is made, a difference which is probably due to influence of temperature, as already pointed out in 1783 by Saussure. The matter, however, has never yet received thorough investigation. The cause of the elongation of the air in consequence of an increase of moisture remained also unexplained. It might be explained now, however, as it is known that the air contains water in a liquid state in its microscopical cavities. The curvature of the surfaces of these microscopical meniscuses, which depends upon the tension of the vapour that incloses the air, must influence the tension on its surface and therefore change its length. Both these causes can be expressed mathematically, at least for the simplest cases, and if we admit a state of equilibrium we can easily see that the tension of the meniscuses on the surface of the air is a function of the relative moisture, and is proportionate to the logarithm of the moisture. The elongation of the air would thus be a function of the relative moisture of a capillary constant, of the coefficients of elasticity of the air, and of the suspended weight.

DR. ARNOD DODEL PORT has recently published the final part of his incomparable "Atlas der physiologischen Botanik." The six plates which constitute it illustrate: *Cystosira barbata*, I.Ag. (a genus of sea wracks), the archegonium and antheridium of *Marchantia* (one of the Liverworts), *Pinus laricio* (third plate), *Lavatera trimestris*, two plates (a genus of Malvaceæ), and *Datura stramonium*, L. (the common thorn-apple). Together with the plates is published the final part of the descriptive text.

IN the current number of the *Annales de l'Extrême Orient*, M. de Lucy-Fossarieu draws attention to the interesting fact in connection with education in Japan, that a large part of its development is due to private assistance. In the past five years forty-two millions of francs have been given voluntarily by private persons for the extension of education. Even this large sum, however, is probably less than the value of the land, houses, &c., given in particular districts for the use of schools.

THE tenth annual Report of the Museum für Völkerkunde, at Leipzig, has just been published, and gives an interesting account of the flourishing condition of this excellent ethnographical institution. The Emperor of Germany again contributes a large sum to the funds of the Museum, and the Crown Prince of Austria has become a member of the institution; the collections have been largely increased, and there are no less than 106 gentlemen at work in various parts of the world extending the connections of and acquiring material for the Museum.

AN earthquake was observed at Tashkend on March 31, at 7 a.m. The shocks were of considerable violence. In the Etna district the volcanic phenomena continue. A violent earthquake occurred at Riposto on the 5th inst., and on the following day oscillations were felt also at Catania, Paternó, and Randazzo. A thick volume of steam emanates from the crater as well as from lateral openings. At Salinella the mud crater had resumed its activity and had caused considerable destruction of property.

DR. PAUL GÜSSFELDT of Berlin, the eminent traveller who started for South America some time ago in order to make geological and other scientific researches in the Cordilleras, reports that he is well satisfied with the results of his journey, and that he had discovered a glacier of the first order in the style of the Aletsch glacier. The glacier is between fifteen and twenty miles in length. Dr. Güssfeldt has measured many summits trigonometrically, made a collection of alpine plants (amongst them a wild potato from above the glacier), and another of geological specimens. On December 31 he intended to leave for the Argentine Republic; thence he proposed to return to Maipu, and then investigate the Aconcagua district.

A NUMBER of unusually bright and large meteors were observed at Prossnitz (Austria) and other places in the neighbourhood on the evening of March 13 last, between 6 and 11 p.m. Some lit up the whole sky and lasted five or six seconds. No trace of any meteoric stone has as yet been discovered.

THE additions to the Zoological Society's Gardens during the past week include a Leopard (*Felis pardus* ♀) from India, presented by Mr. A. P. Marsden; an Ocelot (*Felis pardalis*) from South America, presented by Mr. C. G. Leith; a Ring-tailed Coati (*Nasua rufa*) from South America, presented by Mr. E. Dance; two Porto Rico Pigeons (*Columba corensis*) from the West Indies, a Common Boa (*Boa constrictor*) from Brazil, presented by Mr. C. A. Craven, C.M.Z.S.; an Osprey (*Pandion haliaetus*) from Australia, presented by Dr. Plummer; a White-bellied Sea Eagle (*Haliaetus leucogaster*) from Australia, presented by Mr. E. P. Ramsay, C.M.Z.S.; three Common Rheas (*Rhea americana*) from Monte Video, presented by Mr. John Fair; a Green Turtle (*Chelone viridis*) from the West Indies, presented by Mr. Fleetwood Sandeman; a Leopard (*Felis pardus* ♂) from India, a Small Hill Mynah (*Gracula religiosa*) from Southern India, a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, a Gannet (*Sula bassana*), British, deposited; an Iceland Falcon (*Falco islandus*) from Iceland, purchased.

