Prof. Ayrton read a paper by Mr. Mather and himself, in which arguments were advanced against the existence of a back electromotive force in the electric arc. The authors describe a method of measuring the true resistance of the arc, namely the ratio of a small increase of potential difference to the corresponding increase in the current; this, of course, is a negative quantity. The same authors described a magnetic field-tester, an application of the ordinary exploring coil and ballistic galvanometer method, with a spiral spring to effect rapid rotation of the exploring coil, and a modified D'Arsonval galvanometer with shuttle-wound coil capable of rotating through several turns without losing the proportionality of angular displacement and restoring force.

The velocity of light in vacuum tubes conveying an electric discharge formed the subject of a paper by Messrs. Edser and Starling. Vacuum tubes were placed in the path of the two beams of a Fizeau interference apparatus, and the position of the bands observed. No appreciable shift of the bands was obtained either by setting up an induction-coil discharge, or by the discharge of ten gallon jars through the tubes when placed in series with a piece of wet string. The discharge in the latter case lasted one-thirtieth of a second, and the authors show that a disturbance of the bands of so long duration would have been observed.

Mr. F. G. Baily read a paper on hysteresis of iron in an alternating magnetic field, in which he showed that the hysteresis of iron increases with the field up to a maximum value, in accordance with Ewing's theory. The experiments were made by the isthmus method, using a small laminated armature consisting of thin discs of charcoal iron; the most intense magnetic field used was 22,000 C.G.S. units, and the hysteresis was measured by the rise of temperature of the armature.

On Wednesday, Dr. Gladstone and Mr. W. Hibbert made a communication on the change of molecular refraction in salts or acids dissolved in water. The molecular refraction of a substance is altered when the substance changes its state, and a further slight alteration takes place on diluting its solution; the authors have obtained some evidence of a close connection between these changes and the variations of electric conductivity of the substance and its solutions. Such a connection would have an important bearing on the theory of solution.

The report of the Electrical Standards Committee was read. The Committee hope during the year to institute a comparison between the British and German standards of resistance, and have procured coils for this purpose, which have already been tested at the Reichsanstalt. The Committee, recognising the need for practical units of magnetic field and magnetic potential, recommend for tentative adoption (1) a unit equal to 10^8 C.G.S. lines, to be called a *weber*, (2) the C.G.S. unit of magnetic potential, to be called a *gauss*. They also recommend that the termination *ance* be used in describing the properties of a piece of matter, *e.g.* the resist*ance* of a copper wire, and the termination *ivity* or *ility* for the specific properties of the material, *e.g.* the resist*ivity* of copper would mean the resistance of a centimetre cube of it. Prof. Oliver Lodge explained, and advocated the use of, the proposed units. Prof. S. P. Thompson, while agreeing with the Committee as to the desirability of having units of magnetic field and magnetic potential, thought the choice of their names should be left with the practical men who use them. He believed the proposed *weber* was too large, and advocated the retention of the C.G.S. "line," using the kilo- and mega- for its multiples; further, he did not see any necessity for abandoning the ampere-turn in order to replace it by the *gauss*. Prof. Thompson pointed out a more formidable objection, namely, that the American Institute of Electrical Engineers have attached the name *weber* to a different unit, and have suggested the name *gilbert* for the gauss. Several members continued the discussion, and Prof. Perry expressed his opinion that the question of names ought to be settled by a general congress.

Two pieces of apparatus for tracing the form of the wave of potential in an alternate current circuit were exhibited and described, the one by Messrs. Barr, Burnie and Rodgers, the other by Prof. Ayrton and Mr. Mather.

Mr. E. H. Griffiths exhibited the apparatus designed for the calibration of high-temperature thermometers at Kew Observatory, and described it. A Callendar and Griffiths platinum thermometer is enclosed in a glass or porcelain tube, and can be immersed, along with the thermometer to be calibrated, in a bath of molten metal or sulphur vapour, according to the temperatures required. Its resistance is measured by a Wheatstone bridge, the coils of which are enclosed in a copper box, five sides of which are immersed in a water-bath of constant temperature, while the top is surmounted by a case similar to that of a chemical balance. The coils of the bridge are of platinum-silver, wound double, and are not embedded in paraffin, the object being to allow them to assume the temperature of the box and surrounding water as quickly as possible.

A vote of thanks to the Chairman and Secretaries terminated the proceedings.

CHEMISTRY AT THE BRITISH ASSOCIATION.

