

cut up into groups which are rendered audible to the wireless operator by means of a telephone receiver, which gives a click for every wave train, the signal being, of course, first rectified by the valve, so that a succession of musical sounds are heard in the telephone receiver corresponding to the Morse alphabet. The intermediate or high frequencies in each wave train are beyond human audibility, and are therefore not heard. The wave generated by the valve is, however, a continuous one, that is to say, every time the sending key is pressed a group of continuous waves are sent out at a frequency determined by the wave-length. To render them audible in the telephone at the receiving end, a local valve oscillator is used for generating frequencies slightly lower or higher than the received signal and, by heterodyning or superimposing one on the other, a frequency equal to the difference of the two notes is heard in the telephone receiver. This allows of exceedingly fine tuning, for the frequency of the local generator being under the control of the receiving operator, the difference in pitch is adjusted to 1000 cycles, the best value for human reception. It will therefore be seen that frequencies of as low as 1 can readily be detected, although, when the difference becomes very small, there is a tendency for one oscillator to pull the other into step.

Probably, the most interesting application of the thermionic valve is its use in radio-telephony. Here the valve is used to generate continuous waves in a suitable circuit and, by means of a microphone, the voice of the speaker is made to vary the amplitude of this wave at the different audible frequencies which are used in speech formation. These modulations are then conveyed to the aerial, and the telephone diaphragms at the receiving end are correspondingly stimulated and reproduce the speech exactly as transmitted. Numerous other uses have been found for the thermionic valve, among which may be mentioned direction finding, the navigation of aeroplanes in flight, its use as a rectifier for charging batteries, communication between moving trains, and the control of energy at great distances. In the latter direction mention may be made of communication by radio-telephony having been definitely established between England and Australia. Wherever a succession of signals can be received, they can always be amplified and made to operate selective electrical or mechanical relays for controlling power of any magnitude. The future holds a wonderful vision of vast operations at one end of the earth, being controlled by mankind at the other without any other medium than the æther.

Obituary.

PROF. PHILIPPE A. GUYE.

BY the death of Prof. Philippe Auguste Guye, on March 27, Switzerland loses one of the most eminent of her savants, and the world of science is the poorer by the passing away, in the full maturity of his intellectual powers, of an assiduous and successful cultivator of natural philosophy, distinguished alike for the range and profundity of his knowledge, the force of his genius, his originality, his ingenuity and remarkable experimental skill. Geneva has long been a home of science; some of her citizens are among the most honoured of its votaries, and Guye now assumes his due position on a roll already made illustrious by the names of Saussure, De La Rive, and Marignac.

Philippe A. Guye was born at Saint-Christophe (Vaud) on June 12, 1862. His earliest scientific studies were made at the University of Geneva, where he worked under Graebe, with whom he published papers on diphthalyl and on naphthalene hydrides—a modest enough theme for the 'prentice hand—mainly a repetition of Graebe's observations of ten years previously, which seemed to have been called in question by the subsequent work of Agrestini. After taking his doctorate he repaired to Paris, where he remained some years, working in the laboratory of Friedel. Here he appears to have come under the influence of ideas on spatial chemistry which science owes to Le Bel, and much of his work during the next few years was devoted to their development. In 1892 he was recalled to Geneva to occupy the chair of theoretical and applied chemistry in the university of that city, to which he remained attached for thirty years. During this period Guye, by

his energy and personal influence, his organising power, and the catholicity of his scientific aims, made an indelible impression on the academic life and activities of the university. He surrounded himself with a body of earnest and enthusiastic workers, attracted from all parts of the world, to whom he gave freely from a wealth of ideas which ranged over every department of chemical and physical science. It is estimated that upwards of 600 communications emanated from the Geneva laboratory while under his direction, some 200 of which bore his own name alone, many others being joint contributions by himself and his pupils. His own work was characterised by a rigorous sense of accuracy, by caution and a recognition of possible sources of error, amounting almost to intuition, combined with a capacity for generalisation and a *flair* for fruitful hypothesis which seemed, at times, like divination.

Although Guye began his scientific life under the guidance of Graebe, and at a time when the theory of organic chemistry and its technical applications were developing with extraordinary rapidity and success, systematic organic chemistry of the type with which the name of his eminent teacher is associated had few attractions for him, and it is doubtful whether Graebe's teaching and example had any permanent influence on his career. At all events, on his election to the Geneva chair he embarked upon the long series of investigations on problems of physical chemistry on which his fame mainly rests. He was early attracted to the many issues to which the molecular theory of Van der Waals gave rise. He discovered a series of new relations between the physical constants of liquids and their molecular magnitudes, and he greatly

extended the conception of molecular association in liquids. He devised new methods of determining the molecular weights of substances in the liquid state and at the critical point. He attacked the study of molecular dissymmetry, and traced the connection between optical activity and homology in liquids, between isomerism of position and rotatory power, and with the aid of his pupils he accumulated a great mass of experimental material which served to extend and substantiate his generalisations.

