small electric motor, *H*, driving the water supply device, rotates the inner drum of the gas pump and causes gas to be delivered to the calorimeter proper, *F*, at a constant rate of ½ cub. ft. of gas per hour. The volume of gas is accurately determined from the known dimensions of the pump. Water levelling, which is an essential and troublesome operation with all existing forms of wet meter in order that the gas volume may be accurately known, is no longer necessary.

The calorimeter, *F*, is of very small thermal capacity, so that a reading of outlet water temperature, steady to within about 0·01° C., is attained in about 15 minutes; and this despite the fact that with the calorimeter as at present constructed, the flow of water through the calorimeter is intermittent in character. Later, if found preferable, the water flow will be made continuous. The gas burns at the end of a small tube made of Pyrex glass which is carried by the arrangement including a Watt parallel motion device shown at *J*. The tubes of this parallel motion device can be used for supplying gas and oxygen to the burner, if desired. The constructional materials used in the calorimeter comprise ordinary glass for the combustion chamber, a Pyrex glass burner tube and brass and German silver, the latter being protected by a coating of special bakelite varnish which very effectually prevents corrosion of the base metal by the products of combustion. The water flowing through the calorimeter suffers no deterioration owing to its passage and is re-circulated. The rise of temperature of the water is a measure of the calorific value of the gas supply and can be observed by thermometers inserted respectively in the inlet and outlet water, or can be recorded by thermometers, preferably of the electrical type, connected with an electric recorder.

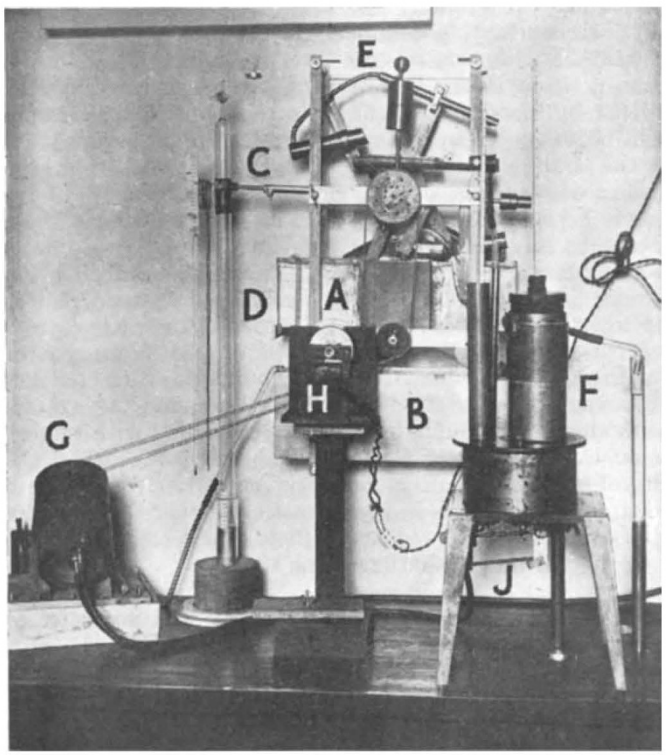

FIG. 1. Dr. Boys's new gas calorimeter.

Concluding his remarks, Dr. Boys stated that he had carried out the whole of the work single-handed and had constructed the whole of the apparatus himself. "For sixty years the Gas Referees have been men of high scientific distinction. My predecessors were Sir Arthur Rücker and Prof. Tyndall and my colleagues and their predecessors were of equal standing. This has always been considered necessary because of the technical difficulties of the questions which they had to decide. The Gas Referees have been in the position of judges, between the gas maker and the gas consumer. Though provision for appeal on their decisions is available, no appeal in all that time has ever been made and heard. Now the Board of Trade is knocking at the door of Parliament to replace the Gas Referees by the cumbersome machinery of the Civil Service."

Dr. Charles Carpenter, president of the South Metropolitan Gas Co., expressed his very high appreciation of the work done for the gas industry by the Gas Referees, and stated that he was unable to understand how the Government is being so misguided as to recommend the abolition of these posts. J. S. G. T.

Obituary

PROF. A. B. MACALLUM, F.R.S.

PROF. A. B. MACALLUM, who died on April 5 at London, Ontario, in his seventy-sixth year, may be regarded as the pioneer of general physiology in Canada. Educated at the University of Toronto, he received his training in physiology under Newell Martin in the then newly organised Johns Hopkins University. Returning to his *alma mater* in 1887, as lecturer in physiology on the staff of biology under Ramsay Wright, he devoted himself to investigations bearing on the interpretation of microchemical reactions.

