Dr. William Ewart and Mr. Frederick Treves have been appointed Additional Examiners for the Third M. B. Examination, for which the number of candidates is unusually large.

Candidates for Lord Walsingham's Gold Medal in Biology and Physiology are requested to send in their essays to Prof. Newton by October 1, 1892.

An interesting report on the course of study pursued in Cambridge by the Local Lecture students during the Long Vacation, 1891, appears in the *Reporter* of December 8. Scientific courses on invertebrate palæontology, chemistry, physics, and physiology were given with success in the University Laboratories; while single lectures, with the object of inspiring interest in other departments, were given by Dr. Hill, Dr. D. MacAlister, and Prof. Darwin. Courses in general literature and art were also arranged, and the result of the whole is deemed by the Syndicate so satisfactory that they propose to regard the Long Vacation scheme as part of their regular work. Forty-seven students took advantage of the facilities offered by the University for acquiring a closer knowledge of the subjects they had commenced under the University Extension Lectures.

It is proposed that two new Syndicates shall be appointed—the first, to be called the Engineering Laboratory Syndicate, is to make arrangements for the further development of the Engineering School in the University, and in particular to endeavour to raise funds for its adequate endowment; the second is to consider the establishment of an Honours Examination in Mechanical Science.

SCIENTIFIC SERIALS.

THE *Quarterly Journal of Microscopical Science* for June 1891 contains:—On the renal organs of certain Decapod Crustacea, by W. F. R. Weldon (plates xxi. and xxii.). It would appear that the nephro-peritoneal sacs of the Decapoda should be regarded rather as enlarged portions of a tubular system, such as that found in Mysis and in the Thalassinidæ, than as persistent remnants of a "cœlomic" body-cavity, into which tubular nephridia open.—On the nephridium of Lumbricus and its blood-supply, with remarks on the nephridia in other Chætopoda, by Dr. W. Blaxland Benham (plates xxiii. to xxv.). In this memoir the author settles the nomenclature of the parts of the nephridium and the course of the various regions; details the structure of these regions in Lumbricus; institutes a comparison with the nephridium in other genera; describes the nephrostome or funnel in *Perichæta malamaniensis*, n.sp., and some other genera; and describes and figures the vascular supply of the nephridium in Lumbricus and in Arenicola.—Notes on the Naidiform Oligochæta, containing a description of new species of the genera Pristina and Pterostylarides, and remarks upon cephalization and gemmation as generic and specific characters in the group, by Dr. A. Gibbs Bourne (plates xxvi. and xxvii.).—On *Pelomyxa viridis*, sp.n., and on the vesicular nature of protoplasm, by Dr. A. Gibbs Bourne (plate xxviii.). This new species of Pelomyxa was found in the mud of a small tank in the neighbourhood of the Madras Presidency College; it would seem to be about the largest known species of the Lobosa, spread out specimens average one-third of an inch in diameter; the vesicles contained chlorophyll, and were numerous; the protoplasm was densely packed with bacteria, the "crystals" of Greef; the pseudopods were coarse and blunt; no reproductive processes were noted; nuclei and nucleoli were present in numbers.—On the medusæ of *Millepora murrayi*, and on the gonophores of Allopora and Distichopora, by Dr. Sydney J. Hickson (plates xxix. and xxx.). From specimens from Torres Straits, preserved by Prof. Haddon, the author has determined that the ampullæ described in the hard parts of this Millepora by Quelch are the cavities containing male medusæ. The medusa of Millepora is a transformed zooid—that is, it is not from the first modified to bear the spermarium, but it is an ordinary zooid of the colony changed into a medusa after the migration of spermospheres into its ectoderm, which are subsequently developed there; these medusæ escape from the ampullæ before the spermatozoa are matured. The male gonophores of Distichopora differ from those of Allopora, but the female gonophores of these genera closely resemble one another. The gonophores of the Hydrocorallinæ and Hydromedusæ are carefully compared; those of the former are not degenerate medusæ.—On a red pigment-forming organism, *Bacillus corallinus*, by C. Slater (plate xxxi.).

