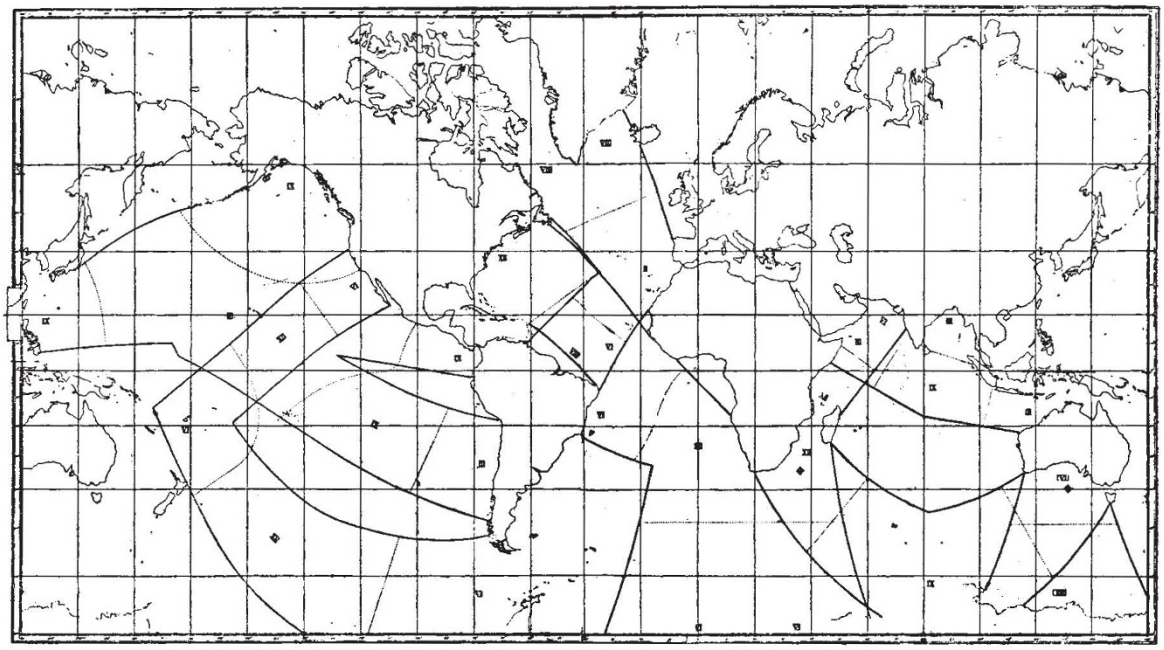
the free period of oscillation, supposing its boundaries all rigid, would not differ much from twelve lunar hours, and the forces are connected with the dominant ocean tides by applying to such an area, or to a system of such areas, the rule that "if to the particles of water in a given oscillating system, each area of uniform depth, and wherein the resistances are proportional to the velocities of the particles, a series of simple harmonic forces having for period the free period of the body of water be applied and a permanent state established, then must the time of elongation be simultaneous with the time when the virtual work of the external periodic forces upon the system becomes zero." Applying this rule, by means of the tidal-force diagrams the time can be found when "the aggregate of the elementary masses, each multiplied by the intensity of the tidal force in the direction of the displacement of the element, and again by a quantity proportional to the value of the maximum displacement (since the oscillation is harmonic), is zero": this is the time of high or low water. The results of this method appear at once in a few simple cases: thus in an east-and-west canal half a wave-length long it is high water at the east end at the component hour 0 or 12, the time meridian being understood to be the meridian of the middle point of the canal; in a meridional canal one wave-length long, whose centre lies between 45° south and 45° north latitude, it is high water at both ends at the component hour 9; if the centre lies beyond these limits, the component hour of high water at the ends is 3.

Before laying down the oscillating areas, Mr. Harris gives a number of lemmas which have to be borne in mind as modifying the motions discussed. To quote one example: "Suppose a stationary oscillation to exist in a canal communicating with a tided sea; let the length of the canal lie between 0 and $\frac{1}{4}\lambda$, then at the time of high water outside it is high water throughout the canal (*e.g.* many Alaskan canals). If the length lie between $\frac{1}{4}\lambda$ and $\frac{3}{4}\lambda$, it is low water for a distance of $\frac{1}{4}\lambda$ from the head at the time it is high water outside (*e.g.* Irish Sea, node at Courtown; English Channel, node at Christchurch). If the length be equal, or nearly equal, to $\frac{1}{4}\lambda$, then the horizontal motion at the mouth, instead of the vertical motion, determines the time of tide within; this tide will be three hours later than the tide outside (*e.g.* the Gulf of Maine).

The systems supposed to account for the principal semi-daily movements of the oceans are outlined on the chart which we reproduce in a reduced form; the Roman numerals indicate the cotidal hours. The main systems are seven in number: (1) North Atlantic, (2) South Atlantic, (3) North Pacific, (4) South Pacific, (5) North Indian, (6) South Indian, (7) South Australian (solar).



UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Applications are invited for the new Wykeham professorship of physics, referred to in a note on May 24 (p. 91). The election will take place in November, and applications must reach the Registrar not later than October 24. The following particulars are given in the *University Gazette*:—The subjects on which the professor will chiefly lecture and give instruction will be electricity and magnetism. The professor will have the charge of any laboratory which the University may assign to him. It is expected that rooms, now otherwise occupied, will be assigned to the professor for a laboratory in the course of the year 1901; 700*l.* will be appropriated to fitting up the laboratory, and provision has been made for spending 250*l.* a year for the first two years on assistance and maintenance. As soon as the professor is elected, he will be entitled to be admitted to a Fellowship at New College of the annual value of 200*l.* In addition, from January 1, 1901, he will receive from New College (1) an annual payment of 200*l.*; and (2) a further annual payment of 100*l.* so long as the College has funds available for the purpose. It is anticipated that this further payment will be paid for not less than twelve or thirteen years.

PROF. MCCALL ANDERSON, Professor of Clinical Medicine in the University of Glasgow, has been appointed to the chair of Systematic Medicine in the same University, in place of Sir W. Gairdner, resigned.

THE war in South Africa has raised many questions of great national importance which are fortunately receiving the attention of many thoughtful people. Prominent among these subjects of discussion is the urgent problem of how to obtain an improved supply of suitably educated officers, which was recently dealt with in a paper read by the Headmaster of Eton at the Royal United Service Institution. Dr. Warre maintains that a wider diffusion of the knowledge of the *elementa* of military science among the educated youth of the nation would tend, not only to raise the standard of military knowledge in the Army and Auxiliary Forces, but to improve the methods of communicating that knowledge to the rising generation, an indirectly widen the area from which a supply of well-educated officers may constantly be drawn. The great majority of the headmasters of our public schools agree with Dr. Warre, and he has drawn up, at the request of the War Office, a memorandum in which he advocates the need for a new Act of Parliament, the tenor of which should be "that all persons *in*

statu pupillari in public secondary schools above the age of fifteen, able and willing to bear arms, should be enrolled for the purpose of instruction in drill, manœuvre, and the use of arms." At the same time the paper makes it quite clear that the Headmaster of Eton thinks mere proficiency in drill is not sufficient—at every step the boy must be taught the reason of everything he is called upon to do, and throughout his training his intelligence must be carefully and steadily developed. Approaching the same question from another point of view, Prof. Armstrong, in a letter to the *Times*, maintains that no amount of mere military training given in schools, or subsequently, will ensure the necessary improvement in our officers, unless the intelligence of boys is more satisfactorily developed in the early years at schools—an end which can best be secured by an adequate training in the scientific method. It may fairly be surmised that the Headmaster of Eton is quite in agreement with Dr. Armstrong as to the paramount importance of early teaching, and that both are equally anxious that intelligent citizens should somehow be produced. Of the value of a familiarity with the methods of science it is here unnecessary to say anything, but it would certainly appear that both contentions are right. What is wanted is Dr. Warre's intelligent military training for public school boys who have all had the advantage of a training in the scientific method for which Dr. Armstrong pleads.

SCIENTIFIC SERIALS.

Transactions of the American Mathematical Society, vol. i. No. 2, April.—On the metric geometry of the plane n-line, by F. Morley. The relations which n-lines of a plane exhibit, when considered in relation to the circular points, have not received, in Prof. Morley's opinion, systematic attention since the important memoirs by Clifford, on Miquel's theorem ("Works," p. 51), and by Kantor (*Wiener Berichte*, vols. lxxvi. and lxxviii.). He applies certain notions which are fundamental in the geometric treatment of the theory of functions, and especially the notion of mapping. The paper is an interesting extension of Clifford's chain, and adds many curious results.—On relative motion, by A. S. Chessin. A memoir extending to 54 pages. The theory developed in it originated in a memoir by Bour in 1863 (*Journal de Liouville*, Ser. 2, vol. viii.). It deals mainly with the so-called "second form" of differential equations of Lagrange, and with the canonical system of differential equations of Hamilton-Jacobi. The first part of the paper deals only with the *theory* of relative motion. The differential equations are derived from one fundamental principle embodied in the so-called "theorem of Coriolis." This enables the author, not only to write down the differential equations of relative motion *immediately* from the corresponding equations of absolute motion, but to obtain equations *as general as those known for absolute motion*. In this first part there are eleven chapters. The second part (promised) is to contain applications of the theory. Among the problems to be discussed is the problem of Foucault's pendulum when the oscillations are not infinitely small, and the problem of Foucault's top, which Gilbert was unable to solve (sur l'application de la méthode de Lagrange à divers problèmes de mouvement relatif). The two problems, our author states, can be easily solved by the theory and formulas given in this first part.—Plane cubics and irrational covariant cubics, by H. S. White.—The paper considers cubics invariant under *partial* transformation by covariants (2, 2), and those invariant under *complete* transformation by covariants (3, 3). There remain for further treatment the two sets of conics invariant under the third transformation (2, 2), and invariant curves of order higher than the third (*cf.* the author's paper in No. 1). The new covariant cubics are eight in number, all of the type called equianharmonics.—A purely geometric representation of all points in the projective plane, by J. L. Coolidge. After some definitions, the writer gives a representation of all points in a real line by lines in a real plane, and then extends the representation so as to include all points in a real plane, noticing in particular those systems of lines which represent points on an imaginary line. He then takes up the subject of chains of points, showing their application to the general theory of projectivity. Finally, he glances briefly at the system of lines which represent points on a real conic, and concludes with remarks as to other possible solutions of the problem and its extension to three dimensions.—The decomposition of the general collineation of space into three skew reflections, by E. B. Wilson. The paper discusses the question, "Is it possible to decompose the general collineations of space into the product of a number of skew reflections; and if so, what is the least number of skew reflections involved in such a decomposition?"—A new method of determining the differential parameters and invariants of quadratic differential quantics, by H. Maschke, exhibits in a preliminary way a symbolic method in close analogy with the symbolism used in the algebraic theory of invariants, for the construction and investigation of invariants of quadratic differential quantics.—On the extension of Delaunay's method in the lunar theory to the general problem of planetary motion, by G. W. Hill, shows that the tediousness of Delaunay's method disappears when the greatest generality is given to the procedure.—Mr. J. E. Campbell writes on the types of linear partial differential equations of the second order in three independent variables which are unaltered by the transformations of a continuous group.

