dislocations would disappear and the metal would be seriously weakened. Hence the practical interest in the possibility that a moving boundary may be able to drag along solid particles.

Ashby and Centamore have carried out a series of beautifully clear and conclusive experiments on highly alloyed copper samples which, by internal oxidation, have been provided with dispersions of B_2O_3, GeO_2, SiO_2 or Al_2O_3. Grain boundaries were caused to migrate in these samples at about 1,000° C under a driving force just insufficient to allow them to break free from the dispersions. Thus the boundaries could move only by dragging the particles along, and if they did this, a band of copper swept clear of particles was left behind. The boundaries were found to be carrying all the particles which had been swept up; there was no coalescence. The width of the band was measured for different temperatures, particle sizes and alloy systems. The ease of dragging diminished in the four systems in the order quoted above—B_2O_3 particles moved readily while Al_2O_3 particles could not move at all.

Near 1,000° C, B_2O_3, GeO_2 and SiO_2 are all viscous fluids, while Al_2O_3 is not fluid at all. The authors conclude that viscous fluid inclusions migrate like bubbles, and comparison with theory confirms that at higher temperatures the diffusion of copper along the matrix/inclusion interface is the controlling mechanism. At lower temperatures, the rate of dragging declines steeply, and the authors postulate that diffusion of copper through the particles plays an essential part. This, of course, explains why Al_2O_3 particles are not mobile at all—diffusion through them is impossible.

In passing, the authors conclude that a coherent inclusion, which has a lattice parallel to and continuous with that of the matrix, should be immobile because of the difficulty of putting vacancies into the interface. This prediction is likely to be correct but will be difficult to test because it is known that coherent particles can be dissolved in the matrix at an advancing grain boundary and then reprecipitate in coarser form once the boundary has passed. This has been demonstrated in a nickel alloy containing coherent γ', Ni_3Al, inclusions (Haessner *et al.*, *Z. Metallkde.*, **57**, 270; 1965) and in copper containing coherent cobalt (Tanner and Servi, *Mat. Sci. Eng.*, **1**, 153; 1966).

Another recent paper has emphasized a further way in which alloy constituents may affect the behaviour of grain boundaries. Dorward and Kirkaldy (*J. Mat. Sci.*, **3**, 502; 1968) have demonstrated that the tendency of solute to concentrate at grain boundaries causes the small solubility of copper in single crystal silicon to increase by a large factor when grain boundaries are present; for example, at 650° C a 350-fold increase was found. The existence of this potentially serious source of error was first established 20 years ago by Voce and Hallowes, who showed that the small solubility of bismuth in copper depends on the grain size, but this work has been forgotten. Solute segregation at grain boundaries is also of practical importance, for dissolved impurities exert a drag on a moving grain boundary just as discrete particles do, and in recent years a body of experiment has been accumulated to describe the role of this drag in determining recrystallization kinetics and also the nature of the preferred orientation created during recrystallization. These studies have thrown up some theoretical puzzles which will be debated at an international conference in Germany in early October.

LEPROSY

Progress on All Fronts

from a Correspondent

THE ninth International Leprosy Congress held at Imperial College, London, during the week of September 16 was attended by more than 500 clinicians and scientists from 70 countries. Although *Mycobacterium leprae*, the causative organism of leprosy, was identified in 1874—before many of the other bacteria causing disease in man—laboratory research on leprosy has progressed very slowly because the causative organism has never been cultured *in vitro*, and only in 1960 was a limited infection produced in animals.

On the scientific side, this congress was dominated by the results obtained from fundamental and applied studies based on experimental model infections in animals. Although only a localized and limited multiplication of *Mycobacterium leprae* results from mouse footpad inoculation of bacilli from man, this model infection has been used successfully to determine the generation time (12–15 days), to screen drugs for anti-leprosy activity and to demonstrate for the first time the emergence of drug resistance in patients on standard treatment with dapsone (diaminodiphenyl sulphone).

The most important advances were, however, those reported from the National Institute for Medical Research, London, members of which reported that a more extensive and generalized infection can be obtained in mice made immunologically incompetent by thymectomy followed by total body irradiation (900 r). Such an infection can be obtained by both local or intravenous inoculation of *Mycobacterium leprae*. This model infection has been unexpectedly rewarding because it has reproduced a disease mimicking lepromatous leprosy seen in man, including nerve involvement and heavy infection of the skin and nose. Moreover, after a year or more, a proportion of these heavily infected mice develop intermediate types of leprosy of the borderline and near-tuberculoid type also seen in man. Similar changes can be brought about in thymectomized-irradiated mice with established lepromatous type leprosy by donating back syngeneic lymphoid cells from normal mice, thus indicating the importance of the immunological capacity of the host in determining the type of disease.

Other immunological aspects of leprosy were featured at the congress. For example, an earlier chance observation that thalidomide suppresses the reactional phases in leprosy was confirmed by a series of double-blind trials. Finally, the much awaited interim results were given of three important trials on the prophylactic effect of BCG against leprosy in children. BCG gave some 80 per cent protection in Uganda, only 56 per cent in New Guinea and no significant protection in Burma. An independent team has, however, already made comparative studies of the methodology in the three BCG trials and was able to report that no significant differences exist in the methods used, so that the differing results must therefore have a biological basis.