towers; the pipe-lines would be tapped to convert the heat through thermostatically controlled calorifiers in consumers' premises. The County of London Plan, with its new roads, both radial and ring, offers not only suitable routes for the large piping which would be required for the main heat transmission routes, but also, since these routes go through areas which are intended for planning on the ten-story-block-of-flats principle, the latter could be designed immediately for district heating with a minimum of capital expenditure, thus saving valuable boiler accommodation and fuel storage.

With regard to competitive forms of heating, the Engineers' Study Group on Economics, collecting information from many organizations, had previously deduced that it is in the national interest to use gas rather than electric power for basic domestic heating, the point being that if large sections of the population could be persuaded to abstain from wastefully using soft coal in domestic hearths and to use coke or other low-temperature carbonized coals instead, it will be necessary, in order to provide such hard fuel at reasonable cost, economically to get rid of great quantities of the minimum gas which is necessarily involved in producing any specified quantity of hard fuel. Prof. C. L. Fortescue, in an informal discussion at the Institution of Electrical Engineers, also arrived at the desirability of increased domestic heating by gas from other arguments. Thus there is competition on technical, social, and economic grounds between district heating by waste-heat from power stations, and domestic heating by means of gas. Electric power is so precious and high-grade that it must be considered out of the question for basic domestic heating, except in special circumstances.

A further reason for the usage of gas for basic domestic heating is the technical one of regulation. It is well known that in suburban areas in which domestic gas-cooking is prevalent, the drop in pressure at the peak-loading, especially for Sunday dinners, is serious. It is therefore desirable to use electric power for cooking, because of its high regulation, which is also essential for lighting and normal power requirements. We are thus led to conclude that electric power should be reserved for those applications where good regulation is desirable, and gas should be used where, through automatic control, such as in gas central heaters, which have been hitherto little used in Great Britain, close regulation is not essential.

What case, therefore, can be made for district heating? It must be based on the fact that electric power is increasingly demanded, and therefore there is a waste of energy, as explained previously. It follows, therefore, that in the national interest district heating should be used where practicable and economic, the gaps being filled by gas. Electric power should be reserved for those applications where it is most effective, such as electric traction, electric lighting, and the manifold large and small power uses where its delicacy of control gives it an advantage over any other competing form of power.

On social grounds, district heating would, at one stroke, if carried out on a large scale in large centres of population, dispose of the necessity of the traditional domestic fire and the consequent wastage of heat into the open sky, the pollution of the atmosphere with unconsumed carbon, and the wide-scale deterioration of buildings because of the sulphur acids emitted into the atmosphere. The point here is that whereas in large power stations the exhaust

gases can be cleaned efficiently, or so dispersed in countryside areas that their effect on man and Nature is substantially zero, there can be no such control over the tiny combustions which occur, to the number of millions, in domestic premises. The general adoption of central heating which has taken place in other countries may not be desirable in Great Britain; in fact, the ideal for our more moderate but erratic climate would be semi-central heating, topped up with a small amount of radiation, gas or electric. In this way the great value of our climate—its variability between extremes which are small in comparison with climates in other parts of the world—is conserved, both indoors and without.

L. E. C. HUGHES.

OBITUARIES

Mr. A. C. Gardiner

ALAN GARDINER died on August 29 at the age of forty-six. The news came as a great shock to his many friends, and hydrobiology suffered a severe loss. He was educated at Oundle and Gonville and Caius College, Cambridge, and inherited a love of science from his brilliant father, the late Dr. Walter Gardiner. As soon as he had graduated in 1920 he began the line of research which always continued to attract him: the problems of plankton ecology, sometimes freshwater, sometimes marine, and refinements in the methods of attack. This work, although broken by periods of illness, was always taken up again, and he was actively pursuing it at the time of his death.

His first investigations, in collaboration with the late Mr. Rowland Southern, were made over several years from a floating laboratory on the River Shannon where it flows into Loch Derg. The amount of data they amassed, biological, physical and chemical, was enormous; in studying the diurnal migration of the animals they at times kept up their sampling and recording at intervals through the day and night for a week or more on end. The working up of all this material took many years, and their splendid studies of lake and river plankton appeared at intervals from 1926, long after the field work was completed. Southern died in 1935, but Gardiner finished the great work in 1938.

Leaving Ireland, Gardiner was appointed in 1924 to the research staff of the Ministry of Agriculture and Fisheries and took up the problems of freshwater biology in relation to pollution at the ministry's laboratory at Alresford. Here came his first serious breakdown in health, and he was forced into exile to Switzerland. On his return he joined the marine Fisheries Laboratory at Lowestoft and devoted himself to such problems as the effects of patchiness in distribution upon the validity of plankton sampling, the quantitative efficiency of nets and the vertical distribution and migration of plankton animals. Ill-health forced him to resign and go back to Switzerland where, as he wrote in a letter, he was teaching "Chemistry, Mathematics, 'As you like It' and 'The Acts of the Apostles' in a school for backward boys".

Better once more, Gardiner was appointed in 1935 to the staff of the Metropolitan Water Board and threw himself enthusiastically into seeking solutions to the many problems of waterworks biology. He was particularly concerned with the factors under-

lying the incidence and duration of the diatom outbreaks which are often of such serious consequence in the clogging of filter beds. Having shown that their rate of growth could only be correlated with abundance of phosphate and silicate in the early part of the season, he was investigating the causal conditions acting later in the year. At the time of his death he was experimenting along several new lines of diatom culture and improved methods of estimating populations.