OUR ASTRONOMICAL COLUMN

SCHMIDT'S VARIABLE STAR NEAR SPICA.—On June 6, 1866, Dr. Julius Schmidt remarked to the south and east of Spica a conspicuous star which he estimated 5·4m., and which was wanting in Argelander's *Uranometria*. It was brighter than the neighbouring reddish-yellow star, 68 Virginis. He found its place for 1866·0, R.A. 13h. 27m. 33s., Decl. −12° 31′·5. It is Lalande 25086, estimated 6·7 on May 10, 1795, and Piazzi XIII. 126, called 8m. in the catalogue, but 7 and 6·7 in the *Storia Celeste*. It was not observed by Bessel nor Santini, but occurs in Lamont's Zone 355, 1846, May 22, when it was rated 8m. In Bremicker's Berlin Chart it is 7m., and 6·7 in Heis. But a special point of interest about this object is Schjellerup's inference that it is identical with the 19th star in Virgo in Ptolemy's Catalogue, as indicated in a note at p. 160 of the translation of the Catalogue of Abd-al-Rahman al-Sûfi, which the Persian astronomer says was of the smaller fifth magnitude, nearer the sixth, though Ptolemy calls it "absolutely of the fifth." In Baily's edition of Ptolemy's Catalogue in vol. xiii. of the *Memoirs of the Royal Astronomical Society*, the star in question is No. 515, and there identified with 68 *i* Virginis: it is called ὁ νοτιώτερος τῆς ἑπομένης πλευρᾶς. Schjellerup, translating from Al-Sûfi, says: "La 19e est la méridionale du côté postérieur du quadrilatère, après *al-simâk*, s'inclinant vers le sud; elle est des moindres de la cinquième grandeur; Ptolémée la dit absolument de cinquième, mais elle est plus près de la sixième. Entre elle et *al-simâk* vers le sud-est, il y a environ une coudée et demie et entre elle et la 17e il y a la même distance. Avec *al-simâk* et la 17e elle forme un triangle isoscèle, cette étoile étant au sommet. La latitude de cette étoile, indiquée dans le livre de Ptolémée, se trouve erronée, parce que, au ciel, elle se fait voir autrement qu'elle ne tombe sur le globe. Car, d'après cela, elle devrait se faire voir au nord d'*al-simâk*, tandis que, en verité, elle se trouve au sud." Al-simâk is Spica, and the 17th star appears to be 76 Virginis. Baily in his Catalogue places the 19th star in longitude 178°, with 3° 0′ south latitude, but in a note he points out that in the edition of Ptolemy, published by Liechtenstein at Venice in 1515, the latitude is 0° 20′ and *north*; with the remark, "The star 68 Virginis agrees with the position given by Ptolemy; but it is difficult to make it accord with the description, as being in the 'latus sequens' of the quadrilateral figure."

Both the variable and 68 Virginis are found in Mr. Stone's Southern Catalogue, the epoch of which is 1880. The auxiliary quantities for the reduction of positions for this year to the assigned epoch of Ptolemy's Catalogue, the first of Antoninus, are, in the usual notation—

A ... 168° 47′·3 ... A′ ... 191° 0′·8 ... θ ... 9° 40′·6,

whence with the obliquity of the ecliptic = 23° 41′·1, Stone's places for A.D. 138 become—

	Longitude.	Latitude.
Var. Schmidt (Piazzi, xiii. 126) ...	180° 52′ ...	−2° 58′
68 Virginis	178° 53′ ...	−3° 14′

As we have seen, Ptolemy's 19th star of Virgo is placed in longitude 178° 0′, latitude −3° 0′; but, as is well known, the longitudes of the Almagest are about one degree too small. Hence Schjellerup's identification of the variable with Ptolemy's star is likely to be correct; the object deserves frequent attention.

