HISTORICAL CHEMISTRY COLLECTIONS AT THE UNIVERSITY OF ST. ANDREWS

A VALUABLE gift of more than eighty books dealing with historical chemistry has recently been made to the library of the Chemistry Department, United College, University of St. Andrews, by Dr. Leonard Dobbin, the doyen of Scottish chemists and a leading authority on the history of his science. Many of these books are rare, and the addition will strengthen notably one of the outstanding collections of the kind in Great Britain. Besides a reference section in constant use by research students and members of the chemistry classes, this departmental library contains a collection of great interest, comprising books, manuscripts, holograph letters, portraits, engravings, and even a few paintings, dealing with alchemy and historical chemistry. The oldest manuscript is a Latin collection of early treatises on alchemy, of the fourteenth century, and there is a fine copy of the first printed work by any Scots man of science—the "Physionomia" of Michael Scot, published in Venice in 1477.

Among other items are some holograph writings on alchemy by Sir Isaac Newton, and an unusually complete set of the alchemical books of Count Michael Maier, "the musical alchemist of Prague". There is also a handsome copy of Agricola's "De Re Metallica" (Basle, 1561), bearing the signature of the second professor to hold the chair, M. F. Heddle, by whom it was bound in leather; this book came back to the Department in a romantic way in 1931. A set of John Dalton's "New System of Chemical Philosophy" bears an inscription in the author's handwriting to his friend, Dr. Joseph Ransome.

Of the total of nearly three thousand volumes in this library, about one-third belong to the historical section. An original small nucleus consisted of books formerly belonging to Prof. Arthur Connell, the first occupant of the chair (1840–62); but most of the items have been acquired during the term of office of the present incumbent, Prof. John Read. Many of them have been described in Prof. Read's recent trilogy of historical works, "Prelude to Chemistry", "Humour and Humanism in Chemistry" and "The Alchemist in Life, Literature and Art". Owing to the cramped accommodation in the Department, it is impossible to do justice to these collections of books, etc., which call urgently for safer housing and an effective system of display. During the past few years a connexion has been established between this library and the Edgar Fahs Smith Collection in the University of Pennsylvania, and Prof. Read has become associate editor of *Chymia*, an annual publication devoted to historical chemistry and emanating from the University of Pennsylvania.

The St. Andrews collection is supplemented by more than two thousand lantern slides, many of which deal with historical chemistry and have been reproduced from original sources. Cognate research collections illustrate by means of original specimens the investigations that have been carried out in the Department, since the days of Purdie, in the fields of stereochemistry, carbohydrate chemistry and terpene chemistry; and there are also some items of Australian interest. In addition, the library contains a balance of 1750 with a 37-inch beam, and a collection of chemical apparatus dating from the days of Black and Priestley in the latter half of the eighteenth century. This apparatus, found in the ancient tower of St. Salvator's Chapel about 1925, includes crucibles, earthenware retorts, glass alembics, a magnificent glass matrass six feet in height, and other items. It is likely that this apparatus was bought in 1811 from Dr. Thomas Thomson, another historian of chemistry, who disposed of a good deal of chemical apparatus to the University of St. Andrews when he resigned his chemistry lectureship at Edinburgh in that year.

AMSTERDAM CONFERENCE ON ION SOURCES

MORE than fifty people, including visitors from Belgium, France, Great Britain, Sweden and Yugoslavia, attended a Conference on Ion Sources which was held in the Zeeman Laboratory in Amsterdam during November 15–16, 1949. Prof. C. J. Bakker, director of the Dutch Institute for Nuclear Physics, opened the Conference, warmly welcoming the foreign participants, and briefly surveying the general problems in ion-source design and operation.

The first speaker, Dr. P. C. Thonemann (Oxford), described the development work on the high-frequency ion source. The principal points discussed included (*a*) the space-charge flow of ions through a metal canal, (*b*) production of a high concentration of atomic gas in the discharge space, and its relation to the proton percentage in the ion beam, (*c*) the extraction and focusing of ions into a canal, and (*d*) the energy inhomogeneity of the ions. Ion currents of 1 m.amp. containing more than 90 per cent protons have been recorded. The paper was illustrated by slides.

Experiments performed with ion sources of the Finkelstein and Penning type were dealt with by Mr. P. V. Veenstra (Utrecht). The discharge current varies with both the anode potential and magnetic field. The position of the maximum current depends only on the anode potential, and its magnitude varies with pressure. If the gas pressure is increased from a low value, a point is reached at which the slowly increasing discharge-current jumps to about five times its initial value. A similar phenomenon occurs with increasing magnetic field. On reducing either pressure or magnetic field, a marked hysteresis is observed. The condition of large discharge-currents Mr. Veenstra termed "the super state", and he reported strong high-frequency oscillations in this state. From both sources he reported currents of about 1 m.amp. (50 per cent protons). Dr. Thonemann suggested that the initiation of the 'super state' corresponds to the formation of a plasma at a potential positive to the cathode. Bombardment of the cathode by positive ions thus enhances the electron emission, and the discharge then shows all the characteristics associated with the low-voltage arc.

