the quantity of fat to be included in the diet, though a certain amount ought to be present.

The section of the report dealing with mineral and vitamin requirements directs attention to the fact that modern diets are deficient in foods rich in minerals and vitamins, that is, protective foods, rather than in foods rich in calories. The protective foods include, first and most important, milk and milk products, eggs and glandular tissues; then green-leaf vegetables, fruit, fat fish and meat (muscle). Among the energy-bearing foods of little or no protective power are sugar, milled cereals and certain refined fats. Pregnant and nursing women should be regarded as in greatest need of protection, and a dietary schedule has been drawn up to indicate how they may obtain adequate supplies of the necessary protective elements. This diet contains a litre of milk, eggs, cheese, potatoes and green vegetables. It is recommended that cod liver oil should be added except in sunny seasons and sunny countries.

Special attention has been given to diets suitable for infants and children up to the age of five years. The importance of breast feeding for nine months is urged. The diet after weaning should contain a litre of milk, eggs, green and root vegetables, cod liver oil and raw fruit or vegetable to supply vitamin C.

Certain general recommendations are made to ensure that the average individual's diet contains a sufficiency of protective elements. Variety in diet tends to safety, though even a varied diet may be deficient in important elements. White flour is deprived of valuable food constituents, and its partial substitution by lightly milled cereals and by potatoes is recommended. The consumption of excessive amounts of sugar is condemned. Milk should form a conspicuous element of the diet at all ages. Fresh fruit and vegetables should always be constituents of the normal diet. By the inclusion in the diet of optimum amounts of the protective foods, adequate provision of all vitamins except vitamin D is readily accomplished.

This report represents the considered opinion of experts in the field of nutrition from Great Britain, the United States of America, France, Sweden, Norway and Russia. The universal adoption of their recommendations would require notable changes in agricultural and economic policies throughout the world, and it now remains for experts in these fields to consider how far it is possible to give practical effect to the recommendations.

S. J. C.

Obituary

Mr. P. C. Gilchrist, F.R.S.

MR. PERCY CARLYLE GILCHRIST, who died on December 16, had for a long time lived in retirement, and was scarcely known to the present generation of metallurgists. Nearly sixty years ago, however, he was associated with the late Sidney Gilchrist Thomas, his cousin, in experiments which ultimately led to the establishment of the basic Bessemer process.

In 1855, Bessemer discovered that a stream of air when blown through molten pig iron removed its carbon and silicon by oxidation, the heat evolved being sufficient to retain the metal in a molten condition. The metal thus produced was brittle owing to its oxidised condition. A year later, Mushet made the important discovery that if manganese was added to the molten metal in the form of ferro-manganese, it removed this absorbed oxygen and enabled sound and malleable ingots to be cast. It so happened that in his early experiments Bessemer used Swedish pig iron which was low in phosphorus. These discoveries led to the establishment of the acid Bessemer process in which the lining of the converter is a siliceous refractory material. This was the beginning of the age of cheap steel. Any irons which had a suitable content of silicon and were low in phosphorus could be treated by this method; but phosphoric cast irons were not amenable to this treatment, since with an acid lining the phosphorus remains in the finished steel and renders it brittle.

In 1870 Sidney Gilchrist Thomas, at that time a junior clerk in the Metropolitan Police Force at a salary of £90 a year, attended a course of lectures at the Birkbeck Institute. For some years he had been devoting his spare time to the study of natural science and in particular of chemistry. At one of these lectures, Mr. George Challoner, the lecturer, said: "The man who eliminates phosphorus by means of the Bessemer converter will make his fortune". Thomas never forgot this, and from that time he became a constant reader of all the literature on the subject. In 1872 he studied in the advanced course of mineralogy at the Royal School of Mines and obtained a first-class. In the following year he was awarded a first-class in the advanced course in inorganic chemistry. After some preliminary experiments, he enlisted the help of his cousin Percy Carlyle Gilchrist, who was then a chemist to certain works at Cwm Avon in South Wales. The original theory of the dephosphorisation process was due to Thomas. At the outset, Gilchrist was doubtful about it, but undertook to make some experiments. Both men were at a disadvantage, for they could only work in their spare time, and their means were slender. Thomas had managed during twelve years service as a clerk to save £800. This money enabled them to take out two patents—No. 4422 in 1877 and No. 289 in 1878.

