laudatus est, hodie coram eodem, templi illius praeside illustrissimo, titulo nostro libenter ornamus.

"sunt hic etiam sua praemia laudi ;
sunt lacrimae rerum et mentem mortalia tangunt."

Duco ad vos Hofmanni discipulum, Faradai successorem, FREDERICUM AUGUSTUM ABEL.

(4) Perveni tandem ad Professorem nostrum Sadlerianum, virum non modo in recentioris quae dicitur Algebrae provincia, sed etiam studiorum mathematicorum in toto regno inter principes numeratum ; qui, quamquam iuris peritia honores summos adipisci potuisset, maluit sese scientiae illi dedicare, quae verbis quam paucissimis, quam illi quae verbis quam plurimis, rerum veritatem exprimere conatur. Quantum tamen prudentia eius Academiae profuerit, et senatus totius concilium et Collegium plus quam unum testantur ; neque Cami tantum prope ripas sed etiam in ipsa Europa atque adeo trans aequor Atlanticum fontes eius aliis patuerunt. Idem, velut alter Socrates, ipsi rerum pulchritudini et veritati mentis oculis contemplandae sese consecravit, arbitratus illa sola quae studiorum suorum in puro velut caelo sint, revera esse, illorum autem imagines quas φαινόμενα vocamus, velut specus εἴδωλα videri ; ipsam vero pulchritudinem percipi quidem posse sed non omnibus explicari. Quam dilucide tamen regnum suum quondam non campo deserto comparavit sed regioni cuidam pulcherrimae primum e longinquo prospectae, cuius partem unamquamque posse deinde peragrari, cuius et clivos et valles, et rivos et rupes, et flores et silvas posse propius maxima cum voluptate aspici. Diu, inter numina silvestria, regionem illam laetam feliciter pererret Professor noster insignis, ARTHURUS CAYLEY.

(5) Extra ipsas Athenas, stadiis fere decem ab urbe remotus, prope ipsam Platonis Academiam, surgit Coloneus ille tumulus Sophocleo carmine olim laudatus, Neptuni templo quondam ornatus, astronomi magni Metonis cum memoria consociatus. Et nos Colonum nostrum iactamus, clivum illum spatio a nobis eodem distantem, locum arboribus obsitum, avibus canorum, ubi in templo quodam stellis observandis dedicato vivit Neptuni ipsius inventor. Quid si Colono nostro deest Cephisus ? sed aqua de clivo illo antiquitus deducta, Collegii Herscheliani sub hortis transmissa, Newtoni in Collegio in fontem exsilit. Quid si Neptuni inventi gloria cum altero participatur ? sed, gloriae illius geminae velut imago perpetua, Geminorum in sidere est stella quaedam quae caeli totius inter stellas duplices prae ceteris fulget. Idem neque stellarum geminarum cursus, neque Saturnum neque Uranum inexploratum reliquit ; neque faces illas caelestes, Leonides vocatas, quas ter in annis fere centenis orbes suos magnos conficere ostendit ; neque motum illum medium lunae qui cum motu diurno terrae collatus per saeculorum lapsus paullatim acceleratur. Talium virorum laudibus non debet obesse quod inter nosmet ipsos vivunt ; pravum enim malignumque foret "non admirari hominem admiratione dignissimum, quia videre, alloqui, audire, complecti, nec laudare tantum, verum etiam amare contigit."

Tot insignium virorum nominibus hodie velut cumulus accessit vir illustris, PROFESSOR ADAMS.

The Senior Wrangler of the year is Mr. Orr, of St. John's ; the Second Wrangler Mr. Brunyate, of Trinity. No woman is placed with the Wranglers ; but one, Miss H. F. Ashwin, of Girton, is bracketed with the first Senior Optime.

The Rede Lecture was delivered in the Senate House on Friday, by Sir F. A. Abel, on the applications of science to the protection of human life.

