umbrageous habit and wide-spreading branches it is extremely valuable as a shade tree. The wood is soft and of little value except as firewood, and the pod is sweet, like that of the carob (*Ceratonia siliqua*), and may probably prove valuable as a food for cattle, for which purpose, indeed, these pods are used in the West Indies. For this reason, and not for that of gathering and dispersing moisture (for which the tree became momentarily celebrated), it is probable the tree may be generally planted.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. Theodore Beck; a Black-crested Cardinal (*Gubernatrix cristatella*), two Red-crested Cardinals (*Paroaria cucullata*) from South America, purchased; a Macaque Monkey (*Macacus cynomolgus*) from India, deposited; a Baker's Antelope (*Hippotragus bakeri*) from Nubia, received in exchange.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE proposals of the Cambridge Mathematical Studies Syndicate for completing the new scheme for the mathematical tripos have been carried. The following summary of the whole scheme of the mathematical tripos which will come into operation in the year 1882 is given in the *Times*. It will consist of three parts, the examination for each part occupying three days. The subjects of the first part are to be confined to the more elementary parts of pure mathematics and natural philosophy, the subjects to be treated without the use of the differential calculus and the methods of analytical geometry. The examination in Part II. will only be open to those who have passed Part I. so as to deserve mathematical honours, and the subjects are algebra, trigonometry, plane and spherical, theory of equations, the easier parts of analytical geometry, plane and solid, including curvature of curves and surfaces, differential and integral calculus, easier parts of differential equations, statics, including elementary propositions on attractions and potentials; hydrostatics, dynamics of a particle, easier parts of rigid dynamics, easier parts of optics and spherical astronomy. Those who pass this second part will be arranged as wranglers, senior optimes, and junior optimes in order of merit. Both the examinations in Parts I. and II. will take place in June. The examination in Part III. will be held in January, and be open only to those who are classed as wranglers. It will last three days. On the tenth day after the end of the examination in Part III. the moderators and examiners, taking into account the examination in that part only, shall publish in three divisions, each division arranged alphabetically, those examined and approved. The moderators and examiners may place in the first division any candidate who has shown eminent proficiency in any one group of the subjects in Schedule III.

THE *University College of Wales Magazine*, the first number of which lies before us, is a neat little publication of fifty-two pages, doing credit to the Oswestry press from which it issues, as well as to the enterprise of the Aberystwith Institution, and the ability of its members. We do not suppose its promoters expect a large general circulation, though there is no reason why the magazine might not be so conducted as to meet with considerable favour in the principality. Curiously enough, the first paper after the introduction is on Persian literature, while one on Welsh literature occupies the sixth place. There is a paper on Cambria at Paris, showing what a good appearance she made at the recent exhibition; a Welsh story, an Oxford letter, college news, &c. We wish the magazine success; and it might do good service by devoting itself to research in various directions in regard to Wales. We should like to see the science professors in this college fill up some of its pages.

THE First Annual Report of the Dulwich College Science Society is, on the whole, satisfactory; the appended lists, forming the bulk of the volume, show that the Society has several diligent collectors, and we hope it will continue to do genuine work and nourish in the scho l a lasting love of real science.

PROF. H. G. SEELEY completed on Friday at the College for Men and Women, 29, Queen Square, Bloomsbury, a course of six lectures on some of the principal forms of extinct animals which resemble reptiles and birds, and have no representatives now living. The subjects have been as follows:—Lecture I.—On the Geological Distribution of Fossil Reptiles and Birds; and concerning points in which Extinct Reptiles differ from those which now inhabit the Earth. Lecture II.—The Ichthyosaurians and Animals of the Open Ocean. Lecture III.—The Plesiosaurians and Animals of the Sea Shore. Lecture IV.—The Dinosaurians and Allied Types of Land Animals. Lecture V.—The Ornithosaurians and other Flying Types of Life. Lecture VI.—The Classification of Reptiles and Allied Fossil Animals, as illustrating some Aspects of the Doctrine of Evolution.

PROF. WURTZ was charged some time since by the French Minister of Public Instruction, to make an inquiry into the organisation of the laboratories and practical instruction given in the several universities of Germany and Austro-Hungary. Prof. Wurtz accordingly made several journeys to the great seats of learning in these two countries, and the *Journal Officiel* of last Saturday publishes at full length his report. Prof. Wurtz insists strongly on the danger of creating large establishments, where students are taught something of everything, and on the necessity of creating special foci for every large section of experimental science. He shows the advantage of special institutes, and insists upon the organisation of chemical, physical, physiological, anatomical, and pathological institutions such as flourish on the other side of the Rhine, and may be established in Alsace-Lorraine. He ends his report by describing the Munich Hygienic Institute.

THE French budget of Public Instruction has been voted *au pas acceleré*. The resolutions proposed by the Commission were voted without any material alterations. The estimates reach about 2,000,000*l*.

