The duration of flight is estimated by repeating the letters of the alphabet, minus w, at the rate of five per second, after experience gained from previous practice.

Among other papers presented to the astronomical department was one by Mr. C. T. Whitwell, on "The Duration of Totality of the Solar Eclipse of May 28, 1900." A table which was given illustrated very forcibly the discrepancies between the calculated and observed durations at various observing stations. It was pointed out that to reconcile the observations and calculations by supposing that there were errors in the adopted value of the moon's diameter, or in the position of the observing station, involved the assumption of greater errors than were probable, though each may account in part for the discordance. Another suggestion, due to Mr. Crommelin, was put forward—namely, that, on account of the irregularities of the moon's limb, the beginning of totality is retarded by an amount corresponding to the movement of the moon required to bring the lowest depressions to the edge of the sun's disc after the assumed geometrical boundary has made contact, while for a similar reason the end of totality would be hastened. A. FOWLER.

CHEMISTRY AT THE BRITISH ASSOCIATION.

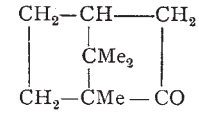
ALTHOUGH the president of section B, Prof. W. H. Perkin, junr., is mainly known as a specialist on polymethylene compounds, his address upon the teaching of inorganic chemistry proved to be of very general interest and was enthusiastically received by a large audience. His contention that the present system of examinations would be advantageously superseded by an inspection of the students' laboratory notebooks was favourably commented upon by Sir H. E. Roscoe and Dr. H. E. Armstrong, although it was admitted that the practical difficulties in the way of such a method are very considerable. The presidential address was followed by the report of the committee on the teaching of science in elementary schools, of which Dr. J. H. Gladstone is chairman; the report consisted principally of a discussion of the returns of the Education Department in so far as they concern the teaching of elementary science. The debate which ensued materially assisted the strong case which was subsequently made out in favour of establishing a separate section of the Association for dealing with educational matters. A paper was next read by Dr. Letts and Mr. R. F. Blake on some problems connected with atmospheric carbonic anhydride and on a new and accurate method for determining its amount, suitable for scientific expeditions; attention was drawn to the variations in the amount of atmospheric carbonic anhydride, and possible explanations of the variations were considered. The authors determine carbonic anhydride in air by absorbing it from about six litres with caustic potash solution, subsequently liberating it by boiling the potash solution with acid in a vacuum and measuring the volume of the carbonic anhydride in a suitable eudiometer. Mr. W. Ackroyd contributed papers on the distribution of chlorine in West Yorkshire and on a limiting standard of acidity for moorland waters. Water from the upper reaches of the West Yorkshire rivers contain from 0·7 to 1·3 parts of chlorine per 100,000, but as the sea or a more populous district is approached, the chlorine number becomes much greater. No cases of plumbism have yet been traced to the solvent action upon lead pipes of water of which the acidity is less than the equivalent of 0·5 part of sulphuric acid per 100,000; this acidity value is therefore tentatively proposed as a limiting standard for potable waters of moorland origin. Dr. T. W. Hime read a paper on the effects of copper on the human body, in which he sought to show that the agitation against the use of articles of food containing small quantities of copper salts is unjustifiable, because a large number of well-known food stuffs contain copper as a normal constituent and because such articles of food exert no poisonous action at all. Reports were received from the committees on the bibliography of spectroscopy and on the preparation of a new series of wave-length tables of the spectra of the elements. Prof. H. B. Dixon and Mr. F. W. Rixon, in a paper on the specific heat of gases at temperatures up to 400°, showed an apparatus for making such determinations at constant volume in which a steel cylinder containing the gas is heated and dropped into a calorimeter; the preliminary results obtained with carbonic anhydride were stated. Mr. F. H. Neville communicated a report on the chemical compounds contained in alloys of which the following is a brief abstract. Intermetallic compounds may be compared with the unstable compounds of the halogens with each other and with sulphur; they often bear a great superficial resemblance to their constituent elements and appear to show marked dissociation, or to form systems in true equilibrium with the liquid mixture of their components.

