papers on questions of greater difficulty or of wider range than the average of those now set. The other papers of this part are, however, to be made easier than the present average. The board hopes to include a paper on chemistry in the future. It is also considered to be desirable that the examiners should be empowered to take into consideration the laboratory and drawing-office work done by the student during his course; but perhaps the most important of the recommendations is that every candidate for the mechanical sciences tripos, unless he has obtained honours in one of the honours examinations of the University, must pass a qualifying examination in elementary mathematics and mechanics, which will be held twice a year.

The special board for biology and geology has renominated Mr. F. A. Potts, of Trinity Hall, to use the University table at Naples for four months from April 1. Applications for the use of this table and for that at the Marine Biological Association's laboratory at Plymouth should be sent in to the chairman of the special board (Prof. Langley) on or before May 24.

Dr. Haddon is giving a special course of lectures on magic and savage religion on Mondays during this term.

PROF. FRIEDRICH CZAPEK, of the Prague Technical High School, has been appointed professor of botany in Czernowitz University. Prof. Armin Tschermak, of the University of Halle, has been appointed professor of physiology and medical physics in the Veterinary High School, Vienna.

IT is announced by *Science* that Adelbert College, Western Reserve University, has received 30,000*l.* from the grandchildren of Mr. Joseph Perkins, formerly a trustee of the college. The money is to be used for a department of sociology and a chemical laboratory.

ON Commemoration Day at Glasgow University on April 18 the honorary degree of Doctor of Laws was conferred upon Mr. James S. Dixon, founder of the lectureship of mining in the University, and Mr. R. E. Froude, superintendent of the Admiralty experimental works at Haslar.

ALTHOUGH we are far behind other nations in governmental recognition of the claims of anthropology, the universities, the older ones leading the way, are following their Continental sisters in making it a subject of systematic study by providing courses of instruction and establishing diplomas and other distinctions. The Oxford committee for anthropology has just issued the regulations for the diploma and the list of lectures for the next two terms. It is pointed out by the committee that not only members of the university, especially those whose work will bring them in contact with native tribes, will benefit from the newly-established course of study, but also those already in contact with native races who feel the need of extending their anthropological knowledge during their "long leave." The schedule of lectures shows that although no provision can yet be made for systematic instruction covering the whole of the very wide field in even a summary manner, students who present themselves are sure of finding helpful and stimulating teaching in all the more important branches of the subject: the chief omission at present is the failure to include social organisation, usually a crux for missionaries and the untrained generally, among subjects on which aid may be sought. The secretary of the committee is Mr. J. L. Myres, Christ Church, from whom all information may be obtained.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 1.—"A Further Communication on the Specificity and Action *in vitro* of Gastrotoxin." By Dr. Charles **Bolton.**

An analysis in the test-tube of the gastric cytotoxin obtained by injecting the rabbit with guinea-pig's stomach cells has shown that it is a complex body. After a single injection there is a great increase in the hæmolysin normally occurring in the rabbit's blood, and after further injections an artificial hæmolysin makes its appearance. The artificial hæmolysin is distinguished from the natural hæmolysin, because the former can be complemented by guinea-pig's normal blood serum, whereas the latter cannot.

There is also present in the immune serum a substance which agglutinates the red blood corpuscles. Closely associated with the appearance of this artificial hæmolytic immune body is that of an agglutinin which acts upon the gastric granules, and also that of a precipitin which acts upon the soluble proteids of the gastric cells. By repeating the injections these substances are found to be present in the blood for several months. Whether they are one and the same or distinct bodies has not yet been proved. After several injections, and not less than about five weeks from the first, a further substance appears in the blood, which possesses an action upon the intact gastric cells. In spite of repeated injections this substance disappears from the blood in about four months. It is probably of the same nature as a hæmolysin, but this point requires proof.

The hæmolytic factor is only active against blood. The actions of the agglutinin and precipitin are not confined to the constituents of the gastric cells, but extend to other proteids of the body. Whether there are separate agglutinins and precipitins for different proteids, or whether the same substances act upon all proteids, has not been determined; at all events, if the same bodies are concerned in all cases, their action upon the proteids of the stomach cells is probably greater than that upon other proteids. Whether the gastrolysin itself is truly specific remains to be proved.

The few experiments that have been undertaken in the case of the human stomach indicate that the human gastric cytotoxin is identical in constitution with that of the lower animals.