WITH the exception of Prof. Runge's announcement of the undoubtedly compound nature of helium, few of the communications laid before Section B at Ipswich are likely to awaken great interest outside chemical circles. The discussions, however, which are now a recognised feature of these meetings, were especially successful, and it is not too much to hope that the joint meeting with the newly-formed Botanical Section may be the means, if only indirectly, of bringing about results of great importance to the agricultural community.

Following the President's valuable address, Sir Henry Roscoe and Dr. A. Harden communicated to the Section an interesting discovery in historical chemistry. It has been generally assumed that Dalton arrived at the idea of atoms with definite weights from a consideration of the proportions in which certain elements combined. From the examination of a number of manuscript volumes of Dalton's own laboratory notes, which they have recently discovered in the library of the Manchester Literary and Philosophical Society, Sir Henry Roscoe and Dr. Harden conclude that Dalton worked out his theory solely from physical considerations as to the constitution of gases. His mind being saturated with Newton's ideas concerning atoms, it was from these that his own atomic theory was developed.

Later on, quoting not only his own results but those of other chemists, he seems to have been led to the law of multiple proportions as the only conceivable mode of combination between atoms. Extracts were given from his notes showing that certain numbers, usually quoted as having led him to his atomic theory, *e.g.* the analyses of marsh gas and olefiant gas, were only inserted in his tables some time after the publication of his ideas.

Prof. Armstrong said it was satisfactory to learn that Dalton had really arrived at his conclusions from truly philosophical considerations, without reference to the very crude numbers, usually quoted as sufficient basis for the laws that he worked out.

The report of the Committee on the teaching of science in elementary schools was read by Dr. J. H. Gladstone. During past years there has been an increase in the number of subjects taught, and in the number of pupils receiving instruction. The alteration in the system of inspection will have an especially useful effect in the teaching of science. The question of the training of teachers is discussed in the report. A course for mistresses on domestic science, dealing as far as possible with the nature of the processes and materials employed in the household, has been found successful. The great obstacles to good science teaching at the present time in elementary schools are: (1) Large classes; (2) multitude of subjects; (3) insufficiency of the training course for teachers in science subjects; (4) effects of the old science and art system, which is clearly far too formal, and pays far too little attention to ordinary requirements.

The courses on elementary physics and chemistry, and the science of common things are found to be more attractive than pure chemistry.

Other subjects dealt with in the report are school visits to museums; the right method of giving object lessons; and the teaching of the metric system. Finally it is suggested as a question worth consideration, whether the recognised school age should not be raised from thirteen to fourteen.

In the discussion which followed the reading of the report, the relation of County Councils to elementary schools was debated, and it was contended that these are helped indirectly by the Councils providing facilities for the training of teachers.

Mr. G. J. Fowler read a paper on the action of nitric oxide on certain salts, by H. A. Auden and G. J. Fowler, in which the action of nitric oxide on different salts at various tempera-

tures is described. Oxy-salts have been chiefly examined, the most interesting results being obtained with the chlorates and iodates of potassium and silver. With potassium chlorate action takes place at the ordinary temperature, chlorine being evolved, but no potassium chlorate being formed. With silver chlorate, chlorine is also evolved, but some chloride is obtained. Potassium iodate yields iodine but no potassium iodide at a low temperature, while silver iodate is completely converted into iodide, no iodine being liberated, or silver nitrate formed. It is suggested that these results tend to show a difference in constitution between the silver and potassium salts.

Prof. Clowes gave an account of further experiments on the respirability of air, in which a candle flame has burnt till it is extinguished. He finds that an atmosphere, which contains oxygen 16·4 per cent., nitrogen 80·5 per cent., carbon dioxide 3·1 per cent., will extinguish a candle flame, but is still, according to the experiments of Haldane, not only respirable, but would be breathed by a healthy person for some time without injury. An atmosphere which extinguishes a coal-gas flame, however, appears to approach closely to the limits of respirability, as far as the proportion of oxygen which it contains is concerned. The candle and lamp flames should be discarded as tests of the respirability of air in favour of the coal-gas flame.

A paper was read by Mr. D. J. P. Berridge, on the action of light upon the soluble metallic iodides in presence of cellulose, in which it was shown that the amount of iodine liberated from potassium iodide by the combined action of light, air and moisture, is greatly increased by the presence of cellulose, this substance probably combining with the potassium hydrate liberated in the reaction. By investigating the conditions of formation of the chocolate stain obtained when note-paper containing starch, and soaked in potassium iodide solution, is exposed to light, evidence is obtained of the formation of a tri-iodide of potassium. The iodides of sodium, calcium, strontium, barium, iron, and zinc, all behave like the potassium salt; cadmium seems alone unable to form a higher iodide.