October 1891 contains:—On immunity against microbes, by Dr. Armand Ruffer, Part 2 (plates xxxxii. and xxxiii.). While the first part of this memoir treated of the struggle which takes place in the healthy body between micro-organisms and amœboid cells, this part details what happens where these organisms have found their way into the tissues of animals. It would be impossible to do justice to the contents of this valuable memoir by an abstract.—On the formation and fate of the primitive streak, with observations on the archenteron and germinal layers of *Rana temporaria*, by Dr. A. Robinson and R. Assheton (plates xxxiv. and xxxv.). The primitive streak is formed in the frog by concrescence of the lips of the blastopore from behind forwards; the ventral moiety of the primitive streak, shortly after the perforation of the anus, ceases to exist and splits up; the dorsal moiety becomes folded upon itself, like and along with the neural plate, and becomes separated from the skin; it gives rise to the whole of the tail with the exception of the greater part of the skin.—On some points in the histology and development of *Myriothela phrygia*, by W. B. Hardy (plates xxxvi. and xxxvii.).—On the structure of an earthworm allied to Nemertodrilus, Mich., with observations on the post-embryonic development of certain organs, by Frank E. Beddard (plates xxxviii. and xxxix.).—On some points in the development of *Scorpio fulvipes*, by M. Laurie (plate xl.). The development of this form adds another to the numerous types of development in the Arrachnida; it is, as shown by its mode of nutrition, a highly specialized form. There is no doubt that the type of development represented by Euscorpius is the more primitive of the two. The chief arguments in favour of this are the remarkable facts of the formation in *Scorpio fulvipes* of a rudimentary amnion, and the formation of yolk-spheres in the earlier stages, and a mass of yolk round which the gut is formed.—Abstract of Maupas's researches on multiplication and fertilization in Ciliate Infusorians, by Dr. Marcus M. Hartog.—On the occurrence of pseudopodia in the Diatomaceous genera Melosira and Cyclotella, by J. G. Grenfell (plate xli.). The author states that he has found pseudopodia in *Cyclotella kutzingiana*, and in one or two small species of Melosira. "At Heytesbury, in Wiltshire, the River Wiley and the brooks were found full of a Melosira in small isolated frustules, with long delicate pseudopodia; a good set of Cyclotellas with pseudopodia were found at Kew Gardens." In the large pond in the gardens of the Botanical Society of London, frustules of Melosira gathered with some specimens of *Archerina boltoni* were found with these pseudopodia; sometimes they were easily seen for a part of their length with a $\frac{1}{6}$ object-glass, but in some cases, as in the diatoms from Kew, "they are generally invisible, even when specially looked for." These pseudopodia are best seen on "well dried material," they are fairly stiff, and are non-retractile to ordinary observation. In length they vary, in Cyclotella from two and a half to six times the width of the valves; they are very permanent, in specimens kept in water they remained apparently unchanged for months; they are generally fairly straight, but sometimes they branch and sometimes two or three spring from a short thickened base. "As to the use of these pseudopods, and the question why other Diatoms do not have them, the chief point to be remembered is that these little Melosiras and Cyclotellas occur mainly as isolated frustules, and are without the power of locomotion. Under these circumstances the pseudopodia serve the purposes of protection, means of attachment, and floats." The author says: "facts point conclusively to the substance of these pseudopodia being protoplasm." It is quite probable that "some kind of cuticle is secreted by the protoplasm." As to the possibility of these growths not being pseudopodia at all, he combats the idea, and institutes a comparison between them and the radiating structures met with in Archerina (the reference to Prof. Ray Lankester's description of this very interesting form should be *Q. J. M. Sc.*, vol. xxv., 1885, p. 61), but it will be remembered that Prof. Ray Lankester refers to the "delicate but stiff filaments" in his description of Archerina, and only uses the term pseudopodia in a conventional sense. As yet we are not convinced by a perusal of Mr. Grenfell's paper that the Diatoms possess pseudopodia in any sense of this term, or that they have any affinities with the Heliozoa.—A very ably written review, signed by George Bidder, on "Dendy's Monograph on the Victorian Sponges, Part I.," which has just been published at Melbourne, concludes this part and volume xxxii. (N.S.) of the *Journal*. The first part of Dr. Dendy's monograph is devoted to the account of the Calcareous Sponges, a group on which Mr.