The Report on Local Lectures gives particulars of a large number of science lectures given in local populous centres. At evening lectures on astronomy at Northampton, Mr. J. D. McClure had a regular audience of 277, and 250 at Aylesbury. The formation of Students' Associations, for mutual aid between the lectures, has been very useful. Several students from Northumberland came up to Cambridge in the Long Vacation, and did practical work in chemistry and biology.

The Syndicate appointed to report on Sir Isaac Newton's manuscripts in the possession of the Earl of Portsmouth, the scientific portion of which he offered to present to the University, have prepared a detailed catalogue of the whole, which is to be published.

Prof. Thomson announces that students who receive permission may work in the Cavendish Laboratory in the Long Vacation. There will be a special course for those who have passed the Mathematical Tripos, and intend taking the Natural Sciences Tripos.

In the Long Vacation, Mr. Fenton will give a general course on Chemistry, Mr. Potter will lecture on Systematic Botany with practical work, Prof. Macalister will lecture on Osteology, and Mr. Wingfield will give a revision course of Practical Physiology for Dr. Foster ; Prof. Roy will lecture on the Elements of Pathology, and will hold a practical course on three days a week.

Prof. Lewis will lecture on Crystallography during July, and Mr. Solly will give elementary demonstrations in Mineralogy during July and August.

SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. x. No. 3 (Baltimore, April).—The number opens with an article by M. E. Goursat, "Surfaces telles que la somme des rayons de courbure principaux est proportionnelle à la distance d'un point fixe au plan tangent" (pp. 187–204), in which are discussed some surfaces of a somewhat more general character than those treated of by M. Appell in the last number of the *Journal*. The title sufficiently indicates the scope of the memoir, which in part touches upon work accomplished by Riemann.—"Remarks on the Logarithmic Integrals of Regular Linear or Differential Equations" (pp. 205–24), by Karl Heun, follows up Fuchs's investigations (*Journal für Mathematik*, lxviii. p. 376). The author has elsewhere shown that the Fuchs equations are not independent of each other when the differential equation is of a higher order than the second, and in this paper he deduces, from elementary considerations, the minimum number of conditions on which the existence of logarithms depends. In addition he gives several theorems concerning the pseudo-singular points.—Mr. C. H. Chapman, in his article "On Some Applications of the Units of an *n*-fold Space" (pp. 224–42), obtains a proof of the rule for multiplying two determinants of the *n*th order by the principles of quaternions.—In "A Problem suggested in the Geometry of Nets of Curves and applied to the Theory of Six Points having Multiply Perspective Relations" (pp. 243–57), Mr. E. H. Moore discusses matters treated of by Von Staudt, Clebsch, Klein, and others.—Adopting the definition of *orientation* given by Laguerre, M. G. Humbert generalizes results previously obtained by Laguerre and himself in a memoir entitled "Sur l'orientation des systèmes de droites" (pp. 258–81), and also brings together some interesting properties of the hypocycloid given already by Cremona and Darboux.

Bulletin de l'Académie Royale de Belgique, April.—Contribution to the study of the albuminoid substances in the white of an egg, by MM. G. Corin and E. Bérard. It was recently shown by Halliburton that the albumen of the serum is a mixture of two or of three albumens, according to the nature of the animal, which coagulate under different degrees of temperature. Applying the same process of research to the albuminoids of the white of eggs, the authors find that five different albuminoid substances are present in this liquid : two globulines, coagulating at +57° and +67° C. respectively, and three true albumens, coagulating at +72°, +76°, and +82°. Besides these new facts, they also offer some interesting remarks on the general character of the relations existing between the albumens and the globulines, and on the opalescence observed when these substances begin to coagulate under the action of heat.—M. F. Folie describes a new method of determining the constant of aberration by means of a series of observations of one and the same star in right ascension. For this method he claims great simplicity, and exemption from the numerous sources of error to which other processes are liable. —To this number of the *Bulletin*, A. F. Renard contributes an exhaustive memoir on the prevailing geological formations of the Cape Verd Islands.