The intermetallic compounds may be isolated from an alloy (1) by filtration, (2) by volatilisation of excess of a volatile metal, or (3) by removing the excess of metal by means of a suitable solvent. Method (1) has been used by Heycock and Neville, who, on filtering a partially solidified solution of gold and cadmium in tin, obtained a crystalline residue having the composition AuCd; method (2) was applied to the preparation of the same compound by distilling the excess of cadmium from an alloy of gold and cadmium. Lebeau prepared the compounds $SbNa_3$, $BiNa_3$ and $SnNa_4$ by distilling the excess of sodium from alloys in ammonia and nitrogen gas. Debray isolated the compounds $PtSn_4$, $RhSn_3$ and $RuSn_3$, and Le Chatelier obtained Cu_3Sn by the action of dilute hydrochloric acid on alloys containing excess of tin; by methods of a similar nature Heycock prepared $PtAl_3$ and Stead isolated the crystalline substances Au_4Pb, Au_5Pb_2, SnSb and Sn_3As_2. There is, in the application of this method, considerable risk of the solvent attacking the crystals, and Stead has found that the formation of crystals having a core differing in composition from the outside constitutes a serious drawback to the method of partial solution regarded as an independent method of investigation. In the systematic study of intermetallic compounds may be placed first that of the chemical equilibrium of the binary system; this is generally expressed by the freezing-point curve, and has been mainly investigated by Roozeboom and Le Chatelier. Next, and perhaps of equal importance, is placed the microscopic examination of the solid alloys; whilst thirdly, and more limited in applicability, comes the determination of the difference of electrical potential existing between a metal and its alloys. On determining the freezing-points of a series of mixtures of two metals and plotting the freezing-points as ordinates against the compositions as abscissæ, a freezing-point curve is obtained which in its simplest form consists of two branches meeting at an angle—the eutectic angle—lying at a minimum point on the curve. In other cases the freezing-point curve shows a maximum point, but this is not cusped and lies on a gradual change of curvature; the freezing-point curve may thus consist of a series of branches connected by summits and eutectic depressions. It is pretty generally recognised that the eutectic alloy is merely a conglomerate and not a compound, but it is a remarkable fact that the position of the eutectic point on the curve often corresponds closely with some simple molecular composition; cases of this have been observed, not only with alloys, but also amongst organic compounds, by Paternò and Ampolla. The branches of the curve upon which summits lie are caused by the separation of compounds of definite chemical composition from the solidifying magma; the maximum points lie at positions corresponding to the composition of the compound, but Le Chatelier considers that the summit does not necessarily lie exactly at the point indicated by the molecular composition, owing to dissociation occurring in the liquid state. This point, however, needs further investigation. The points upon the freezing-point curve merely denote the temperatures at which solid begins to separate from the magma, but Roozeboom has shown that valuable results may be obtained by plotting, not only the temperatures at which solid begins to separate, but also the temperatures at which complete solidification occurs; in general, the one curve lies below the other, but they intersect or become one whenever the alloy solidifies as a whole. The microscopic examination of the pattern shown by the polished surface of an alloy which has, if necessary, been etched or heated to produce oxidation colours has been worked at principally by Osmond, Charpy and Stead. The existence of coated crystals is made evident by this method, as in the case of the bronzes rich in tin, in which Stead has shown that the Cu_3Sn crystals are coated with CuSn. Le Chatelier has pointed out that in these cases the solid alloy is not in equilibrium, and that annealing will, in general, cause considerable change. Charpy and Stead also consider that evidence of the existence of series of mixed crystals is obtained by microscopic examination. Röntgen ray photographs of thin sections of alloys which contain one transparent metal and one more opaque often give good views of the

crystals in the alloy; they were introduced by Heycock and Neville. Laurie and Herschkowitz have studied the potential difference set up between an alloy and the more electro positive metal contained in it, using a salt of the electro-positive metal as the electrolyte. It is shown that if the alloy consists of a conglomerate of the two metals, the potential of the alloy is that of the more electro-positive constituent; if, however, the two metals are mutually soluble in the solid state, the potential of the alloys will change very gradually with change of composition. Lastly, the existence of intermetallic compounds is indicated by a sudden and large change in potential when the composition of the alloy attains that of the compound. The author notes that although the molecular depressions of the freezing-point of one metal by solution in it of a second point in general to the molecular and atomic weights of the second metal being identical, the evidence is not complete because the second metal may exist combined with the first in the solution. The reading of this report was followed by a lively discussion, in which Sir W. Roberts-Austen, Mr. J. E. Stead, Mr. W. J. Pope, Mr. Stansfield and Dr. H. E. Armstrong took part. Mr. J. E. Stead then read a paper on the mutual relations of iron, phosphorus and carbon when together in cast iron and steel, which was illustrated by a very excellent series of drawings and photomicrographs. Prof. J. A. Ewing and Mr. W. Rosenhain gave a paper on the crystalline structure of metals, in which it was shown that the crystalline character of metals like lead, zinc, tin and cadmium is altered by subjecting them to a severe plastic strain at moderate temperatures; evidence was also adduced in favour of the solution theory of annealing. Prof. Barrett read a paper on the electric conductivity of the alloys of iron, and Mr. C. S. Bradley spoke on some new chemical compounds discovered by the use of the electric furnace. The sixth report of the Committee on electrolytic methods of quantitative analysis was presented; it consisted of papers on the determination of bismuth by Prof. J. E. Reynolds, and on the electro-deposition of iron, by Dr. C. A. Kohn and others. A paper on a simple method for comparing the "affinities" of certain acids was contributed by Messrs. H. J. H. Fenton and H. O. Jones. Oxalacetic acid is decomposed by dilute sulphuric acid into phenylpyrazolonecarboxylic acid in accordance with the equation :—

