

graphical research can only be referred to the brochure itself, the seventy pages of which contain much useful and instructive data. Included will be found a number of photographs illustrating various stations, and diagrams showing the method of taking observations. In addition there are four relief maps of the north-eastern portion of Italy (Venice and the adjacent provinces), indicating the scope of operations and their localisation. There is an interesting description of the construction of an experimental tank at Stra.

### POSITIVE RAYS OF ELECTRICITY.<sup>1</sup>

THE first part of the paper contains a discussion of the evidence afforded by the positive rays as to the nature of the ionisation of the gases in a discharge tube and the properties of atoms. The positive rays consist of:—

- (1) Atoms with one positive charge.
- (2) Molecules with one positive charge.
- (3) Multiply charged atoms.
- (4) Atoms with one negative charge.
- (5) Molecules with one negative charge.

All the diatomic gaseous elements which have been examined furnish both atoms and molecules with single charges. The proportion of atoms to molecules varies very largely with the conditions of the electric discharge, and evidence is given that the charged atoms and molecules are produced by different processes. It is suggested that the ionisation which gives rise to molecules is due to cathode rays, while the charged atoms are produced by the impact of charged atoms and molecules.

All the elements examined, with the significant exceptions of hydrogen and a substance of atomic weight 3 ( $X_3$ ), furnish, under certain conditions, atoms with more than one charge. The power of acquiring multiple charges seems to be connected with the atomic weight rather than with the valency or other chemical property of the atom. Thus the atom of mercury, the heaviest atom investigated, can have as many as eight changes, crypton five, argon three, while the lighter atoms, as a rule, have only two. No undoubted case of a doubly-charged *molecule* of an element or compound has yet been discovered.

The negative charge is found on the atoms of some elements, e.g. hydrogen, oxygen, carbon, sulphur, chlorine, but not on the atoms of nitrogen, helium, neon, argon, or mercury. It may be regarded as an indication of the chemical activity of the atom, in so far as this depends upon the intensity of the electric field outside the atom. No negatively electrified molecules of compounds have been observed; the only cases of negatively electrified molecules of elements are those of oxygen and carbon, and these only occur when the elements are liberated from special types of compounds.

The second part of the paper deals with the use of these rays as a method of chemical analysis. Several applications of the method are considered. The first of these is to the detection of rare gases in the atmosphere. It is shown that while none of the heavier gases in the atmosphere occurring in quantities comparable with that of xenon have escaped detection, this is not the case with the lighter gases.

"Neon," it is shown, is not a simple gas, but a mixture of two gases, containing a large quantity of a gas of atomic weight about 20, and a much smaller quantity of one with an atomic weight about 22. The "22" gas was first observed in samples of residues of liquid air supplied by Sir James Dewar, and

has since been found in every specimen of neon examined, including a specimen supplied by M. Claud, of Paris, and a very carefully purified sample of neon prepared by Mr. Watson. The sample from M. Claud contained a small quantity of a substance with atomic weight 3, the properties of which are discussed later on.

Another application of this method was to the analysis of the gas in a small glass tube in which 30 mg. of radium bromide had been sealed for more than ten years; in addition to helium, the gas contained considerable quantities of "neon" or some element with very nearly the same atomic weight; there was also a trace of argon in the gas, a little more than would have been expected from the volume of air in the tube, although the difference was not very great.

The other application of the method is to the investigation of the properties of a substance for which  $m/e=3$ ,  $X_3$ . This gas is given off by most solids when they are bombarded by cathode rays. Reasons are given for concluding that the substance is not the carbon alone with four charges.

The gas has the following properties:—

It can pass through tubes containing red-hot copper oxide, and then over potash without being absorbed.

It is not changed when sparked for a long time with an excess of oxygen, the oxygen being subsequently removed by phosphorus.

It can pass over metallic sodium without being absorbed, nor does it disappear when heated along with sodium vapour.

It is absorbed by charcoal cooled with liquid air, but it can circulate through a glass spiral immersed in liquid air without being condensed.

It combines with mercury vapour when an electric discharge is sent through the mixture; it also combines to some extent with red-hot copper when passed slowly over it. If stored over mercury vapour it seems to diminish, though very slowly. The gas has been detected after it has been stored for several weeks.

The study of the positive-ray photograph indicates that the substance is monatomic, and generally it seems to be similar in its behaviour to the inert gases, although its chemical properties are apparently a little more energetic.

### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. Shipley, master of Christ's College, has been reappointed representative of the University on the council of the Marine Biological Association.

On June 3 the Rev. S. A. Donaldson, master of Magdalene College, was re-elected Vice-Chancellor of the University for a second year.

It is proposed to confer the degree of Doctor of Letters, *honoris causâ*, upon Commendatore Giacomo Boni, director of the excavations on the Forum and the Palatine.

The registry reports that the matriculation this term brings the number of new students for the academic year 1912-13 up to 1200. In the last academic year the numbers were 1156.

Mr. R. Assheton, of Trinity College, and Mr. L. Doncaster, of King's College, have been approved by the general board of studies for the degree of Doctor of Science.

OXFORD.—A summer course in advanced practical organic chemistry, with demonstrations, will be held at Queen's College, on August 1-30, by Mr. F. D.

<sup>1</sup> Summary of the Bakerian lecture delivered before the Royal Society on May 22 by Sir J. J. Thomson, O.M., F.R.S.

Chattaway, F.R.S. The class is open to students who are not members of the University.

THE new college buildings of Bedford College for Women at Regent's Park, London, N.W., are to be opened by the Queen on July 4, at 3 p.m.

