time. Any given element is thus driven for only $1/n$ of a cycle (for a display of n rows) and the brightness is correspondingly lower unless the drive is n times greater or unless some form of memory is either provided or is inherent in the device. If the mechanism of the display is one which saturates at high levels of drive, then the former alternative does not exist. Much of the discussion at the meeting consequently centred on questions of memory, saturation and drive mechanisms.

Nematic liquid crystals were shown by Dr C. J. Gerritsma (Philips Research Laboratories, Eindhoven) to hold considerable promise for many display applications. The "twisted nematic" display in which a helical arrangement of molecules is disrupted by the application of a potential difference can be operated at voltages directly compatible with integrated circuits. The mode of operation which has so far been more widely exploited, however, is "dynamic scattering" in which the liquid crystal changes from a clear to an opaque state when a voltage is applied. The requires rather larger drive voltages (10–20 V).

The various modes of operation exhibit thresholds with varying degrees of sharpness, that for dynamic scattering being the least sharp. A consequence of this is that when the scanning mode of address is adopted for matrix displays (with half the drive voltage applied to the row and half to the column electrodes) many of the elements not being driven experience half the drive voltage and scatter appreciably, thereby weakening the contrast. Dr C. Gooch (Services Electronics Research Laboratory, Baldock) described techniques for markedly improving the contrast of displays based on the dynamic scattering of liquid crystal by applying additional voltages to the unselected rows and columns.

Liquid crystal displays saturate large drive voltages, but their relatively long decay time (~ 100 ms) compared with their rise time (10 ms for dynamic scattering) was said by Dr Gooch to be sufficient for a scanned display of about ten lines without additional memory.

Gas discharge devices, which were surveyed by Mr G. Weston (Mullard Research Laboratories) do not show saturation effects, and matrices of discharge cells ("plasma panels") can be operated in the scanning mode either by the application of greater drive voltages or by using a sustaining voltage to produce a memory effect. They can fairly readily be produced in large areas with up to 60 lines an inch, have high brightness, are compact and with the addition of phosphorus can give multi-coloured displays, and it was suggested that perhaps plasma panels offer the best, although still distant, prospect of a replacement for the cathode ray tube.

CREEP

Steel and High Temperature Alloys

from a Correspondent

THE recent conference on creep organized by the Iron and Steel Institute and held in the University of Sheffield between September 20 and 22 was particularly successful in bringing together metallurgists working on the basic strengthening mechanisms of steels that are resistant to creep and those concerned with the problem of obtaining data on creep for design purposes.

The first session was concerned with the basic concepts of creep strength and included contributions from Professor R. Lagneborg (Royal Institute of Technology, Stockholm) who introduced a dislocation model of creep, and Dr C. M. Sellers (University of Sheffield) who presented a review of the structural changes that can occur in two-phase alloys during deformation at high temperature. Dr B. Wilshire (University College, Swansea) spoke about his ideas on internal and effective stress, and this particular topic was referred to frequently in the course of the meeting.

A contribution from Mr R. F. Johnson and Dr J. Glen (British Steel Corporation) introduced the second session during which some of the engineering aspects of creep were considered. These authors were critical of the value of some of the research that has been carried out on creep mechanisms, for the work has contributed little to the basic purpose of creep testing, namely the supply of design data to engineers. They pointed out that design data are now being required for times up to 250,000 h and conventional extrapolation techniques could scarcely be expected to supply this information, especially for new steels where few data exist. Consequently they asked that efforts be directed towards obtaining fundamental information that would be helpful in deriving design data valid for long endurance. These remarks, not unexpectedly, provoked considerable comment, and it was suggested that some recent theoretical work provided relationships that could be used for long-time prediction. The general impression, however, was that there is a lack of communication between those concerned with the physical metallurgy of creep and those whose task it is to supply reliable creep information for design purposes. Perhaps, as a consequence of the discussions at this conference, the two groups will be encouraged to work more closely.

The microstructure and creep of austenitic steels and Ni-base alloys was the topic for the third session, and several contributors described work

being carried out on 25 per cent Cr and 25 per cent Ni austenitic steels stabilized with Nb, particularly with regard to the metallography of the precipitation of NbC. A contribution by Professor B. Aronsson (Swedish Institute for Metal Research, Stockholm) emphasized the importance of small amounts of nitrogen in improving the creep strength of type 316 austenitic steel; it was suggested that the improvement is due to nitrogen in solid solution rather than to precipitation of nitrides. In a particularly interesting paper, somewhat away from the principal theme of the session, Mr E. G. Wilson (UKAEA, Springfield) described creep experiments on 20 per cent Cr and 25 per cent Ni austenitic steel containing Nb in which the stress was varied. He emphasized the significance of anelastic creep in explaining some of the observations.

The importance of recovery in controlling creep behaviour was clearly demonstrated in a paper by Mr B. E. Hopkins and Dr T. B. Gibbons (National Physical Laboratory) describing creep experiments in Ni-base alloys. They also put forward the interesting suggestion that the dependence on grain size of the minimum creep rate observed in these alloys could be explained if recovery is somehow easier adjacent to grain boundaries.

The final session dealt with the microstructure and creep of ferritic steels and was dominated by papers by Dr J. D. Baird and his co-authors (General Steels Division of the British Steel Corporation). They have made a thorough and exhaustive study of the factors controlling the creep strength of iron alloys. In particular they have shown that interactions in solid solution (between Mo and C and N for example) can be important in short-time creep tests at 550° C, but after about 1,000 h precipitation becomes important and solid solution effects less significant. The importance of dislocations in refining intragranular precipitation was emphasized, and the suggestion was made that the optimum density of dislocations may be achieved in upper bainite.

It would be reasonable to conclude, on the basis of the evidence presented at this meeting, that knowledge of the principles of strengthening for creep resistance has progressed to the stage at which suitable alloys can be specified with some confidence. When the difficulty of providing creep data for the design of components for service at high temperature is considered, however, the situation is less satisfactory, but rapid progress towards a solution can be anticipated.