$$C_{10}H_{10}N_2O_4 = C_{10}H_8N_2O_3 + H_2O,$$

whilst water converts it into the hydrazone of pyruvic acid with evolution of carbonic anhydride. Using decinormal solutions of various acids, it is found that the amounts of carbonic anhydride evolved are inversely proportional to the concentration of the hydrogen ions and hence afford a measure of the affinity constants of the various acids. Mr. H. J. H. Fenton and Miss M. Gosling gave a paper on derivatives of methylfurfural, and Mr. H. M. Dawson spoke on the influence of pressure on the formation of oceanic salt deposits. A paper on recent developments in stereochemistry was read by Mr. W. J. Pope, in which it was pointed out that until a year ago the only known substances exhibiting optical activity in the amorphous state contained an asymmetric carbon atom. Last year, however, Pope and Peachey described a compound which owes its optical activity to the presence in the molecule of an asymmetric nitrogen atom, that is to say, a nitrogen atom which is directly attached to five different groups of atoms. On treating optically inactive methylallylphenylbenzylammonium iodide with silver dextrocamphorsulphonate in a nearly water-free solvent and evaporating the solution, a crystalline mixture of the dextrocamphorsulphonates of dextro- and lævo-methylallylphenylbenzylammonium is obtained which is easily resolved by fractional crystallisation; on treating the aqueous solutions of these salts with potassium iodide solution, crystalline precipitates of the iodides of the two optically active substituted ammonium iodides are obtained. This result proves that ammonium salts are not mere molecular compounds of ammonia with an acid, but are true atomic compounds, in which five atoms or groups of atoms are directly attached to the nitrogen atom. The use of strong optically active acids has also been applied during the present year to the preparation of compounds owing their optical activity to the presence of an asymmetric tin atom. On treating methylethylpropylstannomethyl iodide with silver dextrocamphorsulphonate and evaporating the solution, dextromethylethylpropylstannomethyl dextrocamphorsulphonate is obtained in the crystalline state. On treating the aqueous solution of this salt with potassium iodide solution, dextromethylethylpropylstannomethyl iodide separates as a yellow oil under certain conditions, although under others the iodide becomes inactive owing to the occurrence of racemisation. Similarly, dextromethylethylthetine platinochloride was prepared from optically inactive methylethylthetine bromide, proving that the asymmetric sulphur atom gives rise to optical activity in the same way that the asymmetric carbon, nitrogen or tin atom does. Further, these results prove that the sulphonium compounds contain quadrivalent sulphur, and are true atomic compounds. Since the four elements which we now recognise as able to give rise to optical activity in appropriate compounds are representatives of three groups of the periodic classification, it may be concluded that all the quadri- and quinque-valent elements of the carbon, oxygen and nitrogen families can act as centres of optical activity. Dr. J. B. Cohen, Dr. Divers, Mr. W. Barlow, Dr. H. E. Armstrong, and Dr. F. S. Kipping took part in the discussion which followed the reading of this paper. Dr. A. Lapworth presented a report on our knowledge of the constitution of camphor, in which he showed that the constitutional formula proposed for camphor by Bredt,