Rendiconti del Reale Istituto Lombardo, May.—On an old theory regarding the climate of Quaternary times, by Prof. T. Taramelli. Reference is made to the theory announced in 1840 by Lombardini, who considered that the Quaternary climate was simply a continuation of those of previous epochs, modified by the appearance of more elevated lands upheaved in post-Tertiary times. This anticipates by twenty years Frankland's remarks on the physical causes of the Glacial epoch, and leads the author to formulate a vulcanico-glacial theory based on the views of

these physicists and of Charpentier.—Meteorological observations made at the Brera Observatory, Milan, during the month of April.

Rivista Scientifico-Industriale, May 15.—Remarks on the earthquake at Florence on November 14, 1887, by Prof. P. G. Giovannozzi. Following the system adopted by Serpieri, the author has collected data from various quarters showing that the disturbance was of a purely local character. The chief shock, although so violent as to have been heard by the deaf, passed through the city with such velocity that very little damage was done. It presented all the characters of a true gaseous explosion, taking a vertical direction from a moderate depth below the crust of the earth, and absolutely unconnected with any volcanic phenomena. It is noteworthy that the earthquake followed a long and exceptional period of wet weather, during which a rainfall of 225mm. was recorded within the zone of disturbance.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 17.—"On Æolotropic Elastic Solids." By C. Chree, M.A., Fellow of King's College, Cambridge. Communicated by Prof. J. J. Thomson, F.R.S.

On the multi-constant theory of elasticity, the equations connecting the strains and stresses contain 21 constants. As shown by Saint-Venant, these reduce for one-plane symmetry to 13, for three-plane symmetry to 9, and for symmetry round an axis perpendicular to a plane of symmetry to 5.

Part I. of this paper deals with one-plane symmetry. A solution is obtained of the internal equations of equilibrium complete so far as it goes. It is employed in solving the problem, already treated by Saint-Venant, of a beam, whose length is perpendicular to the plane of symmetry, held at one end, and at the other acted on by a system of forces, whose resultant consists of a single force along the axis of the beam, and of a couple about any line in the terminal section through its centroid. The case when the cross-section is elliptical, and the beam exposed to equilibrating torsional couples over its ends is also treated. Results are obtained confirmatory of Saint-Venant's. They are also extended to the case of a composite cylinder, formed of shells of different materials whose cross-sections are bounded by concentric similar and similarly situated ellipses, the law of variation being the same for all the elastic constants of the solution. The limiting case of a continuously varying structure is deduced.

When a beam of circular section is exposed to torsion, it is proved that warping will ensue proportional to the moment of the twisting couple. Only two diameters in the cross-section, and these mutually at right angles, remain perpendicular to the axis of the beam.

Part II. treats of a material symmetrical round an axis, that of z, and having the perpendicular plane one of symmetry. A general solution of the internal equations of equilibrium is obtained, supposing no bodily forces to act. The solution involves arbitrary constants, and consists of a series of parts, each composed of a series of terms involving homogeneous products of the variables, such as $x^l y^m z^{n-l-m}$, where l, m, n are integers, and n is greater than 3. The terms involving powers of the variables, the sum of whose indices is less than 4, are then obtained by a more elementary process, and these alone are required in the applications which follow.

The first application of the solution is to "Saint-Venant's problem" for a beam of elliptical cross-section. The problem is worked out without introducing any assumptions, and a solution obtained, which is thus directly proved to be the only solution possible if powers of the variables above the third be neglected.

Part III. consists of an application of the second portion of the solution of Part II. to the case of a spheroid, oblate or prolate, and of any eccentricity, rotating with uniform angular velocity round its axis of symmetry, which is also the axis of symmetry of the material. The surface of the spheroid is supposed free of all forces.