Thus far the work had demonstrated the possibility of their process but no more, and they then entered upon a period of difficulty and shortage of money. Mr. Martin, the general manager of the Blaenavon Steel Company in South Wales, came to their assistance, and on March 6, 1878, another patent, No. 908, was taken out. After this, rapid progress was made, and at the autumn meeting of the Iron and Steel Institute, held that year in Paris, they presented a paper entitled "On the Elimination of Phosphorus in the Bessemer Converter". So little was its importance realised that it was not even read, but was adjourned until the meeting in 1879, when it was read by Thomas and published in the *Journal* of the Institute.

Actually this delay was a fortunate occurrence. Among the members attending the meeting was E. Windsor Richards, of Bolckow, Vaughan and Co., Ltd. He made the acquaintance of Thomas, and was so impressed by the importance of the discovery and the personality of the inventor that he determined there and then to urge his directors to give the process a trial. This consent was forthcoming. Windsor Richards and J. E. Stead, consultant to the company, then undertook, in collaboration with Thomas and Gilchrist, the practical development of the process. The difficulties which had to be overcome are well described by Stead in his presidential address to the Iron and Steel Institute in 1920. Certain conditions had to be satisfied. It was necessary to line the converter with a basic material, not merely of the correct composition but also of the requisite texture and stability so that its adhesion to the converter walls during the 'blow' was maintained. It was also necessary to form a rich basic slag at an early stage of the process. Finally, it was found that while the carbon, silicon and manganese in the iron were removed at an early stage of the blow, the phosphorus was not sensibly diminished until later. This necessitated the so-called 'after blow', during which about 80 per cent of the phosphorus that is removed is eliminated.

The first successful charge was blown on April 4, 1879, using an experimental 30-cwt. converter which had been erected for the purpose. A brochure issued by Bolckow, Vaughan and Co. in 1929, the fiftieth anniversary of this event, contains the details of the actual blow and the elimination of the various impurities from the iron. Accordingly, when Thomas read the paper at the spring meeting of the Iron and Steel Institute, practical success had been achieved. In this way the basic Bessemer process was established, and for many years proved to be one of the main processes for producing cheap steel on a large scale. Provided an iron contained the requisite amount of phosphorus, it could be treated by this process. In this way the great phosphoric iron ore deposits were rendered amenable to treatment.

In one respect, the basic Bessemer process is more important than the acid Bessemer process. In the latter the ferruginous slag is a waste product. In the former, Thomas and Gilchrist had discovered the chemical conditions necessary to fix in a stable form the phosphoric acid produced by the oxidation of the phosphorus in the pig iron. A highly basic phosphate of calcium is produced which is similar in composition to the mineral phosphates of North Africa. It is eminently suitable as a plant food, and a demand for basic slag as a fertiliser grew rapidly. Strictly speaking, there is no by-product in the basic Bessemer process, for both steel and slag find a market. Both the steel industry and agriculture are thus greatly indebted to the work of Thomas and Gilchrist.

In Great Britain, the basic Bessemer process has been, to a great extent, superseded by the basic open-hearth process, which enables much larger charges to be worked; it does not require the same limits of composition of the iron, and is amenable to better control. But it has never been completely superseded, and to-day there is indeed a tendency to return to it for certain purposes. A large steel plant which is operating in the Midlands at the present time is working this process.

Gilchrist was the son of Mr. Alexander Gilchrist, a barrister. He was born at Lyme Regis on September 27, 1851. He attended Felsted School and the Royal School of Mines, where he became Murchison medallist. He was elected a fellow of the Royal Society in 1891. He was a vice-president of the Iron and Steel Institute, a member of the Society of Chemical Industry, and a fellow of the Royal Society of Arts. He was also a Chevalier of the Legion of Honour. He married in 1887 Nora, daughter of Captain Fitzmaurice, R.N., and had a son and a daughter. He has survived his collaborator Thomas for more than fifty years.

H. C. H. C.

Dr. Albert A. Gray

Dr. Albert A. Gray, who died in London on January 6, at the age of sixty-seven years, spent his active professional life in Glasgow, where he held the post of lecturer in otology in the University and of aural surgeon to the Infirmary.

Dr. Gray was known at home and abroad as the author of "The Labyrinth of Animals" (2 vols.). This magnificent work demonstrated the naked eye structure of the internal ear of vertebrate animals in a new way. He improved the technique of clarifying specimens to a degree which permitted him to expose in all its detail the internal ear within the transparent temporal bone of all vertebrate animals. In this way he was able to add many new facts to the comparative anatomy of the ear. He sought to found the practice of the ear surgeon on a scientific basis, applying himself in particular to that prevalent cause of deafness known as otosclerosis.

Many marks of recognition were received by Dr. Gray from his professional brethren; he was elected president of the otological section of the Royal Society of Medicine and of the corresponding section of the British Medical Association.