In the afternoon short papers were read. Mr. R. Björnerstedt (Stockholm) reported experiments on a Zinn-type ion source and the precautions necessary to obtain an unambiguous measure of the ion current. It has been noticed that the focused ion currents show a dependence on the probe material. Major E. Thomas (Brussels) read a paper on a high-frequency

ion source under construction for a cascade generator of 1·4 MeV. Mr. M. E. Reinders (Amsterdam) pointed out that in the Nier-type source used in his mass spectrometer the electron beam forms a potential trough which may prevent molecular ions escaping while atomic ions, formed with considerable kinetic energy, escape readily. Thus maximum currents of H^+ and D^+ are obtained with electron currents of 500 μamp., whereas the molecular ion currents of H_2^+ and HD^+ are a maximum for currents of 1 μamp. This discrimination must be considered when, for example, the relative abundance of hydrogen and deuterium are being compared by the atomic ions. The difference in the nuclear separation of diatomic hydrogen and deuterium leads, on dissociation by electron bombardment, to different kinetic energies of the monatomic ions. The same afternoon the Laboratory for Mass Spectrography was visited, and the magnetic ion source of the Heil type was demonstrated. A 180° isotope separator (100-cm. radius) is under construction.

On November 16, Dr. M. Hoyaux (Charleroi) read a paper on "Cyclotron Ion Sources". After reviewing the earlier types of sources, he discussed in some detail the physical and mathematical problems associated with the adaptation of the Von Ardenne-type source for use in a cyclotron. Using as a basis the Broullin theory of the magnetron, he sketched the extension necessary to include the effect of gas collisions on the radial electron density and potential distribution. Theoretical work on the extraction mechanism is being pursued. Experiments at Charleroi on high-frequency ion sources for cyclotrons are due to begin.

The next speaker, Dr. J. Kistemaker (Amsterdam), discussed "Physical Problems in High-Intensity Ion Sources". He divided the subject into three main problems: (*a*) Production of ions in the discharge: for a given filament emission current, a maximum number of ions can be produced by choosing the correct accelerating voltage and increasing to a maximum the total electron path (for example, an oscillating electron source using an axial magnetic field). (*b*) Transport of ions to the exit opening: the potential distribution in the discharge must be such that the ions converge towards the exit opening and are drawn from a volume of intense ionization. (*c*) Extraction of ions: the ion currents are limited by space charge, and sufficient ions must drain towards the exit opening so that penetration of the extracting field into the discharge is not sufficient to extinguish it. Various questions of gas economy were discussed. An ion source has been constructed in which 50 per cent of the total flow through the exit opening are ions. At a gas pressure of 6×10^{-5} mm. of mercury and an extraction voltage of 8 kV., 6 m.amp. of helium ions were measured passing through an exit 1 cm. in diameter.

In the afternoon, Dr. C. Cassignol (Paris) discussed the "Extraction and Focusing of Ion Beams". He mentioned a promising type of magnetron ion source consisting of two short concentric cylinders in which the outer is the anode and the inner a perforated cathode. Due to the extended electron paths, intense ionization is produced at low pressures, and part of the ion current passes through the cathode and is extracted in an axial direction. Experimental results are not yet available. Some interesting information about the operation of the ion source in the Nier isotope separator was given by Dr. R. Bernas (Paris). He has observed that with increasing magnetic field the initial ion current (2 m.amp. focused beam) suddenly drops practically to zero while the probe and discharge current both increase. It is suggested that a sudden transition to a 'super state' completely altered the previous condition in this source, and the ion beam issuing from the exit slit was then widely divergent. Dr. P. M. Endt (Utrecht) then described some experiments on a pulsed Finkelstein source.

In the final talk of the session, Dr. H. Brinkman (Arnhem) suggested that very pure proton currents could be obtained by ionizing hydrogen in a tungsten cylinder maintained at 2,500° C. At sufficiently low pressures, dissociation of molecular hydrogen is practically complete at this temperature. An anode placed in the tungsten cylinder serves to accelerate the electrons. The Conference was closed by a visit to the 30-MeV. synchro-cyclotron in the Institute of Nuclear Physics.

C. J. ZILVERSCHOON

EDUCATION IN BOLIVIA

ANOTHER of the series of basic studies on education in certain Central and South American countries has been prepared under the ægis of the United States Office of Education. The studies are part of a programme to promote understanding of educational conditions in the American countries and to encourage co-operation in the field of inter-American education. Begun in 1943, the project involves travel by Office of Education specialists in the various countries to gather first-hand information on their educational systems and the preparation of reports from these data for publication. "Education in Bolivia" is based on data gathered by R. H. Nelson in Bolivia in 1947 and supplemented since then through documentation (Washington, D.C.: Government Printing Office).

Situated in the west-central region of South America, Bolivia is one of the two countries in the western hemisphere without a sea coast or sea port. Its area is estimated at half a million square miles, which is roughly ten times the size of England. Two principal mountain ranges cross the country from north-west to south-east. Between these ranges lies the High Plain, the largest and highest plateau in the western hemisphere, from which Bolivia gets the popular name of the "Land in the Sky". To the east, in the lowlands of the Amazon and Parana Plain, lies a tropical and sub-tropical section which comprises almost two-thirds of the total area of the Republic. In the highland plateau and the valleys leading eastwards from it are located the largest and most important cities of the Republic, La Paz, Cochabamba, Sucre, Potosi and Oruro.

The climate ranges from tropical heat in the eastern section to arctic cold in the mountains and high plains of the west. In the valleys to the east the climate is temperate. In both these regions the soil is largely poor and thin, but supports a meagre agriculture which supplies in part the needs of the peoples of these areas. In the eastern two-thirds of the country the possibilities of agricultural production are rich, although at present this area is sparsely populated and virtually undeveloped.

The 1,400 miles of railways in Bolivia form a system which connects the principal cities. Road and railway construction are enormously expensive in the rugged mountain areas, and a serious defect in the transportation is the lack of road and railway connexions with the eastern lowlands. Two principal