other's messages in a confused babel of sounds, but will interfere with other forms of radio-communication, as already happens to a considerable extent in America.

The most important consideration is that of wave-length, as simultaneous messages at or near the same wave-length mutually "jam" one another, and it may be mentioned that the margin of wave-lengths within which wireless telephone apparatus can be made to "tune out" other messages is not so fine as it is with the best class of wireless telegraph receivers. In order to avoid interference with other established services, the Post Office has allotted the range of 350 to 425 metres to the broadcasting stations. In this connection it should be recalled that the greater part of ship and shore Morse communication is on a 300 to 600 metre wave, and that amateur stations are allowed a wave-length of 440 metres. The well-known Writtle station will work in future at 400 metres, and the Air Ministry wave-lengths are 900 metres for the Croydon aeroplane service and 1400 metres for long-range weather reports, etc., while most of the powerful stations use longer waves up to the 2500 metres of the Eiffel Tower. Possibility of interference will also be limited by allowing broadcasting only between the hours of 5 and 11 P.M. on week-days or any time on Sundays.

Further considerations are the locality and range of the transmitting stations. To avoid too much overlapping, one station will probably be allowed at each of the following points: London, Cardiff, Plymouth, Birmingham, Manchester, Edinburgh, Glasgow, and Aberdeen, and arrangements will be made between the licencees at these stations as to wave-lengths and times of operation within the allotted limits.

With the view of circumscribing to some extent the field of each station, its power will be limited to that corresponding to an input of 1½ kw. The actual distance over which a station can be heard, however, depends more on the receiving than on the transmitting apparatus, but with modern delicate equipment an approximate idea of the possible working range is given by taking about ½ mile for every watt input. Thus, although a simple set may only be able to hear the nearest of such a group of stations, a really sensitive set, say in London, could readily pick up all of them.

The cost of a receiving set for private use in picking up whatever programmes are to be broadcasted, varies considerably with its sensitiveness. Roughly, the minimum that need be expended will depend on the distance from the nearest public station, assuming that to be the only one the owner desires to hear. A set of this kind with a range of 25 miles or so would cost from 5*l.* to 10*l.* complete with the simple aerial that would be necessary. Actually, however, the cost of the equipment selected for any particular case will depend upon whether the apparatus is required to be used to pick up waves from longer distances as well, such as to hear the wireless concerts already being radiated from the Hague, and the time and other signals from the Eiffel Tower. In this case a detector of the thermionic valve tube type must be employed, with one or more degrees of amplification and a greater range of tuning inductances, etc., and a multicell dry battery or other source of voltage for the tubes, as well as the two-cell accumulator, which would otherwise be sufficient. A moderately sensitive apparatus of this kind, with a range of 75 miles or more, would cost about 20*l.*, and further requirements of sensitivity could easily bring the price to, say, 75*l.* Another point influencing the cost of the equipment is the class of aerial which it is convenient to use, as the more sensitive the set the smaller is the aerial with which it will work over a given distance. As a rule, the simple crystal set will require some form of outside aerial, whereas the more delicate set with amplifying valves will give surprising results with a portable aerial, inside a room, composed of a few turns of wire on a rectangular frame.

Although probably the best results are obtained with these sets by the use of headpiece telephones, loud-speaking sets, audible to a number of persons at once, can be used with all the better-class apparatus, and this feature will doubtless add greatly to the popularity of wireless telephone reception.

A number of firms are devoting themselves to the manufacture of this kind of apparatus, including, of course, such well-known establishments as the Marconi Co. The Radio Communications Corporation is also well to the fore, and, as we have already announced, special arrangements are being made at the Trafford Park Works of the Metropolitan-Vickers Electrical Co. Other firms specialising in wireless receiving apparatus suitable for these purposes include Radio Supplies, C. F. Elwell, Ltd., and the R.M. Radio Company. We hope before long to have the opportunity of publishing some particulars of the actual apparatus made by some of these firms.

Obituary.

T. SANDMEYER.[1]

TRAUGOTT SANDMEYER, well known to all chemists as the discoverer of the reactions which bear his name, was born at Wettingen in Aargau in 1854. Left an orphan by the death of his father the day after his birth, his mother had to resume her former occupation as a school teacher. His father, who was a science teacher, left a library of scientific books, the perusal of which led young Sandmeyer to interest himself in scientific apparatus, and after spending some time in an engineering workshop, entered the employment of Mr. J. F. Meier, of Zurich, a manufacturer of physical apparatus. Sandmeyer afterwards started business on his own account, and supplied apparatus to the Polytechnic institution. He became in this way connected with the staff of the institution, and in 1882 was appointed lecture-assistant to Victor Meyer.

The story is often told how Victor Meyer, in attempting to show his class what was then known as the "indophenin reaction" with coal-tar benzene, used benzene obtained by distilling calcium benzoate with lime and failed to produce the expected result. It is

[1] This account is mainly gathered from an interesting obituary notice by Dr. Fierz in the issue of the Journal of the Society of Chemical Industry for May 15.

not so well known that Sandmeyer directed the attention of the professor, who had forgotten the incident, to this remarkable difference between the two kinds of benzene, which subsequently led to the discovery of thiophene and its numerous congeners. When Prof. Meyer was transferred to Göttingen in 1885, Sandmeyer accompanied him, but very shortly returned to Zurich, where he became assistant to Prof. Hantzsch. In 1888 he joined the firm of J. R. Geigy, manufacturers of dyestuffs of Basle.