D'ARREST'S COMET.—With reference to the remarks last week in this column on the first announcement of the observation of D'Arrest's comet in the Dun Echt Circular, Prof. Krueger, Director of the Observatory at Kiel, writes us from that establishment, as the "Centralstelle für astronomische Telegramme," as follows:—"I wish to state with reference to No. 703, p. 589, as I have done in *A. N.* No. 2507 [not yet received], that Dr. Hartwig had not telegraphed any daily motion of the supposed comet D'Arrest on the 4th April. The hypothetical daily motion was added by myself in the cable-telegram to Cambridge, U.S., because I assumed that the American astronomers were not in possession of an ephemeris. Lord Crawford received, as usual, the same telegram as Cambridge, U.S., with the additional note (in order to avoid double-telegrams) that the telegram had been sent to America. European astronomers received only Dr. Hartwig's original communication."

ON THE SENSE OF COLOUR AMONGST SOME OF THE LOWER ANIMALS[1]

AT the meeting of the Linnean Society on Thurday, April 19, Sir John Lubbock read a paper on this subject. Some years ago M. Paul Bert made a series of interesting experiments with the common Daphnia, or water-flea, which is so abundant in our ditches and pools. He exposed them to light of different colours, and he thought himself justified in concluding from his observations that their limits of vision at both ends of the spectrum are the same as our own, being limited by the red at one end, and the violet at the other.

In a previous communication Sir John Lubbock showed, on the contrary, that they are not insensible to the ultra-violet rays, and that at that end of the spectrum their eyes were affected by light which we are unable to perceive. These experiments have recently been repeated by M. Merezkowski, who, however, maintains that, though the Daphnias prefer the yellow rays, which are the brightest of the spectrum, they are, in fact, attracted, not by the colour, but by the brightness; that, while conscious of the intensity of the light, they have no power to distinguish colours. Given an animal which prefers the brightest rays, it may seem difficult to distinguish between a mere preference for light itself rather than for any particular colour. To test this, however, Sir John Lubbock took porcelain troughs about an inch deep, eight inches long, and three broad. In these he put fifty Daphnias, and then, in a darkened chamber, threw upon them an electric spectrum arranged so that on each side of a given line the light was equal, and he found that an immense majority of the Daphnias preferred the green to the red end of the spectrum. Again, to select one out of many experiments, he took four troughs, and covered one-half of the first with a yellow solution, half of the second with a green solution, half of the third with an opaque plate, and he threw over half of the fourth a certain amount of extra light by means of a mirror. He then found that in the first trough a large majority of the Daphnias preferred being under the yellow liquid rather than in the exposed half; that in the second a large majority preferred being under the green liquid rather than in the exposed half; that in the third a large majority preferred the exposed half to that which was shaded; and in the fourth that a large majority preferred the half on which the extra amount of light was thrown.

It is evident, then, that in the first and second troughs the Daphnias did not go under the solution for the sake of the shade, because other Daphnias placed by their side under similar conditions preferred a somewhat brighter light.

It seems clear, therefore, that they were able to distinguish the yellow and green light, and that they preferred it to white light. No such result was given with blue or red solutions. In such cases the Daphnias always preferred the uncovered half of the trough.

It is, of course, impossible absolutely to prove that they perceive colours, but these experiments certainly show that rays of various wave-lengths produce distinct impressions on their eyes; that they prefer rays of light of such wave-lengths as produce upon our eyes the impression of green and yellow. It is, of course, possible that rays of different wave-lengths produce different impressions upon their eyes, but yet that such impressions differ in a manner of which we have no conception. This, however, seems improbable, and on the whole, therefore, it certainly does appear that Daphnias can distinguish not only different degrees of brightness, but also differences of colour.

[1] By Sir John Lubbock, Bart., M.P.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—Prof. Dewar commenced a short course on Chemical Technology in its relation to Organic Chemistry on April 23.

Mr. Sedgwick is lecturing on the Embryology of Mammals and Birds, and Mr. Caldwell on the Morphology of Gephyrea, Brachiopoda, Polyzoa, Chœtognatha, and Larval Forms, practical work accompanying both courses.

Dr. Hans Gadow is lecturing on the Tegumentary and Muscular Systems of the Vertebrata.

Prof. Darwin's lectures on the Theory of the Potential will include an account of Gauss's treatment of those problems generally associated with the name of Green.

The Demonstrator of Mechanism is giving a course of Mechanics applied to the strains in winding, pumping, and blast engines, and in other machines. A practical class is being formed for instruction in Surveying.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 12.—"Introductory Note on Communications to be presented on the Physiology of the Carbohydrates in the Animal System." By F. W. Pavy, M.D., F.R.S.