is the only one which is in accordance with the facts, and that the Perkin-Bouveault formula must be considered as erroneous. The President, Dr. H. E. Armstrong, Dr. F. S. Kipping and Mr. W. J. Pope joined in the ensuing discussion. A paper was read in which Prof. J. Bredt quoted further evidence in support of the constitution which he has proposed for camphor. Prof. Ossian Aschan, of Helsingfors, gave a paper in which it was shown that on replacing the ketonic oxygen atom in the camphor molecule by two hydrogen atoms the material becomes optically inactive, as it should do if Bredt's formula is correct. The Committee on isomeric naphthalene derivatives, of which Dr. H. E. Armstrong is secretary, reported that Mr. W. A. Davies has continued the study of the action of bromine on betanaphthol, and has obtained two isomeric tribromonaphthols, melting at 155° and 159° respectively. The report of the Committee on isomorphous derivatives of benzene, drawn up by Dr. H. E. Armstrong, was presented. A number of series of homologues of formanilide of the composition $C_6H_5{\cdot}NX{\cdot}COY$, where X and Y are alkyl groups, have been crystallographically examined and numerous crystallographic relationships established by Mr. L. P. Wilson. Dr. Jee has further investigated the isotrimorphous series of 1 : 3 : 4-dihalogenbenzenesulphonic chlorides and bromides, and has proved a relation between the stability of the crystalline modifications of the various compounds and their position in the series. Dr. S. Ruhemann and Mr. H. E. Stapleton gave papers on the synthesis of benzo-γ-pyrone and on the combination of thiophenol and guaiacol with the esters of the acids of the acetylene series. Dr. J. B. Cohen and Mr. H. D. Dakin read a paper on the chlorination of the aromatic hydrocarbons and the constitution of the dichlorotoluenes, in which it is shown that the chief products of the chlorination of toluene are the 1 : 2 : 3- and 1 : 2 : 4- and possibly a little of the 1 : 2 · 5-dichlorotoluene. Mr. C. F. Cross gave a paper showing that Caro's reagent acts on furfural with formation of a hydroxypyromucic acid. Mr. H. T. Brown gave an account of his recent work on the diffusion of gases and liquids. Dr. J. B. Cohen read a paper on smoke prevention, contending that the production of smoke should be regulated by some system of Government inspection. Mr. T. Fairley read a paper on the heating and lighting power of coal gas, and stated that in populous districts from 20 to 50 per cent. of the gas produced is consumed for heating purposes or by gas engines. Dr. A. Liebmann contributed a report on recent improvements in the textile industries, in which he observed that the inflammability of artificial silk, which constituted so serious an objection to the use of the material, has now been entirely prevented; the use of artificial silks is, however, limited by their brittleness and susceptibility to damage by damp. Major-General Waterhouse gave a paper on the sensitiveness of silver to light, whilst Dr. J. H. Gladstone and Mr. G. Gladstone contributed some thoughts on atomic weights and the periodic law. Mr. F. W. Richardson gave a paper on Bradford sewage and its treatment, in which it was noted that the presence of large quantities of wool-grease and nitrogenous impurities make the Bradford sewage peculiarly difficult to deal with; the grease soon chokes up the filters and, if it were absent, the sewage could readily be

treated biologically. Mr. W. Leach, in a paper on wool-combers effluents, also referred to the unsatisfactory character of the purification methods at present applied to the sewage. Mr. W. B. Bottomley discussed the utilisation of the sewage sludge, and contended that the sludge should be pressed and dried, when it forms a valuable manure. Dr. Letts and Mr. R. F. Blake gave a simple and accurate method for estimating the dissolved oxygen in fresh water, sea water, sewage effluents, &c.

SCIENTIFIC SERIALS

American Journal of Science, September.—The gas thermometer at high temperatures, by L. Holborn and A. L. Day. This is a further study of the nitrogen thermometer with platinum-iridium bulb, which is superior to the porcelain bulb. The correction for expansion is 10° at 500°, 30° at 1000°, and 40° at 1150°. The authors make an elaborate comparison of the gas thermometer with the thermocouples, and determine anew the melting points of a number of metals. Those of silver and gold are 955° and 1064° respectively —Monazite, by O. A. Derby. A single granule of the mineral, no matter how minute, can be securely identified by moistening it with sulphuric acid on a slip of glass and burning off the sulphuric acid over a spirit lamp, when the residue shows the characteristic crystallisation of cerium in radiating needles or isolated crystals of the shape of cucumber seeds.—The spectra of hydrogen and the spectrum of aqueous vapour, by J. Trowbridge. When a condenser discharge is sent through a rarefied gas confined in a glass vessel, the gas cannot be considered dry, for aqueous vapour is liberated from the glass. The four-line spectrum of hydrogen in the solar atmosphere is an evidence of aqueous vapour, and therefore of oxygen in the sun. Conclusions in regard to the temperature of the stars exhibiting hydrogen spectra are misleading if purely based upon conditions of pressure and temperature, for electric dissociation plays a determining part. X-Ray phenomena produced by a steady battery current strongly suggest an electrical theory of the origin of the sun's corona.—A new effect produced by stationary sound-waves, by B. Davis. When a small cylinder, closed at one end, is placed in the stationary sound-wave of an organ pipe, it will not only arrange itself perpendicularly to the motion of the wave, but will move across the wave in a direction perpendicular to the stream-lines. When four such cylinders are mounted in the shape of an anemometer on a needle point, they rotate while the pipe is sounded.—Some interesting developments of calcite crystals, by S. L. Penfield and W. E. Ford. The crystals described show a great diversity of habit, often on a single hand specimen, due to different methods of twinning, together with peculiarities in the development of certain crystal faces. Some peculiar cases of rhombohedral twinning are described.—Method of measuring surface tension, by J. S. Stevens. The surface tension is measured by floating an iron wire on the surface of the liquid, and suspending a piece of soft iron by it. The iron is pulled into a magnetising coil immersed in the liquid by currents which increase until the surface is broken through.