Apart from the Sandmeyer reactions and his remarkable synthesis of indigo from thiocarbanilide in 1899, Sandmeyer's discoveries are little known to chemists unconnected with the synthetic dye industry, in which his later activities lay, and where his greatest successes were achieved. He was a man of reserved habits and made few friends outside the small coterie of his collaborators and fellow-workers, but is described by one, formerly associated with him, as a colleague who was always ready to help and advise. His skill as an expert mechanician, his scrupulous care as an experimenter, and his powers of observation often led him to discoveries which others had overlooked, and the long list of new and valuable dyestuffs of which he was the author placed him in the forefront of colour chemists.

In recognition of his work the University of Heidelberg conferred upon Sandmeyer the degree of Ph.D. *honoris causa* in 1891, and in 1915, at the celebration of the 150th anniversary of the firm of J. R. Geigy Co., of which he had meantime become a director, he was made an honorary doctor of the Zurich Technical School. On his retirement in 1919 Sandmeyer left a large portion of his wealth to the pension fund of the firm with which he had been so long associated.

PROF. H. M. HOWE.

PROF. HENRY MARION HOWE, whose death was recently announced, in his seventy-fifth year, was the doyen of American metallurgists. He was well known both here and on the Continent. He was born at Boston on March 2, 1848, the son of Dr. Samuel Gridley Howe, who was one of the earliest to assist the Greeks in their struggle for freedom. His mother, Mrs. Julia Ward Howe, was the author of the famous "Battle Hymn" of the Republic.

Prof. Howe graduated at the University of Harvard in 1869 in arts, and two years later in science at the Massachusetts Institute of Technology. He then engaged in metallurgical work in Pittsburg, Pa., and Troy, N.J., and soon became known as a keen observer and investigator. In 1880 he designed and built the works of the Orford Nickel and Copper Company at Capeltown in the province of Quebec, and at Bergenpoint, N.J. From 1883 to 1897 he resided at Boston, and set up in private practice as a consulting metallurgist and expert witness in metallurgical patent suits. With this he combined the position of lecturer on metallurgy at the Massachusetts Institute of Technology. He was an original member of the American Institute of Mining Engineering, founded in 1871, and soon contributed to its transactions. His first paper was on "Blast-furnace Economy," which was followed by "Thoughts on the Thermic Curves of Blast-furnaces" and "Nomenclature of Iron," the latter a remarkable contribution to the discussion inaugurated by A. L. Holley in his famous paper, "What is Steel?" His first book, published in 1885, dealt with copper smelting. This was followed in 1891 by "The Metallurgy of Steel," a book which did much to lay the foundations of scientific steel metallurgy, and created for him an international reputation in the subject.

In 1897 Prof. Howe was called to the chair of metallurgy at Colombia College, New York, a position which he filled for some fifteen years. On his retiring to become a consulting metallurgist, he was appointed professor emeritus. He was one of the small band of metallurgists who helped to lay the foundations of the science of metallography, and his name will always be remembered in connection with those of the late M. Osmond, Martens, H. Le Chatelier, Tschernoff, Anossov, Stead, Roberts-Austen, and Arnold. In this connection, his principal contribution is his book entitled "The Metallography of Steel and Cast-iron," a monumental work, which displays a remarkable grasp of the subject and an unusual power of weighing scientific evidence. Prof. Howe was not primarily an experimentalist, although in his later years he published several papers with the late A. G. Levy, dealing particularly with the iron-carbon equilibrium. He was, however, a prolific writer, and in all published more than 300 papers. He was vice-president of the Taylor Wharton Iron and Steel Company, and introduced the manufacture of manganese steel into the United States in 1890.

Prof. Howe was president of the American Institution of Mining Engineers, honorary vice-president of the Iron and Steel Institute, chairman of the engineering division of the National Research Council, consulting metallurgist of the U.S. Bureau of Standards, and research associate of the Carnegie Institution of Washington. Many honours came to him from various countries. In 1895 he was awarded the Bessemer Medal of the Iron and Steel Institute, later the Elliot Cresson gold medal of the Franklin Institute, a special prize and gold medal from the Société d'Encouragement pour l'Industrie Internationale, and finally, in 1917, the John Fritz gold medal, the highest honour in the gift of the engineering institutions of the United States of America. He also received several foreign orders, including the Legion of Honour and the Russian order of St. Stanislas. Prof. Howe was a frequent visitor to this country, and his genial personality will be greatly missed by metallurgists over here.

DR. ROBERT BRUCE-LOW.

DR. ROBERT BRUCE-LOW, the distinguished epidemiologist, died on May 11 after a brief illness. Born in Edinburgh in 1846, he was educated at the Royal High School and University of that city, and graduated in medicine in 1867. After a year spent in post-graduate study in London and Germany, he settled down as a general practitioner, first in Lincolnshire and afterwards at Helmsley in the North Riding, becoming the medical officer of health of the latter district.

This nineteen years of general practice gave him