Dr. C. A. Kohn read the second report of the Committee on quantitative analysis by means of electrolysis. The bibliography of the subject has been completed. The experimental work has been carefully organised, and the results on the determination of bismuth and of tin are nearly complete.

Sir H. E. Roscoe presented the report of the Committee appointed to prepare a new series of wave-length tables of the spectra of the elements.

Some interesting communications were made to a joint sitting of Sections A and B; and the account of these, which we give in our report of the work of the former Section, is supplemented by the following notes on Dr. Gladstone's and Prof. Schuster's communications.

Dr. Gladstone's paper was on specific refraction and the periodic law, with special reference to argon and other elements. In former years he had shown that the specific refractive energies of the elements in general were, to a certain extent, a periodic function of their atomic weights. With regard to argon, the specific refractive energy of argon gas as reckoned by Lord Rayleigh's data is 0·159. At the suggestion of Deeley, the bearing of this result on the atomic weight of argon was considered. If the atomic weight be 19·94, the molecular refraction will be 3·15. This figure is almost identical with that belonging to oxygen and nitrogen gas, and differs considerably from that of calcium, which has a molecular refraction of 10·0 and a specific refractive energy of 0·248. These facts tend to suggest an atomic weight of 20 for argon, and to place it in the vicinity of the alkali metals.

The discussion, which was opened by Prof. Schuster, on the evidence to be gathered as to the simple or compound nature of a gas from the constitution of its spectrum, dealt with matters of rather more physical than chemical bearing. Of special interest to chemists, however, was the evidence cited by Prof. Schuster for considering that the variations noticed in the spectra of sodium, nitrogen, and mercury under different conditions were due to differences in atomic aggregation.

Monday's sitting was devoted to a discussion, held in conjunction with Section K (Botany), on the relation of agriculture to science. It was introduced by Prof. R. Warington in a paper entitled, "How shall agriculture best obtain the help of science?" This was devoted to a consideration of the best means for diffusing a knowledge of the scientific principles of agriculture. Certain things could be usefully done by a Board of Agriculture, and others by County Councils. The formation of a really complete agricultural and horticultural library, freely open to the public, and the maintenance of an English agricultural journal, are matters which might fall to the Board of Agriculture. The advantages to be derived from a Government laboratory and experimental station were dwelt upon. Local stations and secondary agricultural schools should be maintained by the County Councils, who also should inspect the technical instruction in their locality. The foundation of habits of observation and logical reasoning must be laid in the elementary school if higher instruction is afterwards to be given. Higher qualifications should be required for agricultural lecturers than is at present the case.

Mr. T. Hendrick contributed a second paper. He spoke of the apathy and even hostility to science shown by the practical agriculturist, and considered the reasons for this attitude.

In other countries national systems of agricultural education and research have been founded by the State. It is hopeless to look to local effort and support, because the practical man expects immediate results, and results out of all proportion to the time and money expended in obtaining them. The time has come when the State must take part in the work and devote to it much larger sums than at present.

Mr. Thiselton-Dyer said that the matter had been carefully considered by the last Government. It was difficult, however, to persuade the Treasury that agriculture was entitled to receive special aid of a kind not given to any of our other great industries, such as iron and textiles. Personally he looked to individual effort and munificence to supply what was needed.

Prof. Marshall Ward pointed out that it was of extreme importance that the results of any investigations should be made known at once and accurately to the practical man, and this was work which might very well be undertaken by Government, but he deprecated any direction or control from a Government department in any matters of original research.

Prof. J. R. Green pointed out the necessity for investigations on vegetable physiology, as bearing on the growth of crops.

Sir Douglas Galton agreed with Mr. Dyer that agriculturists must look to themselves for help, rather than to the Government. The obtaining of really good teachers was the great difficulty.

Lord Walsingham spoke of the difficulty in producing crops which would realise a profit. Wheat-growing was unprofitable in England, and his own attempts to grow tobacco were frustrated by the heavy duty.

Sir J. Evans and Sir H. Roscoe spoke of the work of the County Councils, and Prof. Perceval gave an account of the courses at Wye College.