VACATION courses for instrument-makers and glass-blowers will be held at the University of Leyden from August 21 to September 4. Particulars of the courses can be obtained from the director, Prof. H. Kamerlingh Onnes, or the general secretary, Dr. C. A. Crommelin.

THE Commemoration Day proceedings at Livingstone College on June 7 will be the celebration by the college of the Livingstone centenary. The reception of the special delegates and visitors by the principal will be from 3 to 3.30 p.m., and afterwards a number of addresses will be given and an exhibition held.

At the end of the present academic year Cornell University, N.Y., will lose the services of Prof. H. H. Norris, who has occupied its chair of electrical engineering since 1905, and has been head of the department since 1909. He is resigning in order to undertake editorial work in connection with *The Electrical Railway Journal* and *The Electrical World*.

THE following appointments have been made to the faculty of the new school of technology in connection with Johns Hopkins University, Baltimore:—Prof. C. C. Thomas, of the University of Wisconsin, to the chair of mechanical engineering; Prof. C. J. Tilden, of the University of Michigan, to the chair of civil engineering; and Prof. J. B. Whitehead, hitherto professor of applied electricity in Johns Hopkins University, to the chair of electrical engineering.

AN influentially signed memorial has been sent to Lord Haldane, in his capacity of Chancellor of the University of Bristol, directing attention to the circumstances in which Mr. R. P. Cowl, formerly professor of English literature, was removed from the University of Bristol in 1910. The signatories point out that it appears that a grave injustice may have been committed, and ask for a full investigation of the case. In the first list of signatories there are many distinguished names, including the following men of science:—Prof. W. Ridgeway, Sir Bertram Windle, Profs. R. H. Yapp, J. A. Green, W. M. Travers, P. F. Frankland, Leonard Hill, William Bullock, J. Adams, Gisbert Kapp, F. W. Burstall, W. M. Bayliss, E. W. Hobson, and F. R. Japp.

It is announced in *Science* that Mrs. G. W. Hooper, of San Francisco, has transferred to the University of California 200,000*l.* for the establishment of an institute of medical research. We learn from the same source that the late Prof. Louis A. Duhring, formerly professor in the University of Pennsylvania, in his will disposes of an estate valued at about 100,000*l.* The will creates a trust fund of 5000*l.*, the income of which is to be used for the benefit of the department of cutaneous medicine, and it gives the University of Pennsylvania Hospital 10,000*l.* for the establishment of free beds in which cutaneous, cancerous, and allied diseases shall be treated and studied. After a number of private bequests have been made, the residue of the estate is to be given to the trustees of the University of Pennsylvania, and applied to the treatment of cutaneous diseases and their study.

THE Apprenticeship and Skilled Employment Association has issued its seventh annual report. The work of the association is, among other matters, to watch over the interests of juveniles so far as they are affected by fresh legislation. During the year

under review the association has inquired into the hours of employment of van and errand boys, and the conditions of employment of boy clerks in the Civil Service; and representatives of the association have given evidence before the Royal Commission on the Civil Service. It is satisfactory to know that the London County Council has adopted a suggestion made a short time ago by the association that attendance at continuation classes should be made a condition of employment of their laboratory monitors. These lads on leaving the council's service have, as in the past, been referred to the association, and have in almost every case been successfully placed. The report gives further interesting evidence that there is a growing disposition among public bodies to make use of the services of the association in the matter of boys and girls under their supervision.

THE issue of *The Fortnightly Review* for June includes an article on vocational education by Mr. Cloudesley Brereton. The whole spirit of vocational education is, he maintains, that the manual work and crafts with which it deals should not be taught mechanically, or as a mere rule of thumb, but should be used as veritable instruments of culture. In London, vocational education has led, apart from the polytechnic movement and the great extension of trade schools, to the conversion of the higher elementary schools into central schools, to which has been given a definite bias for the preparation of the pupils for an industrial or commercial life; while the work in the infant schools and lower grades of the elementary schools is every day becoming more concrete and constructive. It is to be hoped, Mr. Brereton thinks, that any scheme of national education will immensely enlarge the facilities for vocational education, and be the means of bringing the university into closer touch with the business world and the locality of which it should be the spiritual and intellectual inspiration. One thing is, he says, at least certain: we shall never gain the full confidence of the business world and the working classes until we can show that education is practical, *i.e.* that it has an economic value; while if we are to retain the confidence of those who believe in the spiritual side of education, we must likewise hold fast to its humanistic ideals. Vocational education in the widest sense means the working out of the combination of these ideals.

## SOCIETIES AND ACADEMIES.

### LONDON.

**Royal Society**, May 29.—Sir Archibald Geikie, K.C.B., president, in the chair.—Prof. A. B. Macallum: *Acineta tuberosa*: a study on the action of surface tension in determining the distribution of salts in living matter. In previous investigations it was found that the salts demonstrated microchemically to occur in the living cell were not uniformly diffused but were condensed or "localised" at points in its cytoplasm, or at parts of its surface. Amongst such salts were the compounds of potassium, which are very soluble and are not known to form precipitates in nature. It was concluded that some other force than simple osmotic pressure was concerned in this distribution of the salts, especially in the cases where the condensations were in those portions of the cell surface where, from the deformation observed, it was inferred that a lowering of surface tension was involved. The explanation advanced was that surface tension was the factor primarily concerned in these condensations. Two years ago an investigation of the distribution of potassium salts in *Acineta tuberosa*, a marine Suctorian Protozoan, gave results which appear to place