

and indications as to applications and processes of industrial manufacture. These articles are of interest not only to the technologist but also to the academic chemist, since they show the relation between the substances which they normally use in the laboratory with the wider world of technology. Care has been taken to use nomenclature which provides easy reference. A bibliography relative to each main item is given. There is also information about manufacturing costs and methods of packing materials for transport; these may not, however, be applicable outside the United States. This reservation applies also to the description of aluminium alloys, which are referred to by their code names.

The aim of the "Encyclopædia" to be up to date is generally reached. The section dealing with analysis, for example, is very satisfactory; an omission noted is that there is no mention of the determination of oxygen by magnetic methods—perhaps it will be mentioned in a later volume under gas analysis. The article draws a useful distinction between accuracy and precision, and also between a quantitative determination and the greater problem of making such a determination possible. The articles are well presented and readable.

There are some statements which without further exposition could lead to misconception; for example, that on p. 535 "that a reaction can take place only if there is a decrease in the free energy between the starting materials and the final products". Some indication of the scope of the "Encyclopædia" is given by the following selection of topics: antianæmia preparations, antibiotics, antifreezes, antioxidants, antiscorbutics and antiseptics. Many of the articles are worth reading as general surveys of particular fields, and the detailed information which they contain is useful for reference. The technologist will be interested in the articles on asbestos, asphalts and various bituminous materials, baking and beer. Those interested in medical matters will find a lengthy description of the technique of blood fractionation, while for the chemist, the sections, for example, which deal with carbon arcs, modern methods of calorimetry, butadiene, benzoyl peroxide, azo-dyes and antioxidants are of interest. Among the many illustrations is a graph which shows that the price of ascorbic acid has decreased steadily since 1937—encouraging in these days of rising costs. If future volumes maintain the standard set by Volumes 1 and 2, the complete series should be a particularly useful addition to libraries. A. C. EGERTON

COSMIC RAYS, MESONS AND NUCLEAR DISINTEGRATION

Cosmic Radiation

Colston Papers based on a Symposium promoted by the Colston Research Society and the University of Bristol in September 1948. Pp. viii+189. (London: Butterworth's Scientific Publications; New York: Interscience Publishers, Inc., 1949.) 25s. net.

THE Colston Research Society is a body of citizens of Bristol and members of its University, which at its foundation fifty years ago had the aim of aiding the development of the University College into a full University; since then, it has assisted research over the whole range of studies in the University. This task having now become so

great that the burden must be shouldered more and more by government funds, the Society has adopted a new policy of devoting its resources to the promotion of annual symposia at the University. The present volume contains the contributions to the first of these symposia.

The subject, cosmic radiation, was particularly suitable for the occasion, because it has been developing with exceptional rapidity in recent years, largely as the result of a new method of investigation the potentialities of which were first fully understood and exploited by Prof. C. F. Powell and his collaborators at the University of Bristol. This method consists in the use of photographic emulsions for the recording and study of nuclear processes. Special emulsions have been developed for the purpose as a result of experience, in which the gelatine contains not only silver halide grains but also other atoms such as boron. Packs of photographic plates are specially useful for studies at very high altitudes, because of their small weight, simplicity, large stopping-power and continuous sensitivity. The silver halide grains are made developable by ionization produced by charged particles passing through the emulsion. When a cosmic-ray particle hits a nucleus in the emulsion, so as to produce a nuclear explosion, the tracks of the issuing particles are made visible by development of the plates and by the piecing-together of strips of emulsion from different plates of the pack; this gives a wealth of detailed information as to the event and its products. The emulsion technique now takes its place with the Wilson cloud chamber and Geiger Müller counter methods as a leading instrument of attack on the problems of cosmic rays and nuclear physics.

The volume contains thirty contributions from laboratories in many countries. Their subjects are too numerous to describe even in outline; among the principal new results mentioned are the following. It is found that the primary cosmic rays include not only the nuclei of hydrogen (mainly protons) and helium, but also a very small proportion of heavier nuclei, with atomic numbers between those of carbon and iron; this fact is thought to favour the hypothesis that cosmic rays are produced by some process of adiabatic acceleration, perhaps in regions of changing stellar magnetic fields, rather than by some catastrophic process. Another recent major discovery now being developed is that there are several different kinds of meson, such as σ and ρ , π and μ , the mass ratios and charge relationships of which are becoming clear. These mesons can now be produced and studied in the cyclotron. Several papers deal with the effects of the absorption, in a nucleus, of different types of primary cosmic-ray particle or meson, and the consequent re-distribution of energy inside the close-packed nucleus. This leads to the emission of protons and neutrons by a process akin to evaporation; also of alpha-particles, which mostly escape with energies well below the potential barrier of the nucleus. When the incoming particle has exceptionally high energy, some of the emitted particles seem to be directly 'knocked-on', and in some cases nuclear fission may occur.

Prof. R. Fürth gives a theoretical deduction of the mass ratios of π - and μ -mesons and electrons (m_e) and protons (m_p), seemingly in good agreement with the best measurements: his theory gives $m_p/m_\pi = 2\pi$ or $m_\pi/m_e = 293$ as compared with the experimental value 260 ± 30 ; and $m_\pi/m_\mu = 1 + 1/\pi = 1.32$, as compared with the experimental 1.33 ± 0.05 .