in a similar category. Of course it is not for this type of information that a reader turns to such a treatise, and the author might well have felt that revision was not worthwhile. But why include it in the first place, thereby adding to the length and cost of the book?

These are trivial criticisms of a work which will certainly become a classic and which future writers on the subject will ignore at their peril.

G. F. C. ROGERS

Turbulent Shear Flows: Selected Papers from the First International Symposium on Turbulent Shear Flows, edited by F. DURST, B. E. LAUNDER, F. W. SCHMIDT and J. H. WHITELAW. Springer-Verlag, Berlin, Heidelberg, New York, 1979.

THE NOTION that one might be able to predict the main features of turbulent flows by solving transport-type equations for a few statistical properties of turbulence occurred independently to many scientists (e.g. Kolmogorov, Prandtl, Emmons); but it was not until the development of the computer, and of adequate numerical methods for solving the equations, that the validity of the notion could be put to the test. Much of the testing has been done by present or former colleagues, students and friends at Imperial College (Mechanical Engineering Department; not Mechanics and Engineering Department, as a misprint on p. 3 would have it!); and it is they who have taken the lead in bringing the subject to international attention. The publication of this work is therefore a welcome opportunity to review the extent to which the high hopes with which we began the work have been realised. Ten years ago, we thought that increasing the number of transport equations would permit the universality of the turbulence models to be steadily improved. Has this happened? Further, we quickly discovered the difficulty of predicting the 'round-jet' data with the same constants as were valid for other free flows; and the handling of low-Reynolds-number turbulence, and of flows with strong body forces, were soon found to present problems. Have these difficulties been subsequently resolved?

The workman-like paper by McGuirk and Rodi on 3D turbulent jets, in Part I of the book, indicates that the Harlow–Nakayama $k \sim \varepsilon$ model with only minor 'tweaking', fits measurements well in major respects; but, where it does not, the authors express the usual hope that a higher-level model will be found which does do so. Other papers comparing predictions with experiments contain similar findings and suggestions. However, what is to be found in Part IV of the book, concerned with 'Developments in Reynolds-Stress Closures', gives little encouragement. Launder and Morse have solved the numerical problems; but they conclude with commendable and unusual honesty: 'the present work has not produced any general proposals'. Nor do other workers in this area appear to be more successful. There are encouraging comparisons between predictions and experiments in Part V, on sub-grid-scale modelling: but the methods of prediction used are enormously expensive, even for flow systems much simpler than that of the round jet; so there is no help to be expected from this quarter for a long time.

As to low-Reynolds-number turbulence, which occurs close to a wall and vitally affects the heat-transfer process, there is an interesting experimental report by Kutateladze, Khabakhpasheva and others; but the theoreticians have steered well clear of the area, with the exception of Durst, whose introductory remarks to Part II report some success, with a version of the $k \sim \varepsilon$ model, in predicting the velocity and energy profiles near a wall.

To judge from the papers in this volume, therefore, one must conclude that the 'high hopes' have not yet been realised; indeed, one might now begin to doubt whether they ever will be. However, despair would be premature for very few of the accessible avenues have so far been explored; and, now that the Reynolds-Stress route has been recognised as arduous, some researchers may return to one- and two-equation models, and find that greater universality can be achieved if other variables are considered than k and ε.

Whether their implications are pleasing or not, this volume does contain facts that users of, and researchers into, turbulence models must take into account. The editors and publisher are to be congratulated on making available, in attractively printed form, a valuable compilation of research results.

D. B. SPALDING

J. G. PEACEY and W. G. DAVENPORT, **The Iron Blast Furnace.** Pergamon Press, Oxford (1979). 258 pp.

THE STATED objective of the authors of this text is to help improve the readers understanding of the blast furnace process. The medium used to achieve this objective is a heat and mass balance mathematical model. Straightforward equations are developed to describe each of the main aspects of the process and then assembled to produce a complete blast furnace model. The development of the model is well presented and should be clearly comprehensible by both practising and aspiring process metallurgists.

After a brief summary of the blast furnace process and some preliminaries on thermodynamics and stoichiometry, the model framework and its development are discussed in some detail. Second order effects such as heat losses, reduction of Si and Mn and the calculation of tuyere flame temperatures are all dealt with succinctly. Model validation is discussed in two chapters. In one the model is shown to behave in a reasonable fashion (i.e. obey all physical constraints), whilst in the second some direct comparisons with furnace operating data are made. The effects of various tuyere injectants on furnace performance are discussed and the text is concluded with a chapter on process optimization using the model.

The text is both well written and well structured – clearly a benefit from the use of this approach in the teaching of young metallurgists for over a decade. It should certainly prove a useful text for students and others who wish to increase their understanding of the blast furnace process. Its reasonable price, about £6 for the softback version, makes this book good value.

Bearing in mind the above comments, I do have some reservations:

(i) Although there are problems at the end of most chapters, many of them require the reader to do a reasonable amount of computer programming; in the latter chapters this requirement becomes extensive. The book would find much greater utility in the classroom and elsewhere if a well documented listing of their computer program was included as an appendix.

(ii) The philosophical approach adopted in the text follows closely the work of Rist as reported in the mid-sixties. Since that time a number of comprehensive zonal heat and mass balance models have been developed within the large steel producing organizations. These models have been used fairly extensively both to help increase process understanding and in the assessment of blast furnace performance. Their predictive capabilities, though, are usually confined to parameter variation on a furnace to which it has just been matched with existing input and output data. From the lack of pertinent references it would appear that the authors are unaware of this substantial body of work. Thus, whilst I agree that this model should provide a useful means to help students understand the blast furnace process, I doubt whether it will be any more successful at optimising commercial operations than existing in-house models.