Gardiner never lost his interest in the sea. Thinking that animals must materially alter the phosphate content of the water by their excretion, he took a brief busman's holiday on the research ship *George Bligh* and, by the simplest experiments, with live plankton animals taken straight from the sea, at once proved his contention. This important factor in marine ecology had hitherto been completely overlooked, and much more will be heard of it in the future.

Gardiner's work had a splendid quality. After reading the late Sir Arthur Hill's account of his father ("Obituary Notices of Fellows of the Royal Society", vol. 3, 1941), one realizes that he inherited not only his love of biology but also his keen faculty of self-criticism and clear thinking; he was always striving after improved methods and greater accuracy. His most recent paper, published since his death, is typical of him: a critical examination of the pigment extraction method of measuring phytoplankton production.

I cherish many memories of him: of sharing a study at Oundle, of natural history expeditions with him both at school and in the holidays, of grand days together at sea on the *George Bligh* and latterly of his happy married life in London. From his early school days he was a martyr to asthma, to an attack of which he finally succumbed. All his life he battled with his health, but for ever made light of it. What a spirit he had, what courage, what a grand sense of humour! From a sanatorium in Switzerland he was a frequent contributor to *Punch*. When things must have looked their blackest his letters still sparkled with fun. He will be missed by so many, missed for his cheerful good company, for his intellectual honesty and for his sound reliable work. But for his ill-health how much more he would have done; in spite of it, how astonishing that he did so much! It is good to learn that the Freshwater Biological Association is to assist in the bringing of his unfinished work to publication.

Our sincerest sympathy goes to his wife and to his mother.

ALISTER C. HARDY.

Prof. A. A. Read

ARTHUR AVERY READ was born at Honiton, Devon, in 1868 and died at Bournemouth on September 24, where he lived after his retirement from a tenure of forty years of the chair of metallurgy in University College, Cardiff. He was educated at Exeter Grammar School, Owens College, Manchester, and at the University of Sheffield (then the Technical School), where he studied metallurgy under the late Prof. J. O. Arnold. He went to Cardiff from Sheffield in 1894 as the first lecturer in metallurgy, and on his retirement in 1933 he had completed his life's work by the establishment of a department worthy of the University of Wales, housed in a modern building, which had been erected with the financial assistance of the Monmouthshire and South Wales Coal Owners' Association.

Read's enthusiasm for his work was such that the new department flourished, and he had the distinction of training the first man to obtain a B.Sc. degree qualification in metallurgy in Great Britain. Many of his former students have become distinguished men in the metallurgical world.

Read realized that a university has a two-fold obligation—not only to teach but also to prosecute original research; and he managed to keep an even balance between these two while at the same time he worked hard to build and equip his Department. His research work, in collaboration with Arnold, on the chemical relations of carbon and iron with various other elements such as manganese, chromium, vanadium, tungsten, cobalt and molybdenum, which were published over a period of years from 1895 until 1915, have proved of great value in the development of modern alloy steels. His interests in non-ferrous metallurgy resulted in the publication of several papers dealing with alloys of nickel, aluminium and copper, work with which Dr. R. H. Greaves was associated.

Outside College, Prof. Read was interested chiefly in the Volunteers and Territorials, and he received the Territorial Decoration. During the War of 1914–18 he was away from College on national service. After the War the University of Wales, and the College at Cardiff, both young institutions, were faced with serious problems, and Read sacrificed his personal inclination to resume his researches and applied himself energetically to University affairs. He brought to bear on academic matters an administrative outlook which was of inestimable value. His work was recognized by the University conferring on him the degree of D.Sc. *honoris causa*.

Read, always an inspiration to his students, won their respect for his straight dealing and then their affection for his kindness and his readiness to champion their cause.

W. R. D. JONES.

Mr. F. Napier Sutton

FREDERICK NAPIER SUTTON, a former alkali inspector in the Ministry of Health, died on September 24, aged eighty years. He was the eldest son of the late Mr. Francis Sutton, public analyst of Norfolk and Suffolk, and the author of the text-book "A Systematic Handbook of Volumetric Analysis".

Mr. Sutton was, for a very long period, works chemist to Messrs. Baily, Sutton and Co., of Great Yarmouth. In 1885 he was appointed assistant to the chief inspector (the late Alfred Fletcher) under the Alkali, etc., Works Act; he was promoted to sub-inspector in 1892 and to inspector in 1908. He retired on reaching the age of sixty-five in December 1927, having then served for forty-two years, during thirty-five of which he was in charge of the London and south-eastern counties district.

After his retirement and, indeed, up to the time of his death, he continued to take a great interest in the affairs of the Alkali Works Department of the Ministry of Health and in chemical industry generally. During 1892–1916 he was secretary of the London Section of the Society of Chemical Industry.

Mr. Napier Sutton was devoted to chamber and orchestral music, and for many years he was a player in some of the leading amateur orchestral societies. He was an expert trout fisherman, and a gifted 'dresser' of trout flies. He was greatly beloved by all his colleagues, and his passing will be widely mourned.