The University of Bern celebrated, on November 15, the forty-fourth anniversary of its foundation. It numbers among its students, about twenty ladies, mostly Russians, who study medicine.

ACCORDING to a new law, all children who finish their education in any school of the Canton of Bern are submitted to an examination. This year 4,610 boys and 4,446 girls were examined (total population of the Canton 537,000), and the results proved unsatisfactory. The Canton continues to occupy the eighteenth and twenty-first places in the Cantons of the Swiss confederation.

A WEALTHY Serbian, Ilija Milosavljewitch Kolaraz, who died a month ago at the ripe age of eighty-two, has left the sum of 100,000 ducats for educational purposes, 10,000 ducats for the publishing of valuable works in the Serbian language, and 60,000 ducats for the foundation of a Serbian university at Belgrade, which is to be known as Kolaraz' University.

SCIENTIFIC SERIALS

Journal of Anatomy and Physiology, July, 1878.—Dr. Ogston, of Aberdeen, gives an account of the growth and maintenance of the articular ends of adult bones. He believes that the articular cartilage produces the osseous tissue beneath it, forms the epiphyses, supplies their waste, and maintains them in their proper size and bulk during adult life.—Prof. Cleland describes the brain in cyclopians or one-eyed monsters, including specimens of human kind, dogs, lambs, and pigs. He finds that there is no trace of a retina in the cyclopian eyeball, and that moreover there is an arrest of the development of the first cerebral vesicle.—Dr. Creighton gives an exhaustive account of the formation of the placenta in the guinea-pig, and refers very prominently to its early development in connection with the structure of the ovaries and supra-renal bodies.—Prof. Turner contributes notes on the fœtal membranes of the reindeer, and on the oviducts of the Greenland shark.—Mr. David Newman's paper on the functions of the kidney gives an account of the physical influences which promote secretion, so far as can be demonstrated by experiments with animal membranes and the kidneys of animals recently killed.—Dr. Dodds' historical and critical analysis of our knowledge upon the localisation of the functions of the brain deals with the anatomy of the brain in this number.

October.—Dr. Cunningham, of Edinburgh, gives his deductions on the intrinsic muscles of the mammalian foot, derived from a large number of dissections; and further describes the muscles of the foot of cuscus and thylacine.—Prof. Miall and Mr. Greenwood conclude their valuable memoir on the anatomy of the Indian elephant, dealing with the alimentary canal and

its appendages, and the other abdominal and thoracic viscera. —Dr. Creighton publishes his observations on the supra-renal bodies based on microscopical investigations of these organs when adult and during development, and shows how they present many features of analogy to the ovaries.—Prof. Humphry gives his reasons for dissent from Dr. Ogston's views on the important share taken by articular cartilage in the growth of bone, as expressed in the July number of the *Journal*.—Prof. Turner describes the placentation of the hog-deer (*Cervus porcinus*).—Dr. Urban Pritchard supplements his previous accounts of the development of the organ of Corti in the internal ear.—Dr. T. B. Henderson, of Glasgow, describes the physiological effects of the inhalation of phosphuretted hydrogen.

Journal de Physique, October.—In this number Prof. Dufet studies the variation of the indices of refraction in mixtures of isomorphous salts, arriving at the experimental law that the differences between the indices of a mixture of two such salts and those of the component salts are in inverse ratio of the numbers of equivalents of the two salts forming the mixture; in other terms the curve which has for ordinates the indices and for abscissæ the equivalents, is a straight line. This law is regarded as a consequence of Gladstone's, on the constancy of specific *refractive energy* in mixtures.—M. Terquem describes an improved way of realising Plateau's liquid laminar systems, giving larger systems with less liquid. Instead of using pieces all rigid, he uses a combination of rigid pieces with flexible threads (silk), *e.g.*, two horizontal rods joined together at the ends with such threads or two rings joined with threads. Many instructive effects are thus had. The liquid used is a solution of soap and sugar, prepared in a special way.—M. Bouty contributes a mathematical paper on the number of elements necessary for determining the exterior effect of an optical system, and M. Bichat gives a new method of measuring the velocity of sound.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 21.—"On Repulsion resulting from Radiation." Part VI., by William Crookes, F.R.S., V.P.C.S.

In this part, with which the research closes, the author first examines the action of thin mica screens fixed on the fly of an ordinary radiometer, in modifying the movements. It is found that when a disk of thin clear mica is attached 1 millim. in front of the blacked side of the vanes of an ordinary radiometer, the fly moves negatively, the black side approaching instead of retreating from the light. When a thin mica disk is fixed on each side of the vanes of a radiometer, the result is an almost total loss of sensitiveness.

