

by a magnet. The fourth kind appears at the openings in a Holtz's funnel-tube; it produces no fluorescence, but can be deflected by a magnet.

A serious state of things was revealed by Prof. A. Johnson in his paper on a Canadian and Imperial Hydrographic Survey. He said that in some parts of the St. Lawrence basin places had been found where the depth of water, charted at five fathoms, was not more than three fathoms, and navigation was thereby rendered dangerous. A committee has been appointed to consider the question of approaching the Canadian Government with reference to a new hydrographic survey.

On Monday the section met in two departments, devoted to mathematics and meteorology respectively. In the mathematical department Dr. Harris Hancock gave a short account of the historical development of Abelian Functions, and the complete paper will be published as one of the reports of the Association. Prof. Henrici proposed a new notation to denote the different products of vectors, which consists in using square brackets for vector products and round brackets for scalar products. He likewise advocated the adoption of Heaviside's term "ort" for a vector, the tensor of which is the number 1. Prof. A. Macfarlane read a communication on the solution of the cubic equation, in which he explained how the two binomials in Cardan's formula may be treated as complex quantities, either circular or hyperbolic; all the roots of the cubic can then be deduced by a general method. Prof. Michelson described some new Harmonic Analyses made by himself and Mr. S. W. Stratton with an instrument which is capable of rendering 80 terms of a Fourier series and of checking the accuracy of its own work. The only limit to the number of terms obtainable is the expense of making the instrument.

In the department of meteorology, Dr. van Rijckevorsel pointed out that the curves of daily temperature for the different meteorological stations in Europe indicate a possible division of the continent into two regions with marked differences of climate. The eastern region includes Russia and adjacent countries, the rest of the continent being in the western region. Small irregularities, such as secondary maxima and minima, are reproduced in all the curves for places in the same region, and serve to show that the temperatures are determined by external causes operating over the whole area. Mr. F. N. Denison described observations on "seiche" movements on Lakes Ontario and Huron, obtained by means of a tidal gauge. Mr. A. L. Rotch reported progress made during the year in the exploration of the air by means of kites. Meteorographs have been raised to a height of 8740 feet above the Blue Hill Observatory, and important information has been obtained concerning humidity, changes of temperature and wind in free air. The value of these results in aiding the forecasting of the weather is so great that the United States Weather Bureau has taken up the subject. Prof. Marvin described his experiments with tailless kites, and afterwards exhibited one in flight in the University grounds.

In electricity, several forms of apparatus for mapping out the form of an alternate current wave were described and exhibited. In the instrument of Prof. Rosa a contact revolving on the dynamo shaft puts a point in the circuit into contact with a potentiometer at any phase of the revolution. By means of an electro-magnetic ratchet arrangement the contact can be advanced in phase by small equal amounts, and the same current similarly rotates a revolving cylinder on which the length of wire necessary for a balance on the potentiometer is automatically recorded. Mr. Duddell makes use of the force urging a straight conductor carrying a current and stretched in a magnetic field; two parallel phosphor-bronze strips are placed in a strong magnetic field and attached to a mirror, so that when the alternating current goes up one of these strips and down the other one, the mirror is deflected. Prof. Braun uses a cathode ray instead of a strip, and puts it in a magnetic field set up by the alternating current; the ray is thus deflected and follows every pulsation of the current. The source of luminosity in the electric arc has been investigated by Prof. Henry Crew and Mr. O. H. Basquin. They maintain an arc between an iron rod and a rotating iron disc by a rapidly intermittent electric current, and observe the arc in the intervals when no current is passing. It is found that the luminosity is of two kinds, a bright cloud yellow persisting some time and a much fainter and rapidly evanescent blue flame; the spectra of these two portions differ in the distribution of intensity of their lines.

The Electrical Standards Committee report that they have decided to undertake the experiments necessary for the specification of the standard of electric current, which will be conducted by Profs. Ayrton and J. V. Jones.

At Wednesday's sitting, Prof. Ramsay described experiments on the refractivity of mixtures of gases, from which it appears that an expansion takes place on mixing hydrogen and helium, and a contraction on mixing nitrogen and oxygen. Prof. Fitzgerald suggested that the viscosity of mixtures of gases should be more fully examined. Prof. Lodge described Zeeman's discovery of the effects of magnetism on spectral lines, and discussed the nature of the dark space between the two lines into which the originally single band is split. Profs. Lodge, Michelson and Runge were agreed that this space is a part of the Zeeman phenomenon, and is not produced merely by the absorption of light in the region round the flame. Several papers on galvanometry were communicated by Prof. Ayrton and Mr. Mather. In the discussion on papers by Prof. Callendar and Mr. Barnes, and Messrs. Spiers, Twyman and Waters, on Clark cells, it was stated by Prof. Webster, that Clark cells with cadmium electrodes in place of zinc are as trustworthy and easily set up as the older form. Such cells have a much smaller temperature coefficient than zinc-cells.