Mr. J. Long considered that schools and colleges for boys and youths and demonstration plots for adult farmers were the best means of bringing home the benefits arising from the application of science to agriculture.

Mr. J. R. Dunstan, in a paper on the subject under discussion, contended that courses of lectures were necessary as pioneer work. Unless farmers have a general knowledge of the principles of science, they cannot really understand the results of experiments.

Prof. Liveing advised the co-operation of County Councils in maintaining a central experimental station. He described the system of agricultural teaching adopted at Cambridge.

Mr. Avery gave some account of the agricultural side attached to the Ashburton School in Devon, and spoke of the difficulty of obtaining pupils.

Mr. T. S. Dymond emphasised the necessity of a knowledge of scientific principles, if farmers were to properly understand experimental results.

Mr. C. H. Bothamley considered agricultural sides to secondary schools much better than schools restricted to farmers' sons. The value of demonstration plots, as distinguished from experimental plots, was very great.

Prof. Warington, in reply, remarked that the whole agricultural position was such that if anything was to be done, it must be done at once, they could not afford to wait.

Mr. T. B. Wood gave an account of work at the experimental plots in Suffolk and Norfolk. The experiments in Suffolk are conducted at two stations with soils typical of large areas in the neighbourhood, viz. at Higham, where the soil is thin and light with a chalk sub-soil, and at Lavenham, where it is a much deeper loam. The experiments at both stations consist in the growth of various crops in rotation with various manures. Each year a report of these experiments is printed and circulated,

and during the summer, lectures and demonstrations are given on the plots. In Norfolk there are no definite fixed stations, but the use of land has been granted by farmers for experiments on the effect of manures on crops grown in the ordinary course of farming. Feeding experiments have also been conducted.

A paper from Prof. H. W. Vogel was read, in his absence, by the Secretary, dealing with the history of the development of orthochromatic photography. Photographs were shown illustrating the advantages of the use of eosin-silver as a sensitiser, the plates being more sensitive to the yellow rays than plates prepared with ordinary eosin.

Mr. C. H. Bothamley read a paper, illustrated by lantern slides and specimens, on the sensitising action of dyes on gelatino-bromide plates. The manner in which the dye acts was discussed, experimental evidence being given against Abney's view that an oxidation product, formed by the action of light on the dye, is the active agent in assisting the reduction of the silver bromide by the developer. The probabilities appear more in favour of Eder's view that the dye or sensitiser absorbs the energy of the light waves, and passes that energy on to the silver bromide with which it is associated, the silver bromide being thereby decomposed, and the so-called latent image being formed.

In reply to questions by Lord Rayleigh, Dr. Kohn, and Dr. Harden, Mr. Bothamley said that, so far as he was aware, photo-chemical action is always preceded by the absorption of light-waves, and in the case of colourless substances it is the ultra-violet rays that are absorbed and do the chemical work. Although the quantitative composition of the latent image is not known, we have, as a matter of fact, considerable knowledge as to its properties. There is no difficulty in determining the absorbing action and the sensitising effect on two contiguous strips of the same plate, and therefore under strictly comparable conditions. No relation can be traced between the fluorescence of a dye and its sensitising action.

The report of the Committee for investigating the action of light upon dyed colours was read by the President. With some few exceptions, all the available red, orange, and yellow colours, as applied to wool and silk, have now been exposed. (Tables are appended giving the general result of the exposure.) As before, it is found that many natural dye-stuffs are by no means so fast as is generally supposed, and are exceeded in this respect by artificial colouring matters.

Two papers on organic chemistry were contributed by Dr. J. J. Sudborough. In the first paper, the author describes the preparation of a monochloro-stilbene from deoxy-benzoin, differing from that described by Linin, as it is a solid, crystallising from alcohol in large colourless plates. An oily compound, corresponding to that of Linin, has been prepared, and is being further investigated. Other stilbene derivatives are described.

In a note on the constitution of camphoric acid, the author draws attention to the fact that, as regards its etherification, camphoric acid shows a marked resemblance to some of the polycarboxylic acids investigated by Victor Meyer and Sudborough, and to hemi-mellitic acid. The formulæ of Armstrong and of Bredt are regarded as best agreeing with the behaviour of camphoric acid in this respect.

