

THE SOLIDIFICATION OF METALS AND ALLOYS

A Symposium held by the Institute
of Metals Division, American Institute
of Mining and Metallurgical
Engineers, February 12, 1950.

Published by

THE AMERICAN INSTITUTE OF MINING
AND METALLURGICAL ENGINEERS

NEW YORK

1951

COPYRIGHT, 1951, BY THE
AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS
(INCORPORATED)

PRINTED IN THE UNITED STATES OF AMERICA

PREFACE

This small, but we hope useful, volume is the outcome of a suggestion made by Mr. Walter Dean, Programs Chairman of the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers in 1949, that the Institute should do more to assist communication between the theoretically minded and the practical members of the metallurgical profession. After preliminary discussion with many individuals including R. F. Mehl, J. H. Hollomon, and E. O. Kirkendall, it was decided to hold a symposium on solidification because of the interest in this subject in both scientific laboratories and industrial casting shops. The symposium was held at the meeting of the Institute in February 1950 under the able chairmanship of Dr. J. B. Austin and Dr. J. S. Marsh. The session consisted of three more or less formal lectures which provided a summarized picture of the principles of solidification and were followed by informal discussion. Only a small fraction of the discussion is recorded herein—that which the discussers themselves deemed worthy of preparing in written form.

The various lecturers were asked not to overemphasize recent research results but to present their subject in some perspective. It was manifestly impossible in a one-day session to cover the entire subject of solidification; among other important topics that were omitted were those of heat flow in mold and metal, and the structures of castings other than steel. Fortunately, both of these are covered in recent publications of our sister society in Great Britain, the Institute of Metals. Their Monograph No. 7, "The Solidification of Metals" by R. W. Ruddle, and the papers now being published by him and others from the British Non-Ferrous Metals Research Association in the *Journal* of the Institute of Metals, should be studied by anyone who finds the present little volume of interest.

The A.I.M.E. and those who attended the Symposium owe a debt of gratitude to the authors and lecturers of the papers contained herein; a debt that can now be shared by a wider audience of readers.

CYRIL STANLEY SMITH

Institute for the Study of Metals
University of Chicago
Chicago, Illinois
July 1950.

CONTENTS

Preface. By CYRIL STANLEY SMITH.	III
The Nucleation of the Solid. By J. H. HOLLOMON and D. TURNBULL.	I
With Discussion by L. F. MONDOLFO, W. I. PUMPHREY and A. R. KAUFMANN	19
The Growth of Metal Crystals. By ROBERT F. MEHL	24
With Discussion by W. C. ELLIS and E. MARBURG	49
The Solidification of Steel Ingots. By B. R. QUENEAU	52
With Discussion by J. W. SPRETNAK, L. F. MONDOLFO, C. E. SIMS, P. D. FROST, R. L. KELLER and E. A. LORIA	68