The meeting concluded with a paper by Mr. J. W. Edmondson, read by Prof. Webster, on spark-length and potential relations in air and dielectric liquids. For air a hyperbolic formula apparently fits the results in the case of spheres of 3 cm. diameter.

A vote of thanks to the President, moved by Prof. Ayrton and seconded by Prof. Lodge, brought the proceedings of the section to a close.

CHEMISTRY AT THE BRITISH ASSOCIATION.

THE meetings of the Chemistry Section were usually well attended throughout the whole of the somewhat protracted sittings at Toronto. A large number of the chemists of Canada and of the United States were present, and added much to the interest of the meeting, both within and without the section room. The section only participated, and that in an informal way, in one united discussion, which took place between Sections I and K on the chemistry and structure of the cell. This was opened by Prof. Meldola in a very striking and suggestive paper on the rationale of chemical synthesis.

In connection with the section an important new committee has been appointed, under the chairmanship of Sir John Evans, for the promotion of agriculture, its object being to report on the methods and results of the Government Agricultural Stations in Canada and other countries, with a view to the establishment of similar institutions in Great Britain. As an unusually large number of papers were read, only those of the most general interest can be here mentioned.

Prof. Ramsay followed up his address, which was none the less interesting because of its speculative character, by an account of the methods employed in the work on helium and in the determination of the remarkable properties by which that gas is characterised. He expressed the opinion that helium is occluded, and not definitely combined in the various minerals in which it occurs. A short communication was also read, in which it was pointed out by Mr. M. Travers that the hydrogen obtained by heating many igneous rocks *in vacuo* is in reality derived from water which is present, and is reduced by various substances, such as ferrous oxide, contained in the material of the rock.

The section devoted a considerable portion of one of its sittings to the consideration of atomic weights, and was fortunate in the attendance of Profs. B. Brauner, F. W. Clarke, E. W. Morley and T. W. Richards, in addition to the home contingent of chemists distinguished in this particular field. Prof. Brauner, resting from his labours on tellurium, has turned his attention to thorium, and has succeeded in making a satisfactory determination of its atomic weight by the oxidation of the double ammonium oxalate. The number which he has obtained is 232.5 (O = 16), and is considerably lower than Cleve's number. Prof. Richards has attacked the problem of the atomic weights of nickel and cobalt, about which great uncertainty has hitherto prevailed, and has analysed the very carefully dried and purified bromides of these metals. The separate determinations agree admirably among themselves, and it seems probable that the

values Ni=58.69, and Co=58.99 will take their places as standards among the numerous other results, which have been obtained in such rapid succession in the laboratory of Harvard.

One of the most attractive items on the programme of the section was the demonstration of the preparation and properties of fluorine, by Prof. E. Meslans. Since the Nottingham meeting, at which the demonstration was made for the first time in England, an important simplification has been introduced into the apparatus required for the production of the gas, which will probably render it possible to include the preparation of this element in the ordinary course of lecture experiments, and may even lead to its economical production on the large scale, should any industrial application of the gas be found desirable. The latest form of apparatus consists entirely of copper, and is larger than the costly platinum apparatus of Moissan, although the same general shape is preserved. The apparatus is charged in the usual way, and is then itself connected with the positive terminal of a battery, the two electrodes being made the negative pole. Fluorine is thus evolved at the internal surface of the apparatus, and a thin non-conducting layer of copper fluoride is deposited upon it. The apparatus after this preliminary treatment is employed exactly in the same way as Moissan's platinum apparatus, but may be simply cooled by ice and salt. The presence of the non-conducting layer of copper fluoride prevents the passage of electricity from the electrode to the side of the vessel, and thus avoids the consequent loss of fluorine; so that the yield in the new modification of the apparatus is much greater than in the original form.

Several papers on subjects connected with physical chemistry were contributed. The first of these was read by Prof. H. B. Dixon, in continuation of his previous work on explosions of gases, and dealt with the curious phenomena attending the commencement of an explosion in a gaseous medium, which may be investigated by photographing the flash. If the mixture be fired at the end of a tube, the disturbance very gradually increases in velocity as it passes along the tube, until after a comparatively great distance has been traversed, the velocity characteristic of the mixture is reached. When, however, the firing-point is 3 or 4 inches from the end of the tube, the disturbance passing slowly down the longer portion of the tube is reinforced by the wave which has traversed the short distance to the end of the tube, and has there been reflected. After this reinforcement, the united disturbances travel at a much more rapid rate, and the maximum velocity is quickly attained. Another investigation on the mechanism of a reaction, but from a different point of view, was described by Dr. J. W. Walker in a paper dealing with the reaction between hydrobromic and bromic acids in aqueous solutions. Time measurements of the rate of liberation of bromine show that most probably the reaction does not take place between six molecules as indicated in the ordinary equation, but between two. It is therefore probable that the reduction of the bromic acid takes place in stages, bromous and hypobromous acids being probably formed as intermediate products. Dr. W. L. Miller, of Toronto University, in a paper on the vapour tensions of mixed liquids, explained the method adopted by himself and Mr. Rosebrough for testing the validity of Gibb's equation for the equilibrium of the vapours of mixtures of liquids at constant temperatures, and demonstrated that actual determinations of the composition of the vapour given off from various mixtures of alcohol and water agree very closely with the calculated numbers. The Röntgen rays again formed the subject of an investigation at the hands of Dr. J. H. Gladstone and Mr. W. Hibbert, who have compared the absorptive power of various salts of the same metal (lithium), and have thus obtained relative values for the various acid radicals.

