that this meaningful expression is still applicable where mountains do not partake in a 'central highland'.

The last morning continued with ecological problems. Dr. H. C. Trumble (Food and Agriculture Organization) described the climate of Indonesia in relation to vegetation and showed the necessity for many more meteorological records. His careful analysis should be read in conjunction with the 'land-systems' of Taylor and Whyte, for bioclimatology must complement their biotopography. Dr. Satyanarayan reviewed in detail the vegetation of the Western Ghats, where, as in Thailand, there is a transition from true humid tropical forest to the sub-arid. His account will be a standard reference for phytogeographers. Dr. Robbins then presented a paper by L. J. Webb on the rain-forest of Queensland; the importance of lianes was emphasized in the definition of forests, and the neglect of them shows how much is yet to be added to tropical ecology. Mr. Womersley gave an account of the work of the Botanical Division of Forestry in eastern New Guinea, and a second paper on the *Araucaria* forests in which he developed the theme that they were relics of ancient, even mesozoic, pre-angiosperm vegetation surviving fitfully in some unknown, possibly catastrophic, manner in the invading sea of broad-leafed forest. I think this paper will become a classic. Mr. P. R. Wycherley (Malaya) gave an elegant sketch of the ruderal behaviour of *Croton hirtus*, and a valuable analysis of an acre of forest in Malaya, such as will become a standard of reference for Malaysian ecologists. The afternoon was devoted to problems of sylviculture in Indonesia, presented by Mr. Mursaid, and in Malaya, presented by Mr. Wyatt-Smith. Striking differences were apparent, especially from the methods described for Ceylon by Mr. de Rosayro, and it was clear, again, that generalization could be misleading. In the evening Dr. Fosberg, as *rapporteur général*, gave an able summary of the proceedings, and closing speeches were made by Prof. Kusnoto Setyodiwiryo and Mr. Sudiman (secretary, Council for Sciences of Indonesia).

After the symposium delegates were taken under the leadership of Dr. A. J. G. H. Kostermans (Indonesia) to the mountain garden and nature-reserve of Tjibodas, to the Botanic Garden at Bogor, for a four-day excursion to the nature reserve of Udjong Kulon at the south-west corner of Java, and on a ten-day excursion to central and eastern Java and to Bali. Few delegates, unfortunately, had time for this trip, but that to Udjong Kulon in the research ship of the Kebun Raya gave them the unforgettable scene of Krakatoa, as the ship sailed about 8 a.m. between the new erupting cone and the old forest-clad mountain-side.

As one whose presence was fortunate rather than premeditated, I may make a few detached remarks. Such a small symposium of picked experts, discussing their problems in such hospitable, if remote, circumstances must always be rewarding. Its success depended in no small measure on the accomplishments of a few delegates, particularly Dr. Robbins and Mr. de Rosayro, who entertained us in the evening. At Tjiawi, we had an audience of students, and the proceedings, instead of being merely documented and shelved, may grow up in receptive minds. Malaya gave a good lead in sending both senior and junior delegates. We should remember these ingredients that the next may be as successful. E. J. H. Corner

PRECIPITATION IN ALLOYS

From the early investigations of Wilm on the age-hardening of aluminium alloys, the study of the decomposition of supersaturated solid solutions has made rapid progress. For the past twenty years the subject has advanced largely through investigators using X-ray diffraction techniques, but within the past two years the pre-eminence of these techniques in this field has been challenged by investigators using the electron microscope to examine metals either directly by transmission or with the aid of extraction replicas. At a conference held at the Institution of Civil Engineers in London on November 28, and organized by the X-ray Diffraction and Electron Microscopy Groups of the Institute of Physics, an opportunity was given for the two groups of investigators to meet, outline their methods of approach and discuss the results obtained.

The conference comprised four principal papers—two devoted to results obtained by X-ray diffraction and two to results obtained by electron microscopy—followed by a general discussion. The first speaker was Prof. A. Guinier (Department of Physics, Conservatoire des Arts et Métiers, Paris), who described the structures of age-hardened alloys in the pre-precipitation stage. He first defined the Guinier–Preston zones in terms of the interface between the zones and surrounding matrix, pointing out the requirements for coherence. He then reviewed the evidence from which it has been possible to deduce the shape, size and structure of zones in various alloys based on aluminium and containing copper, silver, magnesium, silicon, germanium and zinc. In discussing the structure of zones in relation to the properties of alloys, Prof. Guinier pointed out that a change from a purely metallic to partially covalent or ionic bonding may occur as the zones increase in size and thickness.

The results obtained on the same series of alloys, but after examination by transmission electron microscopy, were described by Dr. J. Nutting (Department of Metallurgy, Cambridge). He showed how the predictions made from X-ray diffraction results have been confirmed by electron microscopy. He then went on to outline how the strain fields surrounding coherent precipitates may be observed and to discuss the transition from coherency to partial coherency at the precipitate–matrix interface. The advantages of the electron metallographic approach in revealing precipitate morphology were stressed and the importance of this morphology in relation to mechanical properties was briefly mentioned. The disadvantages of the electron metallographic approach is that it gives no clear indication of the zone and precipitate structure. The possibility of using selected area transmission electron diffraction was suggested as a means of overcoming this difficulty.