Bidder has himself been working at Naples for the last five years. His appreciatory remarks on Dendy's researches prove how much of interesting and new matter lies in manuscript in the laboratory at Naples, and leads us to express the hope that Mr. Bidder will soon follow the example of his senior, and give us a monograph of the Calcarea Homocœla of the Gulf of Naples; with more details on the glandular ectoderm.

Travaux de la Société des Naturalistes de St. Pétersbourg, Section de Zoologie et de Physiologie, tome xxi., livr. 1 (Russian).—On the influence of temperature, and the distance from the section of a nerve, on its electrical irritability, by B. F. Verigo.—Observations on the *Araneina*, by V. Wagner.—The minutes of proceedings contain several interesting notes: namely, a list of the Bryozoa of the Murman coast of Russia, by M. Khvorostansky, containing eighty-one species; on the blood of some invertebrates, by V. Wagner, from which it appears that it always contains two different kinds of cells—the granulous and coloured ones, and the amœboid ones or leucocytes, besides some other cells which, however, must be considered as derived from the above two kinds.—M. Shimkevitch's remarks on the artificial incubation of ostriches in the ostrich park at Heliopolis are also worth mentioning.

Bulletin de la Société des Naturalistes de Moscou, 1891, No. 1.—On the group of the sillimanite and the part played by aluminium in the silicates, by W. Wernadsky (in Russian, summed up in French). The paper contains, besides the description of the experiments already published in the *Comptes rendus*, a discussion of the facts, which brings the author to the following conclusions: the compounds of silicon with aluminium have an acid reaction; they may be embodied in one group, that of the sillimanite. Some of them are hydrates, and some others are salts of these, or of other possible anhydrides. Polymorphic varieties arise in this group with the change of physical conditions, without any perceptible change in the chemical composition.—On the morphology and classification of the Chlamydomonads, by Prof. Goroshankin (in German, with three coloured plates); being a full monograph on the family, in which the following new species are described: *Chlamydomonas De-Baryana*, *C. Perty*, *C. Steinii*, *C. Kuteinikowi*, *C. reticulata*, and *C. Ehrenbergii*.—On some peculiarities in the development and the structure of the skull of *Pelobates fuscus*, by A. N. Sewertzow.—Note on the *Hipparion crassum*, by Marie Pavloff (French).—On the fossil plant-bearing deposits of East Russia and Siberia, by C. Kosmovsky (in French). The close similarity between the supposed Jurassic fresh-water deposits of East Russia and Siberia and the "Artinsk" series is briefly indicated.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 19.—"On the Loci of Singular Points and Lines which occur in connection with the Theory of the Locus of Ultimate Intersections of a System of Surfaces." By M. J. M. Hill, M.A., Sc.D., Professor of Mathematics at University College, London. Communicated by Prof. Henrici, F.R.S.

Introduction.

In a paper "On the c- and p-Discriminants of Ordinary Integrable Differential Equations of the First Order," published in vol. xix. of the Proceedings of the London Mathematical Society, the factors which occur in the c-discriminant of an equation of the form $f(x, y, c) = 0$, where $f(x, y, c)$ is a rational integral function of x, y, c, are determined analytically.

It is shown[1] that if $E = 0$ be the equation of the envelope locus of the curves $f(x, y, c) = 0$; if $N = 0$ be the equation of their node locus; if $C = 0$ be the equation of their cusp locus, then the factors of the discriminant are E, N^2, C^3.

The object of this paper is to extend these results to surfaces.

