pursued with enthusiasm in the United States, Poland and the U.S.S.R., but neglected in Great Britain.

The book under review gives the proceedings of the Topology Conference held at the University of Michigan during June 24–July 6, 1940. Twelve lectures are reported in full, and there are summaries of the shorter papers. The first lecture is by Prof. S. Lefschetz, whose well-known book "Topology" is almost indispensable as an introduction to modern work. Other lectures are by R. L. Wilder, N. E. Steenrod, S. Eilenberg, H. Whitney, S. S. Cairns, P. A. Smith, L. Zippin, S. MacLane and V. W. Adkisson, O. G. Harrold, jun., L. W. Cohen, and E. W. Chittenden. They are difficult to summarize for the non-specialist reader, because the subject has made such great progress in America that the problems on which experts are now working are so remote from the simple starting points.

H. T. H. PIAGGIO.

A STEEL-MAKER'S AUTOBIOGRAPHY

Knotted String: Autobiography of a Steel-Maker
By Harry Brearley. Pp. ix+198. (London, New York and Toronto: Longmans, Green and Co. Ltd., 1941.) 10*s*. 6*d*. net.

THE author of this unconventional autobiography is known to many as the inventor of stainless cutlery steel, and to metallurgists as a practical steel maker, a trenchant critic at meetings of the Iron and Steel Institute, and as the writer of several excellent technical books. Those books contain the fruit of long experience in the melting and working of steel and in the conduct of laboratory research, expressed in language of great simplicity and directness, suggesting the hand of a master of English. They have nothing of the aridity of the ordinary text-book. It is therefore interesting to see how a boy, brought up in one of the dreariest parts of industrial Sheffield, came by his peculiar gifts.

The back-to-back houses of Ramsden's Yard must have been unattractive enough; yet the account of life in them pictures a condition of poverty but not of misery, relieved by much neighbourliness and good humour. Brearley's father being a crucible steel melter, the boy, following various casual occupations for a short time only, and receiving only a bare minimum of schooling, became familiar with the small and grimy workshops in which crucible steel, then the aristocrat of steels, was melted and cast. A cellar boy has leisure to study both technical operations and human nature, and this one was a keen observer of both. By good fortune he became bottle-washer in the laboratory of an analytical chemist, an ascetic who had known great poverty, but had managed to study chemistry at home and abroad. One of the peculiarities of this employer, of whom Brearley always speaks with gratitude, accounts for the strange title of the book. With his encouragement, the young assistant became an enthusiastic student, working at science in a night school and in laboratory hours. How he passed from Sheffield dialect to his limpid English style it is less easy to see. From bottle-washer he advanced to the position of assistant, paying the premium of £50 from his weekly wage of 20s. When this was doubled he married, gave popular lectures on science, became an ardent social reformer, and made his first appearance as a writer of scientific articles.

In 1904 he took up an appointment in Riga, where he stayed for four years, managing a laboratory under difficult conditions and acquiring, by hard experience, much knowledge of the treatment of steel and of human material. The Lettish workmen were ignorant and politically restless, and strikes and the revolution of 1905 added themselves to the technical obstacles which arose. How they could be overcome by good humour, common sense and sympathy can be read between the lines of the narrative. In the last part of the Riga period Brearley acted as manager, and then returned to Sheffield to set up a research laboratory for the firm which employed him.

The Riga experience had shown the advantages of such scientific helps to industry as the thermo-couple, and in the treatment of such special products as naval armour plate and high steel tools there was ample room for more scientific control, in which this laboratory was a pioneer. In the course of experiments on rifle barrels, with the object of lessening erosion, a steel with a high proportion of chromium was prepared and was noticed in the laboratory to be unusually resistant to chemical reagents. The suggestion that it might be suitable for cutlery was not received with enthusiasm, and it was not until 1914 that a Sheffield cutler became interested and together with the inventor worked out the means of making table knives from the new steel, the difficulty being that the process of hardening was radically different from that used for ordinary cutlery, so that in the beginnings there were many failures. No patent had been taken out, and the subsequent negotiations as to the ownership of the invention make a rather sorry story. A lawsuit in the United States established the originality of the invention and involved a visit to America which left pleasant memories.

In consequence of these disagreements, Brearley left his employers and joined the firm with which he has since been associated. Travels in other countries, including Russia, and partial retirement, bring the story to a close, but there are final chapters containing the author's thoughts on many matters, metallurgical and other. One conclusion on which he insists repeatedly is the value of the experience of the practical man. The old steel worker who judges the quality of steel by the appearance of its fracture and by the feeling as it is worked under his hammer cannot express his valuation in quantitative terms, and his expressions may seem crude to the academically trained metallurgist, but he may have the root of the matter in him. Examples are given of specifications hampering industry because certain limits of chemical composition had become a fetish and had been allowed to overrule the experience of those who had to work the steel.

In another book, "Steel Makers", which vividly describes the old crucible process, the author has suggested means for enabling students to gain a practical knowledge of the operations they hope to control, and throughout both books stress is laid on the pleasure which may be felt in the work of one's hands, whether it be in chemical manipulation, in the working of clay, in carpentry, or in the mendi g of boots, all of which are referred to in this narrative. The reader feels that he has made the acquaintance of a skilled craftsman, a lover of good literature, of one who can look back with cheerfulness on his early difficulties, and who through varied experiences has attained to a ripe wisdom which leaves him tolerant of much, but not of social injustice.

C. H. DESCH.