$e \rightarrow O_2 + e$; thus permitting the intermediary alternative step $O^{-1}{}_2 \rightarrow O^{-1} + O + e$.

Investigations of the behaviour of both cathode and anode separately under different conditions of operation of the cell have given us a great deal of information on the catalytic properties of different electrode materials on this all-important electron transfer process.

Since hydrogen is relatively expensive compared with the lighter hydrocarbons or carbon monoxide, the most economical cell in fuel costs would utilize methane or a light hydrocarbon or carbon monoxide. The products of combustion of these fuels include carbon dioxide as well as water, and thus restrictions are placed on the type of electrolyte that can be used.

It seems probable that the reactions of the hydrocarbon at the electrode surface involves a series of catalytic steps, a reforming reaction $CH_4 + H_2O \rightleftarrows CO + 3H_2$ followed by the water gas shift reaction $CO + H_2O \rightleftarrows CO_2 + H_2$, the electrode behaving, in fact, as a hydrogen electrode. Both of the foregoing reactions are susceptible to the influence of appropriate catalysts. Again carbon formation may take place, not only by a cracking reaction, for example, $CH_4 \rightarrow C + 2H_2$, but also by the reaction $2CO \rightleftarrows CO_2 + C$. The thermodynamic data on these reactions which form the basis of fuel technology are well established so the most suitable steam fuel ratio to be used at any given temperature is known.

The most desirable electrode evidently should be an effective catalyst for these basic reactions as well as for electron transfer. I have always had an affection for a hypothetical carbon monoxide air cell in which electron transfer is facilitated by the presence of a *p*-type semiconductor. Self-poisoning of the electrode, a phenomenon common to reactions in which intermediary oxidation products may be formed, has to be avoided.

The practical aspects of cell construction involve consideration of porous electrodes, diaphragms, ionic semipermeable membranes and porous fillings for the interelectrode space.

Dr. Williams has included all this material in his book, together with some interesting information on practical cells which have been constructed in the laboratories of several firms as well as a valuable chapter on the economics of fuel cells in general.

The book is well documented. It does not contain many errors. I cannot commend it too highly for those interested in one of the technological challenges of our time, the fuel cell. ERIC RIDEAL

VACUUM TECHNOLOGY IN GERMANY

Vacuum Technique

(Proceedings of a Meeting of the German Society for Vacuum Technique, Heidelberg, September 18–21, 1962.) Pp. vi+94. (London and New York: Pergamon Press, Ltd., 1965.) 70*s*. net.

EDITED by Prof. G. Günterschulze, *Vacuum Technique* is a handsomely produced book which costs ninepence per page of technical information, most of which has been reported elsewhere and, moreover, is published nearly three years after the conference took place. The book contains seventeen papers, three of which are in English and the remainder in German. The practice of holding a conference concerned with a limited number of papers and yet dealing with vacuum technique and its applications in the broad sense is of doubtful value especially when, as in the present case, there is no central theme at all. Such restricted meetings are probably best confined to a special aspect of this very wide field of science and technology. It is even more doubtful whether it is worth publishing the proceedings in full in an expensive book because most readers will only be interested in the detail of one or two of the contributions. However, to indicate to the potential buyer the value of this costly book a summary follows of its contents.

The papers in English comprise an excellent review by Steckelmacher entitled "Methods of Proving the Gas Tightness of Vacuum Equipment and Components", a paper emphasizing the application of ejector pumps by Savini entitled "Pumping Systems for Freeze-drying Plants" and "Sources of Surface Contamination in Vacuum Evaporation Systems" by Holland.

The papers in German commence with a report of the opening address by Klumb on the present state and tendencies in the development of vacuum technique. The following contributions are on the possibilities of the erection of vacuum apparatus from constructional components (Winkler); constructional details and results obtained with a commercial plant for leak-detection of articles by a radioactive technique using krypton-85 (Uhlemann); mass spectrometer investigations of the gas evolution from plastics (Thieme); the significance of negative ions in residual gas analysis (Ahrens); the production of an electrode-less discharge by the use of concentrated microwaves (Geerk, Kleinwächter and Metze); a universal apparatus for the evaporation of electron microscope preparations and optical glasses (Serwatzky); limitations to the use of vacuum in the preparation of insulating oils for electro-technology (Stoll); the industrial measurement and regulation of vacuum (Schink); the production of microwave tubes by the use of getter-ion pumps (Stolz); metallization in high vacuum of bands of material with special regard to pre- and post-handling (Berisch); a new arrangement for the production of thermal gas streams and the measurement of radiometer forces (Krupp, Robens, Sandstede and Walter); measurement of the sorption, evaporation and decomposition of vacuum materials with an electromagnetic microbalance (Robens, E., Robens, G., and Sandstede); and the application of permanent magnets in vacuum technique (Brinkmann). J. YARWOOD

A LAYMAN'S GUIDE TO THE ATOM

Explaining the Atom

By Prof. Selig Hecht. New edition, with revisions and additional material by Dr. Eugene Rabinowitch. Pp. xviii+237. (London: Victor Gollancz, Ltd., 1965.) 18*s*. net.

"THIS book is for the complete layman", wrote the American author in 1946 as he moulded into book form five lectures for an audience most of whom had had no training in science. Three atomic bombs had been exploded and the Smyth report had been published; Congress had passed a Bill providing the death penalty for giving away the secret of the atomic bomb. Prof. Hecht set out, with very many other scientists, to dissipate ignorance and inform the public of the elementary principles relating to the release of atomic energy and, as Prof. Rabinowitch writes in the foreword to the revised edition of *Explaining the Atom*, he "brought to the campaign his unique gift for clear, simple, and convincing exposition of science".

The result is a most readable book which went into many printings in the United States; it deals briefly with the whole story of the development of atomic theory from the days of Dalton to the end of the nineteenth century when the electron emerged from the 'solid' atom, and then continues with descriptions of the salient experiments from which nuclear theory evolved.

This story has been told, of course, in many British books for the layman and for junior readers, and Hecht's book adds nothing except eminent readability. He seems rather surprised at the excitement created among physi-

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