A number of short papers on organic chemistry were communicated to the section, including a review by Prof. P. C. Fuer, of his work on the constitution of acetone and other analogous ketones; the formation of a benzene ring by the reduction of a 1-6-di-ketone, by Dr. A. Lehmann; condensation products of aldehydes and amides, by Dr. C. A. Kohn; and on the nitro-alcohols, by Prof. L. Hemy, of Louvain. Great interest was excited by a very able paper on the chemistry of methylene, by Prof. J. V. Nef, of Chicago, in which the latest results obtained in the study of compounds containing dyad-carbon were described. Prof. Nef has obtained a very unstable series of substances which he regards as acetylidene derivatives, $RC_2 = C$, isomeric with the normal acetylene derivatives $RC \equiv CR$. The di-iodo-compound is the most stable,

but even this slowly burns when exposed to the air, whilst the other derivatives undergo a much more rapid combustion under the same circumstances. All the compounds are violently poisonous. The di-iodo-derivative can be prepared in a number of different ways, the most interesting of which are (1) the direct action of sunlight on tetra-iodo-ethylene, $I_2C = CI_2$, one molecule of iodine being liberated; and (2) the action of iodine on silver acetylene. On oxidation it appears to primarily yield carbonic oxide and iodine, but the latter converts a portion of the unaltered compound into tetra-iodo-ethylene. The monobromo-derivative bears in its properties a most remarkable resemblance to phosphorus, and is termed by its discoverer "vegetable phosphorus," since it shines in the dark, burns on exposure to the air, and acts as a violent poison, in the same way as phosphorus.

Several papers dealing with local problems were presented by various chemists. The most elaborate of these was a very extensive series of analyses of the virgin soils of Canada, submitted by Dr. F. T. Shutt, who occupies the important position of chemist to the Dominion Experimental Farm at Ottawa. These showed that some of the prairie soils of Manitoba are of extraordinary richness and fertility, whilst the soils of Canada in general may be considered as of a satisfactory character for agricultural purposes. Some interesting analyses of coal from the pre-carboniferous rocks of Canada were communicated by Prof. Ellis, of Toronto. These showed in a very striking way the gradual transition from petroleum and its immediate product of decomposition, asphalt, to anthracite and pure carbon. Prof. Roberts-Austen showed a number of interesting slides, which supplemented the information given in his evening lecture on the metals of Canada, as to the close similarity of the phenomena exhibited by ordinary liquids, and metals in the molten, and even in the solid form. Mr. Ramage also exhibited a series of slides, reproduced from photographs of the spectra of various metals and minerals in the oxyhydrogen flame, showing the presence of many unsuspected constituents in very small amounts.

Great interest was shown in a demonstration by Prof. Andrews, of the plaster of Paris method in blowpipe work. In this method charcoal is replaced by a thin, oblong tablet made of plaster of Paris, mixed with a little boric acid. This can be employed for all the ordinary tests which are conducted on charcoal or platinum wire. Prof. Andrews has, moreover, elaborated a series of extremely delicate and characteristic tests for a large number of metals, which depend on the coloured films produced when compounds of these metals are treated with a solution of iodine in potassium thiocyanate. These consist partly of oxide and sulphide, partly of iodide and oxyiodide, and are very brilliant in colour. Although not so suitable for teaching purposes, these iodide films afford a very ready method for the detection of the constituents of a metal in the field, and will no doubt be welcomed by practical mineralogists.

An interesting, though somewhat speculative, attempt was made by Mr. L. T. Addison to refer the different crystalline forms and specific gravities of the allotropic forms of many of the elements to different modes of arrangement of the same primal forms, the shape of which is intimately connected with the valency of the element.

A break in the routine of business was enjoyed by the members of the section on Saturday, when a visit was paid to the electric power-house at Niagara, and the works for the production of carborundum and of soda by the electrolytic process, which are in its immediate neighbourhood, and derive their energy from the diverted waters of the Fall.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. JULIUS HANN, Director of the Vienna College of Meteorology, has been appointed professor of meteorology at Gratz, in Styria. Prof. Joseph Pernter, professor of cosmical physics in Innsbruck University, has been appointed to the vacancy caused by Dr. Hann's retirement from the Vienna College. Dr. E. von Esmarch, assistant professor of hygiene at Königsberg, has been made full professor. Mr. William Saunders, second master at the Cardigan Intermediate School, has been appointed head master of the Radnorshire County School at Llandrindod Wells.