My last communication (*Proc. Roy. Soc.*, vol. xxxii. p. 418) was entitled "A New Line of Research bearing on the Physiology of Sugar in the Animal System."

During the time which has since elapsed, I have been actively continuing my investigations in the direction started, and the results obtained give an entirely new aspect to the whole subject of the physiology of the carbohydrates in the animal system.

Modern research has shown that, besides the well-known carbohydrate principles, such as sugar, &c., there are several dextrins distinguishable by their optical properties and their cupric oxide reducing power.

From the colloidal principle starch, which has no cupric oxide reducing power, principles (dextrins) are producible by the action of ferments possessing gradually-increasing cupric oxide reducing power until maltose is reached, which constitutes the final product, and which possess a little more than half the cupric oxide reducing power of glucose.

This is one foundation point connected with the researches I have been conducting upon the physiology of the carbohydrates in the animal system.

The other foundation point is that the various members of the carbohydrate group are brought into glucose by the agency of sulphuric acid and heat.

Proceeding upon these facts, and taking the cupric oxide reducing power before and after subjection to the converting action of sulphuric acid and heat, I have prosecuted investigations upon the transformation of the carbohydrates within the animal system with the result of acquiring knowledge of an altogether unexpected nature.

Hitherto what has been observed as regards the transformation of carbohydrates by the action of ferments and chemical agents, has been a change attended with increased hydration—for example, the passage of starch into the successive forms of dextrin and maltose and cane-sugar into glucose.

The issue of the researches, however, which I have been conducting recently, is to demonstrate the passage of carbohydrates exactly in the opposite direction by the action of certain ferments existing within the animal system.

Alike in the alimentary canal, the circulatory system, and the

liver, the conditions exist by which this kind of transformation is effected.

From the mucous membrane of the alimentary canal a ferment is obtainable which converts (1) glucose into a body possessing the same kind of cupric oxide reducing power as maltose; (2) cane-sugar into maltose, and not glucose as formerly asserted; and (3) starch either into maltose or a dextrin of low cupric oxide reducing power.

The presence of carbonate of soda modifies the action of a maltose-forming ferment, and leads to starch passing into a dextrin of low cupric oxide reducing power instead of into maltose.

The portal blood contains a ferment which possesses a maltose or a dextrin-producing power, and the contents of the portal system during digestion are charged with a notable amount of maltose sometimes, and at other times a low cupric oxide reducing dextrin.

After the introduction of glucose into the circulatory system, I have observed the presence of maltose.

The liver also contains a ferment capable, under certain conditions, of carrying glucose into maltose, and I have further witnessed, by the same kind of action as the sugars and dextrins are moved from one to the other, the conversion of a carbohydrate into the colloidal material belonging to the animal system (glycogen) which holds the analogous position of starch in the vegetable system.

Evidence has likewise been supplied that by an action of the same nature as that which moves the carbohydrates from one to the other in the carbohydrate group, they are, under certain conditions, carried into a body out of the group, and thence not susceptible of being brought into glucose by the converting action of sulphuric acid; and, on the other hand, under other conditions a substance is brought into the carbohydrate group, and its nature made recognisable by the converting action of sulphuric acid and its cupric oxide reducing power.

The subject as it even now presents itself is a large one, and I propose to deal with it in detail in a series of communications. The first will be devoted to that which refers to the alimentary canal.