February 8.—"Explosions of Coal-gas and Air." By Prof. Bertram **Hopkinson.**

The explosion of homogeneous mixtures of coal-gas and air at atmospheric pressure and temperature is investigated by means of platinum resistance thermometers placed at various points in the explosion vessel. The vessel is of dumpy cylindrical form and 6·2 cubic feet capacity, and the mixture is fired by an electric spark at the centre. Each thermometer consists of a loop of bare platinum wire about 5 centimetres long and 1/1000th inch diameter, which is placed in series with a battery of constant potential and a reflecting galvanometer, of short periodic time, the deflection of which is recorded photographically on a revolving drum. On the same drum the pressure of the gas is recorded. The arrival of the flame at any wire is marked by a sharp rise in its resistance, and the rate of rise, when corrected for the time lag of the wire, gives a measure of the velocity with which the gases about it combine. It is found that with a mixture consisting of one volume of gas and nine of air the flame spreads from the spark in a somewhat irregular manner, but at a rate of roughly 150 centimetres per second. A thermometer placed near the spark shows a sudden rise of temperature to about 1200° C., after which the temperature remains nearly constant until the flame approaches the walls of the vessel. With the rapid rise of pressure which then occurs the adiabatic compression of the burned gas at the centre causes the temperature there to rise to about 1900° C., with the result that the wire of the thermometer generally melts. At a point near the walls the gas is compressed to near the maximum pressure before ignition, and the temperature consequently rises suddenly to 1200° C. or 1300° C., and as there is little subsequent compression there is not much further rise of temperature. Thus, in consequence of the different treatment of the gas at different points in the vessel, differences of temperature of 500° C. exist in the gas at maximum pressure after an explosion of this kind. That such differences must necessarily exist after an explosion even in a vessel impervious to heat does not appear to have been noticed hitherto. These differences are rapidly obliterated by convection currents, but their magnitude at the moment of maximum pressure is such as to make it impossible to obtain an accurate estimate of the specific heat from the pressure record after the manner of Messrs. Mallard and Le Chatelier. The work of these experimenters is not, however, open to the chief objection that has hitherto been urged against it, viz. that combustion was incomplete when they measured the specific heat. The experiments here described show that the combustion at any point is prac-

tically finished 1/40th of a second after it begins, and that 1/30th of a second after the attainment of maximum pressure the gas in the vessel may be regarded as a mixture of CO_2, steam, and inert gases in chemical equilibrium.

The pressure of the ignited gas at the centre of the vessel is increased during the spread of the flame from one atmosphere to six. During this time it loses no heat, and the rise of temperature observed is from 1200° C. to 1900° C. It follows that between these limits of temperature the average value of γ for these gases is 1·25.

With a weaker mixture containing one volume of gas and twelve of air the spread of the flame is very much slower, about 2½ seconds elapsing before all the gas is burned. Owing to the slow propagation of the flame, convection currents play an important part during the process of ignition; the burned gases rise to the top of the vessel, and the last portion of gas to be ignited is not close to the wall, but immediately under the spark, and a short distance from it; but though the flame is propagated very slowly, the combustion of any given portion of gas, when once started, proceeds almost as rapidly as in the stronger mixture. There is no "after-burning" in the sense of the slow completion of a reaction already begun. Within 1/10th of a second before the time of maximum pressure some gas is still unburnt; within 1/10th of a second after all the gas is completely burned, and the mixture everywhere in chemical equilibrium.

Incidentally, the difference of temperature between a fine wire immersed in the gas and the temperature of the gas is determined by comparing the temperatures of two wires, one having double the diameter of the other, placed close together in the same explosion. The error due to radiation is thus found, and it is shown that if a wire 1/500th of an inch in diameter is getting hotter at the rate of 1300° C. per second, then it must be 200° C. colder than the gas surrounding it. The results are used to find the actual temperature of the gas from that of a wire 1/1000th of an inch diameter immersed in it, and the conclusion is drawn that the temperatures in a gas-engine cylinder cannot be obtained by the use of a wire thicker than this, except by applying corrections amounting to several hundred degrees centigrade.

The bearing of the results on the question of "after-burning" in the gas engine is discussed, and it is shown that the high specific heat of the products of combustion, together with some loss of heat during the passage of the flame through the compression space, accounts for all the peculiarities of the gas-engine diagram. The form of diagram obtained with weak mixtures is due simply to the very slow propagation of the flame, and not to any delay in the attainment of chemical equilibrium at a point which the flame has already reached.

