

subject. Kant's thing-in-itself is made a condition of inter-subjective experience (p. 241), which is (to say the least) a misleading appraisal; Mill's immensely subtle argument about the foundations of inductive reasoning is dismissed with the usual hackneyed remark that it is 'circular'. These examples (though they could be argued) suggest that despite the undoubted sharpness and accuracy of most of the accounts to be found here, the author's authority is no substitute for caution on the part of the reader, particularly when it is remembered that the best of the histories of philosophy are those that are deeply felt and take up a certain position. This becomes obvious when the discussion centres around the more recent of Russell's philosophical interests, such as pragmatist theories of truth, when the argument, though still as lucid as ever, becomes rather more heated.

But these are minor criticisms. Certainly this new excursion into our cultural heritage is another astonishing venture testifying to the brilliance and almost legendary energy of its author.

GERD BUCHDAHL

## A HISTORY OF IRON AND STEEL IN CHINA

The Development of Iron and Steel Technology in China

By Dr. Joseph Needham. (Second Biennial Dickinson Memorial Lecture to the Newcomen Society, 1956.) Pp. xii+76+31 plates. (London: The Newcomen Society for the Study of the History of Engineering and Technology, 1958.) 57s.; 8.15 dollars.

THIS book, an expansion of a lecture founded in memory of Dr. H. W. Dickinson, who was educated at the Manchester Grammar School and at Owens College, is beyond doubt a first-rate contribution to scholarship. In the field of Chinese science and technology the author speaks with a unique authority based on both wide and deep knowledge.

That China had an ancient and, for the times, an advanced metallurgical industry has long been known, but isolated as it was, the exact nature and chronology of this have been largely matters of conjecture. So far as iron and steel are concerned, we now know how and when it developed, and a most astonishing story it is. Although in Europe it was the end of the fifteenth century A.D. before molten cast iron was first produced except by accident, Dr. Needham adduces the most cogent evidence to show that this was being done in China on a by no means insignificant scale two thousand years before. How this was done, the product obtained, and the probable reasons—the existence of ores high in phosphorus producing highly phosphoric irons of increased fusibility and the invention of really effective double-acting bellows—are all referred back to the literary sources and illustrated. The fifty-odd illustrations, ranging from cast iron moulds of the fourth century B.C. to photomicrographs illustrating modern investigations of the processes described, are all of great interest and value.

From the second century B.C., if not before, this cast iron was used to produce steel by a most carefully controlled decarburization in an air blast, the method of the 'hundred refinings'. Rather later,

much of the Chinese steel was made by a 'co-fusion' technique in which wrought and cast iron were heated together in crucibles, the pasty lumps of the former being bathed in the high-carbon liquid. By a gradual diffusion of carbon a steel of approximately eutectoid composition can be produced. In connexion with this production of steel one is inevitably reminded of the work of Réaumur of the very early eighteenth century A.D. The basic correspondence of these processes with those of Huntsman, Bessemer and Siemens and Martin is clearly very much in the mind of Dr. Needham. Indeed, so far as the Bessemer process is concerned, he points out that immediately before the work of William Kelly in the United States, four Chinese workers were imported as experts at his furnaces at Kuttawa.

Many other topics are discussed, from magic swords and human sacrifices to assist the furnace produce the required product, to early Chinese tilting furnaces, and the abundant footnotes are often a sheer delight.

This book on the development of the iron and steel industry has a special interest in view of the present-day small-scale production of iron in China, often by processes which cannot differ essentially from those here described. We must now await even more impatiently a corresponding treatment of the non-ferrous metals.

F. C. THOMPSON

## USE OF ISOTOPES IN ORGANIC SYNTHESSES

Organic Syntheses with Isotopes

By Arthur Murray, III, and D. Lloyd Williams. Part 2: Organic Compounds labelled with Isotopes of the Halogens, Hydrogen, Nitrogen, Oxygen, Phosphorus, and Sulfur. Pp. ix+1147-2096. (New York: Interscience Publishers, Inc.; London: Interscience Publishers, Ltd., 1958.) 188s.

MURRAY and Williams have produced a valuable contribution in this second part of their compilation of organic syntheses involving the use of isotopes. While Part I dealt with the synthesis of nearly 500 compounds labelled with carbon-13 and carbon-14, Part 2 is devoted to a similar treatment of syntheses involving the isotopes of 8 other elements, compounds of bromine, chlorine, iodine, nitrogen-15, oxygen-18, phosphorus-32, sulphur-35, deuterium and tritium occupying 30, 15, 65, 151, 33, 30, 82, 400, and 54 pages respectively. The book provides full practical details, in a format rather like that employed in "Organic Syntheses", for the preparation of several hundred individual compounds. Each preparation is headed by the reaction scheme laid out with full structural formulæ, together with the reference from which it has been abstracted. Then follows the "Procedure", a section of explanatory "Notes" and finally "Other Preparations" in which the literature dealing with the preparation of the compound is briefly reviewed.

The compounds are classified under the element concerned and sub-classified according to the chief functional group, for example, acids and acid derivatives, amines, heterocyclics, hydrocarbons, etc. With this arrangement rapid scanning of particular sections is feasible, and the book thus provides a ready source for the chemist searching not only for possible recipes