Mr. H. J. H. Fenton gave an account of the preparation and properties of a new organic acid obtained by oxidising tartaric acid under certain conditions in presence of a ferrous salt. It can be obtained by the oxidation of moist ferrous tartrate in the air, and it is found that this reaction is much accelerated by light. The acid has been isolated, and proves to be a dibasic acid having the formula $C_4H_4O_6 + 2H_2O$. It gives a beautiful violet colour with ferric salts in presence of alkali. The constitution of the acid is under investigation. Heated with water it is resolved into carbon dioxide and glycollic aldehyde, the latter substance polymerising to form a sweet-tasting solid gum having the formula $C_6H_{12}O_6$.

The Committee for investigating isomeric naphthalene derivatives report that the fourteen isomeric tri-chlor derivatives have been obtained.

Dr. M. Wildermann read two papers on physical chemistry. In the first, experimental evidence was quoted, showing the validity of Van 't Hoff's constant, Dalton's law, &c., for very dilute solutions. In the second paper, on the velocity of reaction before perfect equilibrium takes place, an attempt was made to develop equations of equilibrium from experiments made by others on the rate of solidification of phosphorus and other substances.

Messrs. C. F. Cross and C. Smith contributed a paper on the chemical history of the barley plant. The work had been carried out during the two years 1894 and 1895 on the experimental plots at Woburn, and the general conclusions drawn were that the conditions of soil nutrition had very little influence upon the composition of the plant; that the straw grown in wet seasons had a high feeding value and conversely a low paper-making value; and that the compounds known as furfuroids were continuously assimilated to permanent tissue in a normal season, but in a very dry season the permanent tissue is drawn upon by the growing plant for nutrient material which is ordinarily drawn from the cell contents.

THE RETIREMENT OF PROFESSORS.

THE report of the Committee appointed by the Treasury to consider the question of the desirability of a fixed age for the compulsory retirement of professors serving under the Crown has been recently published as a Parliamentary paper. The Committee consisted of Lord Playfair, Lord Welby, and Sir M. W. Ridley, M.P. Mr. C. L. Davies was secretary. The report, which is addressed to the Lords Commissioners of her Majesty's Treasury, is in the following terms :—

We have taken the evidence of presidents and professors of the Queen's Colleges in relation to their retirement upon superannuation at fixed ages, as determined by the Order in Council of August 15, 1890. We are of opinion that the Commission of 1888, upon the report of which, to some extent, that Order in Council was based, did not intend that the limitations of age applied to Civil servants generally should be deemed applicable to presidents and professors of colleges, who are appointed and serve under different conditions from those which prevail in the Civil Service.

These presidents and professors are appointed at a maturer age, and have, by the nature of their employment at seats of learning, less tendency than Civil servants to become inefficient at the age of sixty-five. Indeed, up to that age it is often found that their efficiency increases, by experience in teaching, as their age progresses, though undoubtedly a time does arrive when advancing age weakens the receptivity of the professor to new discoveries in science, and diminishes the inclination to alter his instruction in order to adapt it to these changes. When this occurs the students are the sufferers. In the German Universities this well-known degeneration of intellectual activity among the aged is partly compensated by the appointment of active young "extraordinary professors," who, though not on the ordinary staff of the colleges, are allowed to give competing lectures within their walls. In Edinburgh an extra-mural competition is encouraged, and in each Scotch University, when professors show diminished efficiency through age, it is the duty of the University court to superannuate the professor under a pension scheme, which is charged upon a fixed Parliamentary vote for all the Scotch Universities. The Queen's Colleges in Ireland are in a different position, for they are only to a small extent dependent upon votes in Parliament, being mainly supported out of the Consolidated Fund. They are, in consequence of this peculiarity, in more intimate connection with the executive Government, with which the presidents are in frequent communication as to the working of the college and the efficiency of the professors, who are appointed by the Crown and can be dismissed by the Crown. The statutes which govern the Colleges also emanate from the Crown, and are not, like those of other colleges, the product of academic autonomy.

Under these circumstances, we are of opinion that there should be fixed rules as to superannuation of presidents and professors, and that they should be made by college statutes and not by an Order in Council.

We are of opinion that when a professor reaches sixty-five years of age the president of the college should be bound to report to the Government the condition and efficiency of the teaching. If these are and continue to be satisfactory, the professor need not be superannuated till seventy, but at this age his retirement should be absolute.

In regard to presidents, we are of opinion that the age of seventy should be the period of retirement, but, should the visitors of the college formally report that the college would suffer by the loss of the experience which the president has acquired, we think that the Treasury, and not the Irish Office, should have power to continue him as president for a certain