March 15.—"A Discussion of Atmospheric Electric Potential Results at Kew, from selected Days during the Seven Years 1898 to 1904." By Dr. C. **Chree**, F.R.S.

The paper contains an analysis of atmospheric electricity results at Kew on selected fine-weather days—usually ten a month—from 1898 to 1904.

All days were excluded when rain fell or negative potential was recorded. All data are given in absolute measure (volts per metre). The diurnal inequalities for individual months and the year are represented by curves. These all show two distinct daily maxima and minima. The minima always occur near 4 a.m. and 2 p.m. The times of the maxima are more variable, the day interval between the two being longer in summer than in winter.

The highest mean potential gradient occurs in December. Whilst the amplitude of diurnal inequality is greatest in mid-winter, the ratio in which it stands to the mean daily value is then least. The diurnal inequalities for the several months are analysed in 4-wave Fourier series. The 12-hour term is, in general, the most important; the changes in its amplitude and phase angle throughout the year are comparatively small. The 24-hour term is much larger in the winter than in the summer months, and its phase angle varies greatly. Attention is also given to the phenomena of individual days. The difference between the highest and lowest hourly values averages two and a half times the amplitude of the regular diurnal inequality, and is fully larger than the mean value for the day.

Of various meteorological elements temperature is found to have much the most marked influence, high mean potential and large diurnal range of potential being associated with low temperature in every month of the year, except the hottest (July).

An appendix compares the diurnal inequalities of potential and barometric pressure. Diurnal inequalities were got out for each month of the year for the barometric pressure at Kew for an 11-year period. The similarity between the diurnal inequalities of the two elements is found to be confined to the 12-hour terms; the 24-hour terms present diametrically opposed phenomena in the two cases. The afternoon minimum and evening maximum of potential are in every month notably in advance of those of barometric pressure. If any relationship of cause and effect exists between the *regular* diurnal changes in the two elements, the pressure change would seem to be the effect, the potential change the cause.

Geological Society, April 4.—Mr. R. S. Herries, vice-president, in the chair.—A case of unconformity and thrust in the Coal-measures of Northumberland: Prof. G. A. L. **Lebour** and Dr. J. A. **Smythe.** The sections described occur on the coast north of the Tyne, near Whitley Sands, between Table Rocks and Briar-Dene Burn. The base of the "Table-Rocks Sandstone" is found to rest unconformably upon a series of alternating shales and sandstones, among which is a well-marked band of clay-ironstone crowded with *Carbonicola acuta*, one of those "mussel-bands" which are found to be perhaps the most remarkably persistent strata in the north of England Carboniferous rocks.—The Carboniferous succession below the Coal-measures in North Shropshire, Denbighshire, and Flintshire: Dr. Wheelton **Hind** and J. T. **Stobbs.** This paper opens with a critical account of previous research among the Carboniferous rocks of North Wales. Then follows a detailed account of the various beds, exposed in numerous quarries worked for road-metal, iron manufacture, lime, cement, chert, or building-stone. Fossil lists are given from each exposure of importance. A range table is given of the chief brachiopods and corals, and the palæontological sequence is compared with that occurring at Bristol and in the north of England.