In 1903 Guye turned his attention to the study of atomic weights, and, in particular, to a critical examination of the experimental basis upon which these magnitudes rest. He thereby followed and perpetuated a tradition with which the fame of the Geneva school of chemistry, as personified by Marignac, will always be connected. Practically the greater number of the 100 contributions to the literature of chemistry which we owe to Guye's pen during the past twenty years are devoted to this subject, upon which he lavished all the powers of his matured intelligence, his experience, ingenuity, and manipulative skill. Thanks to his organising capacity and the ability and enthusiasm of his collaborators, we have been furnished with a series of fiduciary values which are probably among the best determined of physical constants, in which every known source of error has been rigorously scrutinised, and, so far as possible, eliminated. Naturally the trend of modern developments of ideas concerning the essential nature of the elements, and their fundamental relations and possible interdependence, attracted Guye's alert intelligence, and at the Brussels meeting of the International Conference in June last he pointed out their significance in connection with the proposed re-organisation of the work of the International Committee on Atomic Weights, of which he was an enthusiastic advocate, and on which, had he lived, he would certainly have made his influence felt as a member.

It might be supposed from Guye's mental characteristics, and from the nature of his studies, that he would have little sympathy with the technical applications of chemistry. No such surmise could be further from the truth. Although not a professed technologist, he had a considerable knowledge of manufacturing chemistry, and he enjoyed the confidence and esteem of the leaders of chemical industry throughout Switzerland, to whom he was always accessible, and by whom his counsel and advice were highly appreciated. His name will always be associated with the extraordinary development of electrochemical synthesis in Switzerland, to which his lectures and writings largely contributed.

Guye exercised great influence in scientific circles in Geneva, and took a leading part in the organisation of Swiss science. He presided over the Swiss Physical and Natural History Society, was a member of the central Committee of the Helvetic Society of Natural Sciences, and president of the Swiss Chemical Society and of the Council of Swiss Chemistry. In 1903 he established the *Journal de Chimie physique*, in which the greater number of the communications from his laboratory after that year were published, and he was mainly instrumental in placing *Helvetica Chimica Acta*—now the leading chemical journal in Switzerland—upon a sound and permanent foundation.

Guye's merits as a man of science were widely recog-

nised. He was a member of the Scientific Academies of Petrograd, Madrid, and Bucharest, an honorary member of the Chemical Societies of France and England, a corresponding member of the French Institute, and a foreign associate of the Reale Accademia dei Lincei, and he shares with his countryman Marignac the honour of being a Davy medallist of the Royal Society. To the great regret of his many friends in England, the illness which ended in his death prevented him from coming to London to receive the medal in person.

He has another association with the memory of Davy, who died at Geneva, which British chemists will not forget. They are grateful to Guye for his pious care of the tomb which holds the remains of the great chemist.

T. E. THORPE.

PROF. W. B. BOTTOMLEY.

PROF. WILLIAM B. BOTTOMLEY, Emeritus Professor of Botany at King's College, University of London, died at Huddersfield on March 24, aged 58, after a long and trying illness which began in April 1918 with a seizure resulting from thrombosis. During the four succeeding years these seizures returned at intervals until the end.

Prof. Bottomley was born at Apperley Bridge, Leeds, on December 26, 1863, and was educated at the Royal Grammar School, Lancaster, and at King's College, Cambridge. He then studied at Heidelberg, where he received the Ph.D. degree. He was lecturer in biology at St. Mary's Hospital from 1886 to 1891. In the latter year he was appointed professor of biology at the Royal Veterinary College, and at the same time served as assistant in botany to Prof. Oliver at University College, London, and as a Cambridge University Extension lecturer. In 1893 he was appointed to the professorship of botany at King's College, London, which post he held until his resignation in 1920.

In 1905 Prof. Bottomley made a journey round the world in connection with University Extension work. He did a great deal of extra-mural lecturing under various auspices, and was well known as an excellent lecturer before either a scientific or a popular audience.

Prof. Bottomley's chief scientific interests were in connection with plant nutrition and the relation of these problems to agriculture. Towards the end of the nineteenth century he actively concerned himself with various co-operative agricultural movements, such as the Agricultural Banks Association and the English Land Colonisation Society. He was a man of great enthusiasms, and it is much to be regretted that he was unable to complete the important work with which his investigations were concerned. His name will always find a place in the history of plant nutrition, along with those of Boussingault, Lawes, and others. His most important contribution to the subject of plant nutrition was probably the discovery of what he called auximones, or growth-promoting substances, in materials such as peat which had been subjected to the action of nitrifying bacteria. The acidity of the raw peat had first to be neutralised by the action of ammonifying organisms. Experiments at Kew and the Imperial