PART I.—*The Equation of the System of Surfaces is a Rational Integral Function of the Co-ordinates and one Arbitrary Parameter.*

When there is only one arbitrary parameter, each surface of the system intersects the consecutive surface in a curve, whose equations are the equation of the surface and the equation obtained by differentiating it with regard to the parameter. (These equations will be called the fundamental equations in this part.) Hence each surface touches the envelope along a curve. It is known that the equation of the envelope may be obtained by eliminating the parameter from the fundamental equations and equating a factor of the result to zero. But it frequently happens that there are other factors of the result (or discriminant) which, when equated to zero, do not give the equation of the envelope.

These factors are connected with loci of singular points. If each surface have one singular point, the locus of all the singular points of the surfaces of the system is a curve. Its equations, therefore, cannot be found by equating a factor of the discriminant to zero. But if each surface of the system have upon it a nodal line, then the locus of the nodal lines of all the surfaces is a surface, and its equation may be found by equating to zero a factor of the discriminant.

The singular points in space, the form of which depends only on the terms of the second order, when the origin of co-ordinates is taken at the singular point, are:—

(i.) The conic node.
(ii.) The biplanar node or binode.
(iii.) The uniplanar node or unode.

It is shown that a surface cannot have upon it a curve at every point of which there is a conic node. Hence there are two varieties of nodal lines to be considered; the first, being such that every point is a binode, may be called a binodal line; and the second, being such that every point on it is a unode, may be called a unodal line.

It is shown that if $E = 0$ be the equation of the envelope locus, $B = 0$ the equation of the locus of binodal lines, $U = 0$ the equation of the locus of unodal lines, then the factors of the discriminant are, in general, E, B^2, U^3, respectively.

This is the general theorem, but it is assumed in the course of the investigation, when the discriminant is being formed, that the fundamental equations are satisfied by only one value of the parameter at each point on the envelope locus or on a locus of binodal or unodal lines.

The investigation is accordingly carried a step further, and it is shown that if the fundamental equations are satisfied by two equal values of the parameter at points on an envelope locus, or on a locus of binodal or unodal lines, the factors of the discriminant are E^2, B^3, U^4, respectively.

The geometrical meaning of the condition that the fundamental equations are satisfied by two equal values of the parameter in the case of the envelope is that the line of contact of the envelope with each surface of the system counts three times over as a curve of intersection, instead of twice as in the ordinary case. The meaning of the condition in the case of the loci of singular lines is that each of these loci is also an envelope.

PART II.—*The Equation of the System of Surfaces is a Rational Integral Function of the Co-ordinates and two Arbitrary Parameters.*

When there are two arbitrary parameters in the equation of the system of surfaces, the equation of the locus of ultimate intersections is found by eliminating the parameters between this equation and the two equations obtained by differentiating it with regard to the parameters. (These equations will in this part of the investigation be called the fundamental equations.)

In general the locus of ultimate intersections is a surface. The exceptional cases in which it is not a surface are enumerated at the end of the paper. These include the case where the equation of the system of surfaces is of the first degree in the parameters. Hence it will be supposed that the degree of the equation of the system of surfaces in the parameters is above the first.

In general, the locus of ultimate intersections possesses the envelope property, and the equation of the envelope is determined by equating the discriminant, or a factor of it, to zero.

If factors of the discriminant exist which, when equated to zero, give surfaces not possessing the envelope property, then these surfaces are connected with loci of singular points.

Now the locus of singular points of a system of surfaces whose equation contains two arbitrary parameters is in general a curve. Hence its equations cannot be determined by equating to zero a factor of the discriminant.

But if every surface of the system have a singular point, then *in general* its co-ordinates may be expressed as functions of the two parameters of the surface to which it belongs. Hence the locus of the singular points is a surface. It will be proved that it is a part of the locus of ultimate intersections. Hence its

[1] The theorem was originally given by Prof. Cayley, in the *Messenger of Mathematics*, vol. ii., 1872, pp. 6–12.