Chemical Society, April 5.—Prof. R. Meldola, F.R.S., president, in the chair.—An improved apparatus for measuring magnetic rotations and obtaining a powerful sodium light: W. H. **Perkin,** sen. The improved apparatus consists of a short but very powerful coil carrying a powerful electric current. The coil is cased with steel, and has a 3-inch gun-metal tube through the centre, the interior of this being the position of the magnetic field. The glass measuring tubes are supported in this tube in a metal trough which can be kept at any required temperature. A method of obtaining a powerful sodium light was described, which consists in heating a platinum boat containing sodium chloride by a small oxygen-coal gas flame. This causes the sodium chloride to volatilise, and the vapour, passing into a flame produced by a large Bunsen burner, gives a very intense, yellow light, which can be maintained for a long time.—The rusting of iron: G. T. **Moody.** The explanation of rusting as a process involving the production of hydrogen peroxide, as advanced by Dunstan, is directly negatived by experimental evidence, which shows that atmospheric corrosion results first from the interaction of iron and carbonic acid, whereby ferrous salt is formed, and subsequently from the more or less complete oxidation of ferrous salt by oxygen. It is found, moreover, that the composition of iron rust is not fairly represented by the formula $Fe_2O_2(OH)_2$, as stated by the foregoing investigator.—The estimation of carbon in soils: A. D. **Hall,** N. H. J. **Miller,** and N. **Marmu.** The soil is treated with chromic acid, and the resulting gases passed over a short length of copper oxide. The carbon dioxide formed is absorbed by alkali and estimated by double titration.—Electrolysis of salts of $\beta\beta'$-dimethylglutaric acid: J. **Walker** and J. K. **Wood.**—Bromo- and hydroxy-derivatives of $\beta\beta\beta'\beta'$-tetramethylsuberic acid: J. K. **Wood.**—Some new *o*-xylene derivatives: G. **Stallard.**—A new solvent for gold, preliminary note: J. **Moir.** The author finds that gold-leaf dissolves fairly readily when floated on an acid solution of ordinary thiocarbamide, and solution

is accelerated by the presence of an oxidising agent. The gold compound produced forms brilliant, colourless, six-sided lozenges, and contains 45·4 per cent. of gold.—The molecular condition in solution of ferrous oxalate, a correction: S. E. **Sheppard** and C. E. K. **Mees.**—Acetyl and benzoyl derivatives of phthalimide and phthalamic acid: A. W. **Titherley** and W. L. **Hicks.**—The dynamic isomerism of phloroglucinol: E. P. **Hedley.** The following conclusions were established:—(1) that in neutral solutions phloroglucinol exists in both modifications, the enol being greatly in preponderance over the keto-form; and (2) that this equilibrium is undisturbed by the class of solvent.—Studies in asymmetric synthesis, v., asymmetric syntheses from *l*-bornyl pyruvate: A. **McKenzie** and H. **Wren.**—*l*-Methyl*cyclo*hexylidene-(4)-acetic acid: W. H. **Perkin,** jun., and W. J. **Pope.**—Condensation of benzophenone chloride with α- and β-naphthols: G. W. **Clough.**—The constitution of coerulignone (cediret), a preliminary note: J. **Moir.**—A comparative crystallographic study of the perchlorates and permanganates of the alkalis and the ammonium radical: T. V. **Barker.** On comparing the perchlorates with the permanganates, it is found that the effect of replacing an atom of chlorine by one of manganese is much the same as that induced by the substitution of sulphur by selenium, say, in the sulphates of the same metals. The crystallographic evidence for placing manganese in the seventh group of the periodic classification, so far as such evidence goes, is therefore of the strongest possible kind.—Contribution to the theory of isomorphism based on experiments on the regular growths of crystals of one substance upon those of another: T. V. **Barker.**—Constitution of salicin. Synthesis of pentamethylsalicin: J. C. **Irvine** and R. E. **Rose.** It is shown that salicin (and hence also helicin and populin) contains the same γ-oxidic linking as the methylglucosides and sucrose.—A product of the action of *iso*amyl nitrite on pyrogallol: A. G. **Perkin** and A. B. **Steven.** The main bulk of the product formed in this reaction has the composition $C_6H_4O_3$, and it appears likely that it may consist of hydroxy-*o*-benzoquinone.—A reaction of ellagic and flavellagic acids: A. G. **Perkin.** Ellagic acid is oxidised by sulphuric acid to a compound having the formula $C_{14}H_{16}O_{10}$. Flavellagic acid yields a similar oxidation product.—Some thio- and dithio-carbamide derivatives of ethyleneaniline and the ethylenetoluidines: O. C. M. **Davis.**

DIARY OF SOCIETIES.

THURSDAY, APRIL 26.

ROYAL INSTITUTION, at 5.—The Digestive Tract in Birds and Mammals: Dr. P. Chalmers Mitchell.

SOCIETY OF ARTS, at 4.30.—Seistan, Past and Present: Colonel A. H. McMahon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Long Flame Arc Lamps: L. Andrews.