Macallum's first paper, on the demonstration of iron in chromatin, was published in 1891 (*Proc. Roy. Soc.*, 50, 277) and it was followed two years later by a second one (*J. Physiol.*, 26, 268; 1893) dealing with the path of absorption of this element from the alimentary canal. Methods were then

tested and elaborated for the micro-chemical demonstration in cells and tissues of other elements, especially phosphorus, potassium, calcium and chlorine. He showed (*Proc. Roy. Soc.*, B, **76**, 217 ; 1905) that the colour reaction which tissues give under the influence of light when impregnated with nitrate of silver is not due, as had been supposed, to protein itself but to halogens, so that this staining method could be used for determining the distribution of chlorides in various cytological elements.

Being a keen student of the then rapidly expanding knowledge of physical chemistry, Macallum saw the possibility of using micro-chemical reactions to investigate the position in the cell of adsorbed ions and of thereby determining the extent to which this might be influenced by surface tension. Realising that the chloride reaction was independable for this purpose, because of slow penetration of the reagent, he devised a method by which potassium can be identified microchemically through its precipitation with hexanitrite of cobalt and sodium (*J. Physiol.*, **32**, 95 ; 1905). He showed that when proper precautions are taken, the reagent penetrates the cell rapidly and that the position of the yellowish compound which it forms with potassium can be revealed by subsequent treatment with ammonium sulphide.

A thorough investigation, extending over several years, was then made of the distribution of potassium in plant and animal cells, and it was found that the element is concentrated in regions of the cell in a manner to suggest that alterations in surface tension are responsible. In a review of these researches published in 1911 in *Ergebnisse der Physiologie*, there is a full discussion of the hypothesis that the properties of division and movement in cells, as well as of secretion and absorption, can be attributed in part, at least, to surface tension phenomena. In a later discussion of his results (1913) (Presidential Address, Soc. of Biol. Chem.), Macallum advanced the view that the chief factor in muscular contraction "is the attraction between the molecules constituting the superficial film of a sarcostyle and forming an interface with the sarcoplasm surrounding the sarcostyle". This attraction, which is the cause of the surface tension, is not equal throughout the doubly refracting discs, as is shown by the fact that potassium salts are localised at the ends of the longitudinal axis, indicating, according to the Gibbs-Thomson principle, that the surface tension is lower here than on the lateral surfaces. During contraction, the discs tend to become spherical because the surface tension of the lateral surfaces becomes less. Speculations follow concerning the relationship of the breakdown of the lactic acid precursor to these changes in surface tension, and the paper is interesting reading in the light of the more recent researches in this field.

Macallum also made numerous observations by chemical methods of the percentage amounts of inorganic ions in the tissues and body fluids of various animals. He showed that when regard is paid to the relative proportions of sodium, potassium and calcium, rather than to the absolute concentrations of these ions, there is a striking resemblance between the composition of the ocean and the inorganic composition of the blood plasma of mammals. His first paper in this field appeared in 1903 (on "The Inorganic Composition of the Medusæ", *J. Physiol.*, **29**) and the conclusions there drawn are sustained in a second one published in 1910 ("The Inorganic Composition of the Blood of Vertebrates and Invertebrates and its Origin", *Proc. Roy. Soc.*) in which there is a discussion of the relationship of the development of the kidneys to the inorganic composition of the blood plasma of various marine invertebrates and vertebrates. In this paper Macallum points out that the establishment of a constant internal medium was the first step in the evolution of vertebrates from an invertebrate form and advances the view that the kidney was essentially the first typically vertebrate organ.

Throughout all his investigations, Macallum maintained a broad philosophical outlook and his thorough knowledge of biology and indeed of natural science in general enabled him to find various applications for the results of his laboratory investigations. As examples may be mentioned papers dealing with the origin of life on the globe (read before the Royal Canadian Institute about the year 1903) and the physical and chemical factors in heredity (address as president of the Biological Section of the Royal Society of Canada in 1910).

No account of Macallum's career would be complete that did not refer to his painstaking work from 1916 until 1921 as the first administrative chairman of the Advisory Council for Scientific and Industrial Research of Canada. His influence on the development of scientific research in the Dominion has been very great, partly through his active participation in the work of the Royal Canadian Institute and the Royal Society of Canada, and partly through his association first with the University of Toronto and latterly with that of McGill in Montreal.

Macallum was a man of imposing presence and forceful character, and it will be long before he is forgotten in Canadian scientific circles.

J. J. R. M.

Dr. E. W. Washburn

Dr. Edward Wight Washburn, who died on February 6 at the age of fifty-two years, was the chief of the Division of Chemistry of the U.S. Bureau of Standards at Washington. He was well-known to a wide circle as a physical chemist of distinction and the author of an "Introduction to the Principles of Physical Chemistry".

Washburn was a graduate of the Massachusetts Institute of Technology, where he was a pioneer in the study of the hydration of the ions in aqueous electrolytes. From 1908 until 1922 he held appointments in physical chemistry and then in ceramic