Linnean Society, April 5.—Sir John Kirk, vice-president, in the chair.—Messrs. R. M. Barrington, G. E. Comerford-Casey, F. V. Dickins, and E. Cambridge Phillips were elected Fellows of the Society.—Mr. E. M. Holmes exhibited a specimen of birch-tree sap which had been found to exude from a cut branch one inch in diameter, at the rate of 4 oz. per hour during the night and 7 oz. to 8 oz. per hour during the day before the leaf buds had expanded, showing that the rapid rise of the sap was in this case not dependent on transpiration, but probably on endosmose accelerated by the expansion of the wood caused by solar heat. The sap had been collected and analysed by Dr. Attfield, and its contents recorded in the *Pharmaceutical Journal*.—There was exhibited for Mr. R. Morton Middleton a well-marked example of wood showing the extensive ravages of the Isopod, *Limnoria lignorum*. The wood was from the pier piles of West Hartlepool, where the said Crustacean's depredations are very destructive.—The Secretary read a paper on the indiarubber-tree of the Gold Coast, by Capt. Alf. Moloney. In this the author stated that the *Landolphia owariensis* grows extensively in the countries of Akim, Aquapim, and Croboe; and he strongly recommended the natives and traders of Lagos to encourage rubber as an article of trade instead of solely depending as at present on palm oil. He described the habit of the live plant, and the method employed in extracting the rubber therefrom.—Mr. F. W. Phillips in a communication described a new species of freshwater Infusorian allied to the genus *Gerda*. It was proposed provisionally to name the new form *G. caudata*. It was obtained at Hertford, and in company with the rotifer *Æcistes pilula*.—A paper was read on *Hemicarex*, Benth., and its allies, by Mr. C. B. Clarke; in this he gives a revision of the genera and species of *Kobresia*, *Hemicarex*, *Schœnoxiphium*, and *Uncinia*.

Zoological Society, April 3.—St. George Mivart, F.R.S., vice-president, in the chair.—The Secretary read some extracts from a letter he had received from Mr. J. Sarbo in reference to the Gayal. The writer observed that *Bos gaurus* (the Gaur) and not *Bos frontalis* (the Gayal) is the Wild Ox of Assam, and that the *B. frontalis* is not known in a wild state, but only as a semi-domesticated animal owned by various wild tribes from Assam to Arracan.—Mr. Sclater called the attention of the meeting to the skin of a Brown Crow from Australia, which had been sent to him for examination by Mr. Albert A. C. Le Souef, C.M.Z.S., and which he was inclined to regard as a variety in plumage of *Corvus australis*.—Mr. A. G. Butler read a paper containing an account of a collection of Indian Lepidoptera made by Lieut.-Col. Charles Swinhoe, chiefly at Kurrachee, Solun, and Mhow. Thirty-two new species were described, and numerous field-notes by Col. Swinhoe were incorporated in the paper.—Col. J. A. Grant read some notes on the Zebra met with by the Speke and Grant Expedition in the interior of Central Africa in 1860-63, which certainly belonged either to the true Zebra (*Equus zebra*) or to its closely allied northern form, the recently described *Equus grevyi*.

Meteorological Society, April 18.—Mr. J. K. Laughton, M.A., F.R.A.S., president, in the chair.—T. G. Bowick, E. C. Clifton, H. Culley, Dr. W. Doberck, A. N. Pearson, Prof. H. Robinson, and J. E. Worth were elected Fellows of the Society.—The following papers were read:—On cirrus and cirro-cumulus, by the Hon. F. A. Rollo Russell, M.A., F.M.S. The author points out that next to frequent readings of the barometer and a knowledge of the distribution of atmospheric pressure, observation of the character of clouds, especially of cirrus, is of the greatest use in attempting to forecast coming weather. Observation of cirrus can plainly be made use of in a telegraphic system of weather forecasts as easily as observation of the barometer, and the employment of a number of scattered cirrus observers largely increases the probability of this form of cloud being noted. The paper contains a description of twelve different varieties of cirrus, with the weather they signify or at least precede, as observed by the author during the last eighteen years.—Some notes on waterspouts, their occurrence and formation, by George Attwood, F.G.S. This contains an account of several waterspouts observed in the Pacific Ocean, and also one seen in the Atlantic Ocean. The author believes that the waterspouts in the Pacific Ocean were caused by a cloud heavily charged with cooled moisture drifting from the high mountains of Costa Rica coming into contact with air-currents and clouds travelling in a different direction, and of a warmer temperature; by which contact the cloud heavily charged with moisture was given a rotatory motion, causing it to discharge part of its moisture and make it assume a cylindrical figure and fall down by its own gravity.—Records of bright sunshine, by W. W. Rundell, F.M.S. This is a discussion of the sunshine records made in the United Kingdom during the years 1881 and 1882, from which it appears that there is more bright sunshine upon the coast than there is inland.—Note on wind, cloudiness, and halos; also on results from a Redier's barograph, by E. T. Dowson, F.M.S.—On the cold weather of March, 1883, by W. Marriott, F.M.S. The weather of this month will long be remembered for its very cold, dry, and windy character. The winter had been very mild, dull, and wet, and continued so to the beginning of March. A sudden change took place, however, on the 6th. A severe northerly gale set in on that day, accompanied with snow showers and a keen biting wind. This gale was most violent in the North Sea, and caused sad havoc among the fishing fleet on the east coast, no less than 382 men and boys being drowned. The temperature fell considerably, the maximum being below 40° almost all over the country, and in the North of England only a trifle above the freezing point. The same conditions prevailed for the next two or three days, the temperature however falling still lower, and on the 10th the minimum occurred in the central and northern districts. The most remarkable weather of the month took place from the 21st to the 24th. Owing to a brisk fall of the barometer over France an easterly gale was experienced over this country, and as the temperature was low and the air very dry the wind was exceedingly bitter and keen, and its effect upon the human frame was most distressing.