MATHEMATICAL SOCIETY, at 5.30.—Perpetuants and Contraperpetuants: Prof. E. B. Elliott.—(1) A Question in the Theory of Aggregates; (2) The Canonical Forms of the Ternary Sextic and Quaternary Quartic: Prof. A. C. Dixon.—On the Question of the Existence of Transfinite Numbers: P. E. B. Jourdain.—Some Theorems connected with Abel's Theorem on the Continuity of Power Series: G. H. Hardy.—On a Set of Intervals about the Rational Numbers: A. R. Richardson.—On Two Cubics in Triangular Relation: Prof. F. Morley.—On the Accuracy of Interpolation by Finite Differences: W. F. Sheppard.

FRIDAY, APRIL 27.

ROYAL INSTITUTION, at 9.—Ore Deposits and their Distribution in Depth: Prof. J. W. Gregory, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Petroleum Fuel in Locomotives on the Tehuantepec National Railroad of Mexico: Louis Greaven.

PHYSICAL SOCIETY, at 5.

AËRONAUTICAL SOCIETY, at 8.—The Use of the Balloon in the National Antarctic Expedition: Captain Robert Falcon Scott, R.N.—The Experiments of the Brothers Wright: Sir Hiram S. Maxim.—The Carrying Power of Aëroplanes: M. José Weiss.

MONDAY, APRIL 30.

INSTITUTE OF ACTUARIES, at 5.—Reversionary Securities as Investments: C. R. V. Coutts.

TUESDAY, MAY 1.

SOCIETY OF ARTS, at 4.30.—Social Conditions in Australia: Hon. J. G. Jenkins, Agent-General for South Australia.

ZOOLOGICAL SOCIETY, at 8.30.—Additional Notes on Anthropoid Apes, with Exhibition of Specimens: Hon. Walter Rothschild.—On Mammals collected in South-west Australia by Mr. W. E. Balston: Oldfield Thomas, F.R.S.—On the Lepidoptera collected during the Recent Expedition to Tibet: H. J. Elwes, F.R.S., and Sir George Hampson, Bart.

WEDNESDAY, MAY 2.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Fourteenth "James Forrest" Lecture: Unsolved Problems in Metallurgy: R. A. Hadfield.

SOCIETY OF ARTS, at 8.—Submarine Signalling: J. B. Millet.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Estimation of Fat in Homogenised Milk: H. Droop Richmond.—Milk Analysis: H. Droop Richmond and E. H. Miller.—Note on the Composition of Saffron: A. E. Parkes.—On the Polenske Method for the Detection of Cocoanut Oil in Butter: Dr. S. Rideal and H. G. Harrison.—On the Presence and Detection of Cyanogen in Java and other Beans: R. R. Tatlock and R. T. Thomson.—On the Examination of Linseed, Olive and Other Oils: R. T. Thomson and H. Dunlop.

THURSDAY, MAY 3.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—*Probable Papers:* On a Static Method of Comparing the Densities of Gases: Prof. R. Threlfall, F.R.S.—The Stability of Submarines: Sir William H. White, K.C.B., F.R.S.—The Action on Bacteria of Electrical Discharges of High Potential and Rapid Frequency: A. G. R. Foulerton and A. M. Kellas.—The Action of Pituitary Extracts upon the Kidney: Prof. E. A. Schäfer, F.R.S., and P. T. Herring.

ROYAL INSTITUTION, at 5.—The Digestive Tract in Birds and Mammals: Dr. P. Chalmers Mitchell.

CHEMICAL SOCIETY, at 8.30.—The Relation between Absorption-Spectra and Chemical Constitution, part v.: The *iso*Nitroso-compounds: E. C. C. Baly, E. G. Marsden, and A. W. Stewart.—The Action of Tribromopropane on the Sodium Derivative of Ethyl Malonate, part ii.: W. H. Perkin, jun., and J. L. Simonsen.—Brazilin and Hæmatoxylin, part vii., Some Derivatives of Brazilein: P. Engels, and W. H. Perkin, jun.—Pipitzahoic Acid: J. M. Sanders.—The Constitution of the Hydroxides and Cyanides obtained from Acridine, Methyl-acridine and Phenanthridine Methiodides: C. K. Tinkler.—The Constitution of Ammonium Amalgam: E. M. Rich and M. W. Travers.—Action of Light on Potassium Ferrocyanide: G. W. A. Foster.

LINNEAN SOCIETY, at 8.—Origin of Gymnosperms (*Continuation of Discussion*): Dr. D. H. Scott, F.R.S.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Some Observations on Bacterial Tank Operations: Dr. W. O. Travis.

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