

of oxide, however, prevents the magnesium from forming a homogeneous mass; hence it is necessary to work under conditions approximating to a vacuum. Although on the face of it a simple process, the reduction of magnesia by carbon presents many difficulties. The temperature needed is 2000° C. or more, and the reaction is reversible. As the vapour cools, the oxide tends to reform, and even with an efficient condenser and dilution with an inert gas the dust obtained is contaminated with oxide. Using briquetted materials heated in an arc furnace, and cooling the vapour in a jet of strongly cooled hydrogen, by which means the temperature of the vapour is very quickly reduced to about 200° C., the condensed dust may contain only 90 per cent of the metal. Redistillation is required in an atmosphere of hydrogen or natural gas with the filtration of the oxide particles, followed by direct condensation to the liquid state. It is not surprising that the process has proved difficult to carry out and that serious explosions have occurred.

The substitution of calcium carbide for carbon as the reducing agent eliminates the formation of a gaseous product which can bring about the reverse reaction on cooling. The reaction,



is carried out in vertical gas-fired retorts of heat-resisting steel in which the mixture of magnesia and the carbide is heated. A vacuum is maintained, and

the metal condenses in a compact form instead of as dust. Reduction with ferro-silicon occurs at a temperature of 1200–1400° C. and possesses the advantage that calcined dolomite may be employed. This process is being developed on a large scale in the United States, where the ferro-silicon can be produced in electric furnaces in scattered plants having a surplus of hydro-electric power.

A process for the reduction of magnesia by aluminium is an interesting example of the application of laboratory high-vacua technique on a commercial scale. The magnesia, obtained from sea water, is calcined, ground and mixed with aluminium or aluminium alloy. Briquetted under pressure, the mixture is charged into crucibles and pre-heated to about 400° C. The crucibles have a downward central outlet leading to the condenser placed beneath. The self-contained unit consisting of crucible and condenser is raised into an electrically heated vertical cylindrical furnace. The furnace is then sealed and heated to 1100–1250° C. under a pressure of less than 4 mm. of mercury. The magnesium distils over into the water-cooled condenser, in which it solidifies as a mass of crystals of high purity; the mass is readily transferred, on breaking the seal, to the remelting furnace, from which it is cast into ingots. A continuous furnace on the same lines has been designed, and, as aluminium swarf and other reducing agents may be employed, the process possesses great elasticity.

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## NEWS and VIEWS

### Research in the United States

IN a recent statement made by Sir Ernest Simon before the Parliamentary and Scientific Committee, some outstanding facts were given concerning research in the United States. The research unit of the Bell Telephone Company, for example, has some 5,000–6,000 research workers concentrated on the one problem of telephonic communication. In the United States there seemed to be little need to persuade the business man, hard-headed though he be, of the value of research. He is now so firmly convinced by the results of the last twenty years, in peace and in war, of the necessity of research, that expenditure has risen to an astonishing figure, and, during the great depression, the research budget was the last to be cut. In 1940, according to an official report, industry was maintaining some 2,200 laboratories with a research staff of 70,000, at an annual cost of three hundred million dollars. Sir Ernest wondered what the expenditure is in Great Britain; he doubted whether it was £4,000,000, yet it was to be noted that the United States population was only three times greater than ours. Per head he estimated that the United States were spending five times as much as we spend on university and industrial research. The results were significant. America now leads in hydrocarbon research, the world order being now: United States first, Germany second, Russia third and Great Britain fourth. Yet coal is our only special large-scale natural resource, and success in the difficult post-war period in exporting enough to pay for our essential imports will depend to a substantial extent on the most scientific treatment of our coal in order to get from it the maximum value.

This question of research is, of course, broadly

divisible into two parts: research conducted by industrial organizations and research conducted by universities, and Sir Ernest Simon had some equally striking points to make concerning American universities. Their size and number is almost startling. When, during 1937–38, we had about 50,000 university students in Britain, America had a million. Their income was £97,000,000, while ours was just over £6,000,000. American grants from Government authorities were ten times, and from private generosity, twenty times as great as ours. In engineering, for example, there were, in the same year, 12,000 graduates from the American schools compared with about 800 in Great Britain. Now none more than ourselves realize that this comparison either of research or of numbers of universities and students may quite easily be very misleading. There are many factors which need close examination before final and valid conclusions can be drawn. The standards of graduate qualification must be closely examined and more particularly the work done by post-graduate students. The same care is needed when comparisons of arrangements for research are made, for research is a word capable of many interpretations. In saying that, we have no intention of attempting to detract from the vast and expert work of American research organizations and of American universities. By whatever test which may be applied it seems clear, from the points made by Sir Ernest Simon, that America has set and is setting an example which ought, without any avoidable loss of time, to be followed in Britain. The discussion which followed Sir Ernest's statement showed how the problem was appreciated by his listeners and gave indications of where research here should be encouraged and fostered.