IRIDIUM–PLATINUM ALLOYS

DR. A. S. DARLING has recently published a critical discussion of the constitution and properties of the iridium–platinum alloys*. Until comparatively recently it was generally believed that these metals were completely miscible in each other in both the liquid and solid states—the liquidus curve, lattice parameters, electrical resistivity and microstructures all suggesting a continuous series of solid solutions. At the same time, there were other facts difficult to reconcile with such a view. As early as 1886 Le Chatelier had observed a thermal abnormality in the 20 per cent iridium alloy around 700° C., and in 1940 Masing, Eckhardt and Kloiber settled the matter by showing that a natural crystal from the Urals had a well-defined two-phase structure.

The true nature of the equilibrium diagram was finally established by Raub and Plate (*Z. Metallkunde*, 47, 688; 1956), who showed that there is a miscibility gap with a maximum at 975° C. and 50 atomic per cent. At 700° C. this gap extends from 7 to 99 atomic per cent of iridium. That earlier workers had failed to appreciate the true state of affairs was due to the extreme sluggishness of the change, annealing periods of the order of a year being required to establish "some semblance of equilibrium" in parts of the two-phase region. The most accurate method of determining this phase-boundary appears to be from measurements of electrical resistance.

The strength and hardness of the alloys increase rapidly with the iridium content, 30 per cent raising the tensile strength from 10 up to 56 tons per sq. in. for the alloy quenched from 1,100° C., the Vickers Pyramid Number increasing seven-fold. Cold-working has an equally marked effect, and the tensile strength of cold-drawn 20 per cent iridium wire may exceed 100 tons per sq. in. Very high hardness values can, as would be expected from the diagram, also be produced by quenching followed by subsequent ageing, the 50 per cent alloy quenched from 1,400° C. and reheated to 700° C. for 15 hr. having a Vickers Pyramid Number around 500. It is not clear, however, whether the fully aged alloys retain sufficient ductility to permit the hardness to be raised still further by cold work.

Alloys containing up to 40 per cent of iridium have been hot-forged and even drawn into wire, and when melted in the argon arc, alloys of still higher iridium contents can be worked with difficulty. The presence of iridium considerably increases the resistance of platinum to corrosion, the 40 per cent alloy being virtually unattacked by boiling aqua regia. The high evaporation losses of these alloys at high temperatures is attributed to the volatility of iridium oxide, a matter of importance in connexion with their use in pyrometry.

Among the more important uses of these alloys Dr. Darling mentions their applications in electrical contacts, precision resistors and potentiometer slide-wires. The 10 per cent iridium alloy used in combination with a 40 per cent palladium–gold wire which generates an electromotive force of 34 millivolts at 600° C. forms a useful thermocouple for moderate temperatures. Bridge wires in electric detonators, fuses and cartridge igniters, the needles used for the initial perforation of diamond wire-drawing dies, suspensions for scientific instruments and hair-springs are other uses to which these alloys have been put.

* *Platinum Metals Rev.*, 4, No. 1; Jan. 1960.

DEVELOPMENT OF LEARNING IN THE RHESUS MONKEY

DURING the past five years Harry F. Harlow and his colleagues have conducted an integrated series of researches into the learning capabilities of rhesus monkeys from birth to intellectual maturity*. Control over the monkey's environment has been achieved by separating the infants from their mothers at birth and raising them independently.

Half a decade is too brief a period to establish a definitive programme on the maturation of learning ability in the rhesus monkey, particularly in the later age-ranges. Within this period of time, however, techniques and tests have been developed which demonstrate that such a programme is feasible. The monkey is capable of solving simple learning problems during the first few days of life, and its capability of solving ever-increasingly complex problems matures progressively, probably for four to five years.

Early in life, new learning abilities appear rather suddenly within the space of a few days, but, from late infancy onward, the appearance of new learning powers is characterized by developmental stages during which particular performances progressively improve. There is a time at which increasingly difficult problems can first be solved, and a considerable delayed period before they can be solved with full adult efficiency.

The monkey possesses learning capacities far in excess of those of any infra-human primate, abilities comparable to those of low-level human imbeciles. The monkey's learning capabilities give little or no information concerning human language, and only incomplete information relating to thinking.

These are the generalizable limits of learning research on rhesus monkeys, but they provide an animal with vast research potentialities. There is a wealth of learning problems which the monkey can master, and at present the field is incompletely explored. The maturation of any learning function can be traced, and the nature and mechanisms underlying interproblem and intertask transfer can be assessed. Great research potentialities exist in analysing the fundamental similarities and differences among simple and complex learnings within a single species. The monkey is a subject ideally suited for studies involving neurological, biochemical and pharmacological correlates of behaviour. Rhesus monkeys can be raised under completely controlled conditions throughout a large part and, probably, all of their life-span, and the research of the future will probably correlate the neurophysiological variables, not with the behaviour of the static monkey, but with the behaviour of the monkey in terms of ontogenetic development.

* *American Scientist*, 47, No. 4; December 1959.