The limiting form of the solution, when the polar axis of the spheroid is supposed to diminish indefinitely, is applied to the case of a thin circular disk rotating freely about a perpendicular to its plane through its centre. The solution so obtained is shown to satisfy all the conditions required for the circular disk, except that it brings in small tangential surface stresses. According to this solution the disk increases in radius, and diminishes everywhere in thickness, especially near the axis, so as to become biconcave. All, originally plane, sections parallel to the faces become very approximately paraboloids of revolution.

Again, by supposing the ratio of the polar to the equatorial diameter of the spheroid to become very great, a surface is obtained which differs very little from that of a right circular cylinder. The corresponding form of the solution obtained for the spheroid, when the ratio of the polar to the equatorial diameter becomes infinite, may thus be expected to apply very approximately to a long thin cylinder. This is verified directly, and it is shown that this solution is in all respects as approximately true as that universally accepted for Saint-Venant's problem. According to the solution the cylinder shortens, and every cross-section increases in radius but remains plane.

Part IV. treats of the longitudinal vibrations of a bar of uniform circular section and of material the same as in Part II. Assuming strains of the form—

$$\text{radial} = r\psi(r)\cos(pz - \alpha)\cos kt,$$
$$\text{longitudinal} = \phi(r)\sin(pz - \alpha)\cos kt,$$

$\phi(r)$ is found in terms of $\psi(r)$ by means of the equations established in Part II. From these equations is deduced a differential equation of the fourth order for $\psi(r)$, and for this a solution is obtained containing only positive integral even powers of r. A relation exists, determining all the constants of the solution in terms of the coefficients a_0 and a_2 of r^0 and r^2. In applying this solution to the problem mentioned, terms containing powers of r above the fourth are neglected, and it is shown to what extent the results obtained are approximate.

On the curved surface, the two conditions that the normal and tangential stresses must vanish lead to the following relation between k and p—

$$k = p\left(\frac{M}{\rho}\right)^{\frac{1}{2}}\{1 - \tfrac{1}{4}p^2a^2\sigma^2\}.$$

Here ρ denotes the density and a the radius of the beam, while M is Young's modulus, and σ the ratio of lateral contraction to longitudinal expansion for terminal traction. This agrees with a result obtained by Lord Rayleigh ("Theory of Sound," vol. i. § 157) on a special hypothesis.

Proceeding to the terminal conditions, it is shown how p is determined from the conditions at the ends. Since a_0 depends only on the amplitude of the vibrations, we are left with no arbitrary constant undetermined. If the bar be so "fixed" at its ends that the radial motion is unobstructed, this leads to no difficulty, but if an end be "free" a difficulty arises. At such an end the solution requires the existence of a radial stress $\propto (2i + 1)^3 r(a^2 - r^2)/l^3$, where i is an integer depending on the number of the harmonic of the fundamental note, and l denotes the length of the bar. There will thus be a difference in these cases between the results of experiment and those of the accepted theory, even as amended by Lord Rayleigh. This divergence will increase rapidly with the order of the harmonic, and, though very small for a long thin bar, will increase rapidly as the ratio of the diameter to the length is increased. Since, in dealing with the conditions at the curved surface, terms of the order $(a/l)^5$ were neglected, the same remarks apply, though to a smaller extent, in the case of the "fixed-fixed" vibrations.

May 31.—"Investigations on the Spectrum of Magnesium. No. II." By Profs. Liveing and Dewar.

Since our last communication on this subject, we have made many additional observations on the spectrum of magnesium under various circumstances, and have arrived at some new results. Speaking generally, we find that differences of temperature, such as we get in the flame of burning magnesium, in the arc, and in the spark, produce less differences in the spectrum than we had before attributed to them. For instance, the lines which previously we had observed only in the spark discharge, we have since found to be developed in the arc also, provided the discharge occur between electrodes of magnesium.[1] In making these experiments we used thick electrodes of magnesium, and brought them together inside a glass globe about 6 inches in diameter, fitted with a plate of quartz in front

[1] Compare the appearance of the lines of hydrogen in the arc discharge. Roy. Soc. Proc., vol. xxx. p. 157; and vol. xxxv p. 75.