In order to examine the action of screens still further an instrument is described having the screens movable, and working on a pivot independent of the one carrying the fly, so that the screens can move freely and come close either to the black or to the white surfaces of the disks. By gentle tapping the screens can be brought within 2 millims. of the black surfaces. A candle is now brought near, shaded so that the light has to pass through one of the clear disks and fall on the black surface. The black side immediately retreats, the clear disk remaining stationary for a moment, and then approaching the light. If the candle is allowed to shine on the plain side of the black disk, no immediate movement takes place. Very soon, however, both disks move in the same direction away from the candle, the speed of the clear disk gradually increasing over that of the blacked disk.

Instead of allowing the clear screens to freely move on a pivot, an instrument was made in which the screens could be fixed beforehand in any desired position in respect to the blacked disk. It was then found that with the screens close to the blacked sides of the vanes the fly rotates very slowly in the negative direction, stopping altogether when the candle is moved five or six inches off. With the screens 1 millim. from the black surface the direction is negative, and the speed at its maximum. When the screens and disks are 7 millims. apart a position of neutrality is attained, no movement taking place. When the distance is further increased, positive rotation commences, which gets stronger as the screens approach the bright sides of the disks, where the positive rotation is at its maximum. The author adduces reasons for considering that the negative rotations here observed are caused by the warming up of the black surface by radiation falling direct on it, through the clear mica screen, and the deflection backwards of the lines of molecular pressure thereby generated.

The action of these radiometers being complicated, owing to the surfaces of the vanes being different in absorptive power, another instrument was made in which the vanes were of polished aluminium, perfectly flat and symmetrical with the bulb. The screens were of clear mica movable in respect to the vanes, and at right angles to their surface. When exposed to the light of a candle it was found that with the screens brought up close to the disks, the rotation was as if the unscreened side were repelled; at an intermediate position there was neutrality. Explanations are given of these movements, but without the illustrative cuts they would be unintelligible.

Experiments on radiometers having movable screens interposed between the vanes and the bulb are next given, and these are followed by a long series of experiments on the influence of movable screens on radiometers with cup-shaped metallic vanes, the screens being varied in shape and position in respect to the plane of rotation, as well as in respect to the distance from the vanes.

A similar series is given with metallic cylinders as vanes, and from the behaviour of the latter kind of radiometer an explanation is given of the various movements previously obtained. It is found that when the screen touches the convex surface of the vanes the rotation under the influence of light is always positive. It commences at a low exhaustion, increases in speed till the rarefaction is so high that an ordinary radiometer would begin to lose sensitiveness, and afterwards remains at about the same speed up to the highest rarefaction yet obtained. At any rarefaction after 87 M (millionths of an atmosphere) there is a neutral position for the screen. When it is on the concave side of this neutral position the direction of rotation is positive, and when on the convex side of the neutral position it is negative; the speed of rotation is greater as the vanes are further removed from this neutral position on either side. The position of this neutral point varies with the degree of exhaustion; thus at 12 M the screens must be 3 millims. from the convex side; at ·18 M they must be 13 millims. from the convex side. The higher the exhaustion the greater the distance which must separate the convex side of the hemi-cylinders and the screens.

The author gives explanations of these phenomena based on the following already ascertained facts:—When thin aluminium vanes are exposed to light the metal rises in temperature and becomes equally warm throughout, and a layer of molecular pressure is generated on its surface. The thickness of this layer of pressure, or the length of the lines of force of repulsion varies with the degree of exhaustion, being longer as the exhaustion increases. The lines of force appear to radiate from the metal in a direction normal to its surface. The force of repulsion is also greater the closer the repelled body is to the generating or driving surface, and the force diminishes rapidly as the distance increases, according to a law which does not appear to be that of "inverse squares." Diagrams are given illustrating the author's explanation based on the above data.

An apparatus is next described not differing in principle from the last, but having, in addition to the aluminium hemi-cylinder and movable mica screen, a small rotating fly made of clear mica, mounted in such a way that it could be fixed by means of an exterior magnet in any desired position inside the bulb. The screen was also capable of adjustment by means of another magnet; the aluminium hemi-cylinder in this apparatus being fixed immovably. The adjustible indicator being very small in diameter in comparison to the other parts of the apparatus, and, being easily placed in any part of the bulb, was expected to afford information as to the intensity and direction of the lines of pressure when a candle was brought near the bulb. Experiments have been tried, *a*, with the screen in different positions in respect to the hemi-cylinder; *b*, with the indicator in different parts of the bulb; *c*, with the candle at different distances from the hemi-cylinder on one side or the other; *d*, with the degree of exhaustion varying between wide limits. It would be impossible to give an intelligible abstract of the results obtained with this apparatus without numerous diagrams It may, however, be briefly stated that they entirely corroborate the theories formed from a study of the behaviour of the instruments previously described.

The next part of the paper treats of the action of heat employed inside the radiometer. In a previous paper the author