Bulletin of the American Mathematical Society, June.—Prof. Cole furnishes an account of the *Proceedings* at the New York April meeting of the Society, and abstracts several of the papers read; and Prof. Holgate performs a like office for the April meeting of the Chicago section of the Society.—J. G. Hagen gives a short sketch of the history of the extensions of the calculus. The abstract is confined to those theories that are in close relation to the infinitesimal calculus and the theory of functions, and excludes geometrical methods and methods of demonstration. To name one or two points discussed, they are Cauchy's "Calcul des Résidues," Schell's "Quotial and Instaural," the exponential function of higher order, the logarithmic methods of Bergbohm and Oltramare, and the extension of the calculus of finite differences.—Reviews are given of Burnside's "Theory of Groups," by Dr. G. A. Miller; of D'Ocagne's "Traité de Nomographie," by Prof. Morley; of Barton's "Theory of Equations," by J. Maclay; of Rice's "Theory and Practice of Interpolation," by Prof. E. W. Brown; of Von Braunmühl's "History of Trigonometry," by Prof. Cajori; of M. Boyer's interesting "Histoire du Mathématiques," by the same writer; and of Frischauf's "Vorlesungen über Kreis- und Kugel-Functionen-Reihen," by W. B. Ford.—Varied information is supplied in the "Notes" and "New Publications."

The numbers of the *Journal of Botany* for May, June, and July are almost entirely occupied by articles descriptive of new species, or relating to the geographical distribution of plants, chiefly in the British Islands. Mr. H. N. Dixon records the detection of an addition to British mosses in *Amblystegium compactum*, and Mr. S. M. Macvicar an addition to British Hepaticæ, in *Pellia neesiana*.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, June 21.—Prof. Thorpe, President, in the chair. The following papers were read.—Researches on morphine, I., by S. B. Schryver and F. H. Lees. Morphine readily exchanges an alcoholic hydroxyl group for halogen, yielding the bases chloromorphide, $C_{17}H_{18}O_2NCl$, and bromomorphide; when heated with water these substances give isomorphine, $C_{17}H_{19}O_3N$, and on reduction chloromorphine yields desoxymorphine hydrochloride $(C_{17}H_{19}O_2N,HCl)_2,3H_2O$. These four new bases are not narcotics.—On the oxime of mesoxamide and some allied compounds, by M. A. Whiteley. Nitrosyl chloride converts malonamide into the isonitroso-derivative, $CONH_2.C(NOH).CONH_2$; nitrous acid converts the latter into a pseudonitrole, $CONH_2.C(NO)(NO_2).CONH_2$, and hydriodic acid reduces it to aminomalonamide,

$$CONH_2.CH(NH_2).CONH_2.$$

—On dimethyldiacetylacetone, tetramethylpyrone and orcinol derivatives from diacetylacetone, by J. N. Collie and B. D. Steele. Disodiodimethylpyrone and methyl iodide react, giving dimethyldiacetylacetone, $C_7H_8O_3(CH_3)_2$, which is converted into tetramethylpyrone, $C_7H_8O_2(CH_3)_2$ by hydriodic acid; the residues from the preparation of dimethyldiacetylpyrone contain trimethylpyrone, $C_8H_{10}O_2$, and an orcinol derivative, $C_9H_{12}O_2$.—Dehydracetic acid, by J. N. Collie. The author has succeeded in preparing dehydracetic acid from triacetic lactone.—The decomposition of hydroxyamidosulphates by copper sulphate, by E. Divers and T.