SYDNEY

Linnean Society of New South Wales, February 28.—C. S. Wilkinson, F.G.S., president, in the chair.—The following papers were read:—On the coal flora of Australia, by the Rev. J. E. Tenison-Woods, F.L.S., F.G.S., &c. This was a complete monograph of all the known fossil coal plants, including the new species recently discovered by the author. A diagnosis of each genus and species was given, together with a history of the subject and its literature. The author also added his own views with reference to the classification, in which he regards some of the Newcastle beds as Pervian, some as Trias, and the Ipswich beds (Queensland), the Victorian carbonaceous

(Bellerine, Cape Otway, Apollo Bay, Colac and the Wannon), Tasmanian (Jerusalem), and the Hawkesbury sandstone as Jurassic or Lower Oolite. He expresses a doubt whether the Wianamatta beds can be regarded as a distinct formation, his own opinion being that they are shales distributed at various levels all through the Hawkesbury sandstone. The new species of plants described are: *Phyllotheca concinna*, *Equisetum rotiferum*, *Vertebraria tivoliensis*, *V. towarrensis*, *Sphenopteris* (*Aneimoides*) *flabellifolia*, *S.* (*A.*) *f.* var. *erecta*, *Trichomanides laxum*, *T. spinifolium*, *Thinnfeldia media*, *T. australis*, *T. falcata*, *Alethopteris currani*, *Tæniopteris carruthersi*, *Gleichenia* (?) *lineata*, *Jeanpaulia bidens*, *Ptilophyllum oligonerum*, *Brachyphyllum crassum* (which the author thinks may be a variety of *B. manidare*), *Sequoiites australis*, *Walchia milneana*, *Cunninghamites australis*. Besides these new species, the following Indian or European fossils are new to Australia:—*Podozamites lanceolatus*, Lindley and Hutton; *Merianopsis major*, Feist; *Angiopteridium ensis*, Oldham. The monograph is meant to be a complete reference for students on the subject of Australian coal fossils, and is illustrated by six plates of heliographs and two of lithographs.—Further contributions to the flora of Queensland, by the Rev. B. Scortechini, F.L.S.—Descriptions of two new fungi, by the Rev. Carl Kalchbrenner. The species described are *Polyporus Pentzkei* and *Paxillus hirtulus*, both from the Daintree River, Queensland.—Notes on the fructification of the Bunya Bunya in Sydney, by the Hon. James Norton, M.L.C.—Descriptions of some new fishes from Port Jackson, by E. P. Ramsay, F.L.S.—The President read some notes on the Tuena Gold Reefs, by M. F. Rate, mining engineer.

Berlin

Physical Society, March 16.—Dr. Frölich exhibited a torsion galvanometer prepared in Messrs. Siemens and Halske's establishment for measuring electricity mechanically, in which the deflection of the magnetic needle is indicated by the corresponding torsion of a spring whose constant expansion power is known. The torsion galvanometer was at first constructed for measuring the current of the large dynamoelectric machine fitted up in Ocker for copper electroplating, and which at least resistance possesses a power of 800 amperes. Here it was impossible to employ either a dynamometer, owing to the irregularity of the mercurial contact, or a tangent compass, which has to be directly inserted in the main circuit. Hence measurement could be effected only by lateral closing, and as Dr. Frölich fully explained, the determination of the potential at any required number of points in the circuit, as rendered possible by the new apparatus, gives the data for ascertaining the electromotor strength, the resistance, and the power of the current. He described in great detail the construction and adjustment of the new appliance, in which, after insertion of determined resistances in the lateral circuit, the number of volts can be read off, and from these the amperes and ohms determined in the simplest manner. The torsion galvanometer is prepared in two forms, vertical with a magnet suspended to a cocoa fibre, and horizontal with a magnet resting on an edge. The latter form is intended especially for cases in which the apparatus undergoes no delicate manipulation.—Prof. Neesen briefly mentioned modifications which he has introduced both in the heat regulator used by him and in his ice calorimeter, illustrating them with diagrams. He has found them work well in practice.