An account of her investigations on precipitation in aluminium alloys when using X-ray diffraction techniques was given by Miss J. M. Silcock (Fulmer Research Institute, Stoke Poges, and Department of

Metallurgy, Liverpool). She showed how the addition of small amounts of cadmium to an aluminium–copper–magnesium alloy leads to the formation of a superstructure with cadmium atoms around the edge of the plate-like zones which prevent their further growth. The structure of the zones in aluminium–copper alloys to which lithium and indium have been added was then described. The influence of cold work upon subsequent precipitation phenomena is a topic of great theoretical and practical interest. Miss Silcock reviewed some of the earlier investigations in this field and then described results she had obtained which indicate that prior cold work limits the number of orientations in which the θ′ phase forms on aging aluminium–copper alloys. Cold-worked aluminium–copper alloys containing cadmium behave in the same way as alloys free of cadmium, an effect which was attributed to an association between the cadmium atoms and the extra vacancies introduced during deformation.

The study of precipitation phenomena in steels has lagged far behind the work on light alloys. The main reasons for this are that X-ray techniques are not readily applicable to the early stages of the precipitation reactions since it is impossible to prepare single crystals of martensite, while at the later stages, bulk chemical extraction techniques followed by X-ray diffraction of the extracts serves only to identify the phases and gives no idea of the size, shape and distribution of precipitated particles. With the aid of extraction replicas and the electron microscope, the study of precipitation reactions in steels has greatly advanced, and recent results obtained in this field were described by Prof. R. W. K. Honeycombe (Department of Metallurgy, Sheffield). He described the morphological changes associated with the decomposition of martensitic plain carbon steels and then discussed the modifications introduced by the addition of strong carbide-forming elements, contrasting the different effects of chromium, molybdenum and vanadium, and the influence of small additions of niobium and tantalum. Precipitation in austenitic steels has not been studied in as great detail as that in ferritic materials, but Prof. Honeycombe described some new results on the formation of chromium carbides and niobium carbides in a standard creep-resistant austenitic steel.

The discussion which followed the principal papers was concerned mainly with the presentation of new results obtained by electron microscopy. Miss K. B. Day (British Aluminium, Gerrards Cross) put in a plea for the retention of the oxide replica technique for studying precipitation in aluminium alloys, illustrating the many advantages of the technique for investigating the advanced stages of precipitation reactions. P. M. Kelly (Cambridge) described how he had been able to prepare thin foils of steel from bulk material which were suitable for examination by direct transmission in the electron microscope. The results he obtained on high-carbon martensites and tempered plain carbon steels were illustrated. A film on precipitation in an aluminium–4 per cent copper alloy was shown by G. Thomas and M. J. Whelan (Cambridge). The film was obtained by aging thin foils of the alloy on a heating stage in the electron microscope and recording the structural changes as observed on the viewing screen with a cine-camera. The film showed conclusively that the final stages of aging involved the resolution of small particles and growth of large particles of the θ-phase.

A number of contributors presented results on the precipitation of vacancies in pure metals and alloys. R. E. Smallman (U.K. Atomic Energy Authority, Harwell) showed electron micrographs of the effects produced when vacancies were precipitated from nickel, copper, silver and gold and discussed the results obtained in terms of the energies of stacking faults in the respective metals. P. B. Hirsch (Cambridge) presented similar results and gave an account of the formation of tetrahedral stacking faults in gold. The formation of dislocation spirals by the condensation of vacancies on screw dislocations in an aluminium 4 per cent copper alloy was described by M. J. Whelan and G. Thomas (Cambridge). These spiral dislocations provide favourable sites for the nucleation of precipitates and are responsible for the structures shown by Mme. A. R. Weill (Paris) of abnormalities in the distribution of the θ′ precipitates after aging.

The object of the conference, in attempting to bring two groups of workers together, was admirably conceived; the fruits of this union will be awaited with interest. For the electron microscopists at least the agreement between their results and those obtained by X-ray diffraction was reassuring, and vindicated their efforts of the past few years in the development of the thin-foil techniques for the direct examination of metals by transmission.

J. NUTTING

FUEL RESEARCH

THE report of the Fuel Research Board for 1957*, issued on October 31, 1958, is particularly noteworthy for the fact that it records the decision to close down the Fuel Research Station at Greenwich, and transfer to the new Warren Springs Laboratory at Stevenage only two main items of research. These are the programmes of work concerned with the measurement and abatement of air pollution and with the synthesis of oil from carbon monoxide and hydrogen, which are obtained from the gasification of coal.

In recent years quite a number of other organizations have also been concerned with research on fuels, most of them in connexion with more or less specialized aspects of fuel technology and its associated bearing on industrial practice.

The new laboratory at Stevenage is envisaged as the centre of research in Britain on air pollution, though again many aspects of the problem associated with processing must necessarily rest to some degree in the domain of other organizations. The co-operative scheme for the measurement of pollution together with the collection and analysis of the results will also be continued at Stevenage. A new and much required programme of research will be undertaken on the chemical reactions of pollutants in the atmosphere, and on dispersal and convective processes in the atmosphere.

An interesting feature of the report is the reference to the development of a small portable instrument,

* Department of Scientific and Industrial Research. Fuel Research 1957: Report of the Fuel Research Board with the Report of the Director of Fuel Research for 1957. Pp. iv+59+4 plates. (London: H.M. Stationery Office, 1958.) 4s. 6d. net.