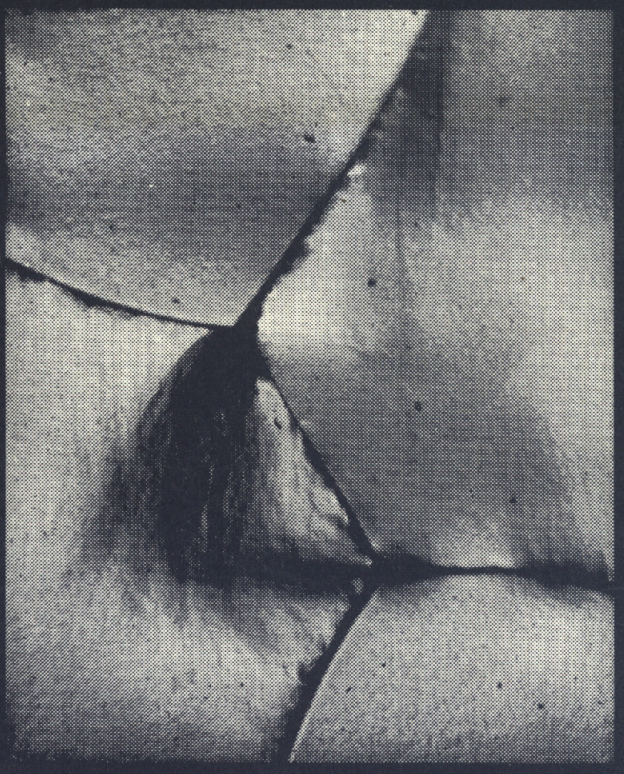
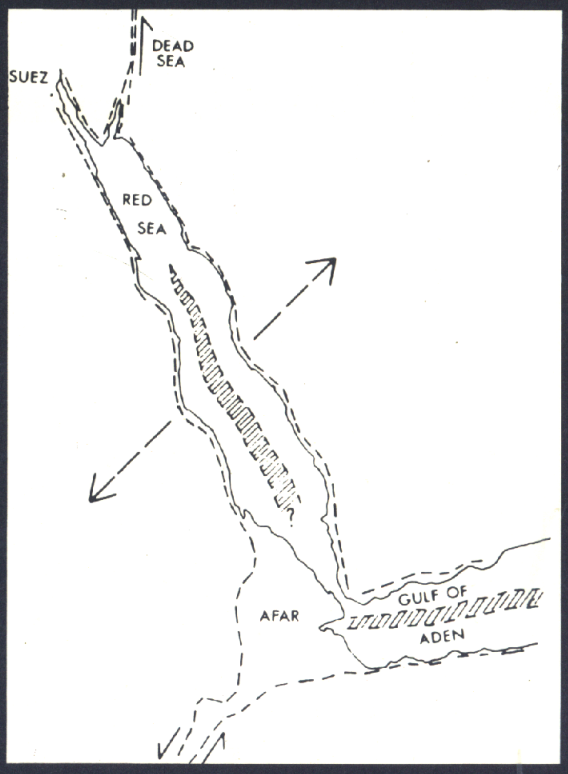
CREEP OF ENGINEERING MATERIALS AND OF THE EARTH





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CREEP OF ENGINEERING MATERIALS AND OF THE EARTH

A ROYAL SOCIETY DISCUSSION
ORGANIZED BY
A. KELLY, F.R.S., ALAN H. COOK, F.R.S.,
AND G. W. GREENWOOD

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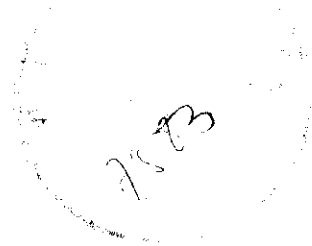

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PREFACE

This meeting was organized in order to bring together scientists concerned with the behaviour of engineering materials and those concerned with understanding geological and geophysical phenomena in terms of materials behaviour. The topic chosen for consideration was the slow deformation and fracture at low rates of strain of metals, and of rocks. The hope was to cover the laws of flow and the development of textures in rocks, minerals and metals, so that scientists in engineering, geology, geophysics and mineralogy might stimulate one another by learning about each other's methods, problems and progress.

The deduction of the creep laws for the mantle of the Earth was discussed by Professor J. Weertman and this was followed by a review by Professor F. A. Leckie of how constitutive equations governing the flow of metals can be set up and how the accumulation of creep damage during the life of a component may be used to predict when unsafe behaviour or rupture will occur. A detailed account was given by Professor A. Nicolas of how stress estimates may be made from the examination of dislocation or subgrain structures in mantle peridotites, and this was followed by a comprehensive review of our knowledge of the flow and fracture of materials under high temperatures and moderate hydrostatic pressures. Professor M. F. Ashby in his presentation showed how to produce deformation maps indicating the stress temperature and strain rate régimes, within which certain mechanisms of flow are likely to predominate. All save one of the papers presented at the meeting are reproduced here; the only one omitted is that on the flow of quartz and quartzite by hydrolytic weakening. A detailed account of creep in olivine was given by Professor C. Goetze. The recrystallization of metals during hot deformation and the recrystallization textures produced in metals and quartz were covered in detail by Dr C. M. Sellars and by Professor R. W. Cahn respectively. Dr J. H. Gittus gave an account of the high temperature deformation of two phase structures.

Lastly, fracture was covered in a discussion by Dr W. B. Beeré of the stresses and deformation at grain boundaries in metals and this was followed by an account of similar phenomena at geologic faults by Dr G. C. P. King. Finally, an account of fracture during creep was given by Professor G. W. Greenwood.

At the start of the meeting, apparent similarities between metallurgical and geological processes were emphasized and, in the summary given at the end of the meeting, the significant divergences in the scale, and how the similarities may arise, were commented upon.

The discussions were most stimulating and have suggested many interconnections between the disciplines of metallurgy, mechanical engineering, geology and geophysics.

A. KELLY
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