Paris

Academy of Sciences, April 16.—M. Blanchard in the chair.—M. Jordan read a note on the works of the late Prof. H. Smith, and M. Bertrand added some remarks on the award of the mathematical prize.—Two new methods for determination of the right ascension of polar stars, and of the inclination of the axis of a meridian above the equator, by M. Lœwy.—Memoir on the temperature at the surface of the ground and of the earth to 36m. depth, as also of the temperature of two pieces of ground, one bare, the other covered with turf, during 1882, by MM. Becquerel. This confirms previous results.—Graphic demonstration of a theorem of Euler concerning the partition of numbers, by Prof. Sylvester.—On the project of the interior African Sea, by M. de Lesseps. After a visit to the region, he affirms (with several associates) the urgency and feasibility of the scheme.—M. Wolf was elected Member in the Section of Astronomy in place of the late M. Liouville.—On the evolution of malignant pustule in man and its treatment with iodised injections, by M. Richet. So long as general infection has not commenced, by bacteria or their spores entering the blood, active local treatment with tincture of iodine is efficacious.—Experiments on caustic anæsthesia, and observation of a case of ulcerated tumour of the breast operated with the aid of this method, by M. Guérin. A space was cauterised round the tumour with Vienna caustic and incised throughout; then the tumour was detached.—Mechanical action produced by magnets and by terrestrial magnetism (second memoir), by M. Le Cordier.—Calculus of a double integral, by M. Callandreau.—Observations of the Swift-Brooks comet at Lyons Observatory, by M. Gonessiat.—Law of periods (continued), by M. de Jonquières.—On the groups of transformations of linear differential equations, by M. Picard.—On functions with lacunar spaces, by M. Poincaré.—On a generalisation of the theorem of Fermat, by M. Picquet.—On the heat of combination of glycolates and the law of thermal constants of substitution, by M. Tommasi.—On the liquefaction of oxygen and nitrogen, and on the solidification of sulphide of carbon and alcohol, by MM. Wroblewski and Olszewski. By making ethylene boil in vacuo, they obtained temperatures as low as −136° C. Liquid oxygen was obtained easily; it is colourless and transparent like carbonic acid; is very mobile and forms a very distinct meniscus. Sulphide of carbon freezes about −116° C. Alcohol solidifies (after being viscous about −129°) about −130°·5, forming a white body. Liquid nitrogen (colourless, and with visible meniscus) was obtained later.—Researches on phosphates, by MM. Hautefeuille and Margottet.—On artificial Hausmannite, by M. Gorgeu.—On the chloride of pyrosulphuryl, by M. Konovaloff.—On the difference of reactional aptitude, &c. (continued), by M. Henry.—Researches on the essence of Angelica of roots (*Angelica officinalis*), by M. Maudin.—Some effects of climate on the rapidity of growth of plants, by M. Capus. His measurements of various trees and shrubs in the botanical garden of Samarcand show the remarkable rapidity of growth there in April, May, and June.—Orientation of leaves with reference to light, by M. Mer. Certain parts of leaves (the border generally) receive the luminous impression, while other parts (petioles, motor-enlargements) perform the movements necessary to place the former in a favourable position.—Contribution to the experimental study of the elongation of nerves, by M. Minor. He supports the view that this stretching is a purely local operation, a sort of incomplete section of a nerve.—Experimental studies on the physiological action of iodoform, by M. Rummo.—New experimental researches on the physiological action of veratrine, by MM. Pecholier and Redier.—The synthesis of the heavens and the earth, by M. Moigno. He deduces all from ether, first forming hydrogen. Universal gravitation is the direct effect of impulsions of ether.—A *frontal electric photophore*, for medical use, was described by MM. Helot and Trouvé. It is an incandescent lamp, supplied from a bichromate battery, and fitted with a reflector and convergent lens. It is attached to the forehead.

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