Annalen der Physik, No. 8.—Structure, system and magnetic behaviour of liquid crystals, and their mixture with solid ones, by O. Lehmann. The author has succeeded in proving that all the characteristics of crystallisation which the "liquid crystals" described by him do not possess, cannot logically be made part of the definition of a crystal. The only general characteristics of crystals are that they are not isotropic, and that they possess a molecular directive force which governs their shape, and the manner in which their constituent particles are deposited. The directive force is preserved by means of the surface tension, and crystals may therefore be liquid or solid, but they cannot be gaseous. Liquid crystals may be produced by depositing solid crystals on the cover glass of a microscope and gently heating them above the fusing point.—Generation of electricity in liquid air, by H. Ebert and B. A. Hoffmann. A body suspended above liquid air acquires a strong negative charge. This electrification is due to the friction of minute particles of very cold ice suspended in the air vapour. The authors constructed a kind of electrifying machine by means of a tube containing a piece of wire gauze through which the vapour of liquid air was driven.—Spectrum of radium, by C. Runge. The author has located three of Demarcay's lines with the precision necessary to distinguish them from neighbouring solar lines. The lines located have wave-lengths of 4826·14, 4682·346 and 3814·591 respectively.—Influence of a spark-gap upon the generation of Röntgen rays, by A. Winkelmann. The maximum gaseous pressure at which X-rays can be produced may be raised by introducing a spark-gap into the circuit, the best position for it being next the kathode. Hydrogen yields X-rays at greater pressures than air or carbonic acid.—Fall of potential and dissociation in flame gases, by E. Marx. The author proves that an apparent failure of Ohm's law in flame gases is due to the fact that owing to the scarcity of ions the saturation current is soon attained.—Hall effect in flame gases, by the same author. Owing to the great speed of the ions in flame gases, and the difference in the velocities of the positive and negative ions, a Hall effect is much more appreciable in flames than in electrolytes. The author demonstrates the existence of such a Hall effect in the case of a flat Bunsen flame into which a fine spray of a solution of some alkaline salt is blown.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 24.—M. Maurice Lévy in the chair.—Nature of the combustible gases found in the air of Paris, by M. Armand Gautier. The author has shown in previous papers that the ratio of carbon to hydrogen found by his method of combustion in dilute mixtures of methane and air is 2·4, instead of the theoretical 3. The much higher value of this ratio found in the air of Paris proves that there must be present gaseous substances richer in carbon than methane, such as benzene vapour or its analogues. The experimental results obtained are in accord with the assumption that in 100 litres of Paris air there are 19·5 c.c. of hydrogen, 12·1 c.c. of methane, 1·7 c.c. of benzene vapour and 0·2 c.c. of carbon monoxide.—Experiment in wireless telegraphy with the human body and metallic screens, by MM. E. Guarini and F. Poncelet. The electric waves were generated by a Wimshurst influence machine and were allowed to act directly upon a coherer. It was found that the human body acted perfectly as a screen.—On crystallised calcium aluminate, M. Ém. Dufau. The crystallised aluminate is obtained by heating a mixture of calcined alumina and lime in an electric furnace. Its formula is $CaAl_2O_4$; it forms transparent needles which do not scratch glass.—On Russian flour, by M. Balland. Proximate analyses of three samples of Russian flour are given.

CONTENTS.