Savannah reactor, no doubt with corresponding reduction in costs.

The authors state that "one promising use is a new class of 30-knot 'express' cargo vessel. Two such vessels could be built and operated at a lower cost than four conventional 21-knot cargo vessels of the MARINER type and could produce the same or greater cargo-carrying capacity."

The volume *Radioisotopes and Radiation* is by John Lawrence, Bernard Manowski, and Benjamin S. Loeb. The United States Atomic Energy Commission is now spending $80 million per annum on biological and medical research, with a doubling time of about 6 years. Examples are given of metabolic studies with carbon-14 compounds using a breath analyzer enabling vitamin B-12 and folic acid deficiencies to be determined. Iron-59 is used as a diagnostic tool in studying obscure anemias and other blood diseases, and for studying the movement of iron within the body. Tritium-labeled thymidine has been of great help in proving the replication processes of DNA and in studying genetic coding. Radioisotopes enable researchers to study cardiac output, kidney function, and liver function.

A wide variety of scanners is used in locating the distribution of isotopes such as iodine-131 to study thyroid disorders or carcinoma, positron-emitting isotopes to detect brain tumors, and strontium-85 to locate bone lesions. Liver scanners and spleen scanners are clinical tools. Whole-body counters are being used to measure the loss of iron-59, which is characteristic of different diseases, or of whole-body potassium-40 in studies of muscular dystrophy.

An interesting account is given of the elimination of the screwworm from various areas by irradiating male flies, and of successful work on the melon fruit fly in Hawaii.

Radiation-induced mutations in plants have produced certain important commercial varieties: Sanilec bean, seaway bean, gratoit bean, florad oats, Alamo X oats, NC4 x peanuts, and Penrad barley.

Radiation sterilization of food has been a success, with bacon sterilized by 4.5 megarads without change of flavor after 2 years. Radiation sterilization of fish is now nearing commercial application with the construction of a pilot plant at Gloucester which is capable of irradiating a ton of fish per hour with 250,000-curie cobalt-60 source. The radiation sterilization of hospital supplies such as sutures, scalpels, syringes, gloves, and surgical dressings is now a well-established process.

Great hopes were entertained a few years ago that radiation could be used as a catalyst in many commercial chemical processes. So far the number of successes is few. The manufacture, by the Dow Chemical Company, of ethyl bromide by use of an 1800-curie cobalt-60 source was a first example. Cross-linked polyethylene film has been successfully produced by radiation, and more than 1000 tons per annum are now being produced. The Esso Research and Engineering Company has developed a foamless detergent, SAS, to the stage of pilot-plant operation.

The volume *Education and the Atom* is by Glenn Seaborg and Daniel M. Wilkes. Seaborg gives an account of the philosophy behind the Atomic Energy Commission's support of fundamental science, which provides 1200 contracts in the physical and life sciences, engineering, and mathematics, from which 4000 graduate students are supported. One of the problems is to increase the 15 to 20 strong centers of science by a greater spreading of federal support. One of the techniques is for several agencies to join forces in supporting one institution. Thus, the Institute of Molecular Biophysics at Florida State University has received support from the Atomic Energy Commission, the National Science Foundation, the National Institutes of Health, and the Air Force. One of the new developments, common to both sides of the Atlantic, has been to provide "General Research and Training Grants" of the order of 5 percent of the total grants to universities and colleges engaged in project research. The Research Councils in Britain now make a grant to the institution of £200 per annum for each graduate student receiving a research and training grant. Seaborg considers that "serious coordinated studies of the present support structure and a possible supplement and alternatives are necessary, and are being undertaken by both Congress and the Executive Branch."

Very interesting figures are given for the present faculty and student structure of eight national laboratories, showing that the number of postdoctoral workers is now more than half the numbers of candidates for graduate degrees. The authors reiterate the advice of the present Scientific Advisory Committee that when new federal research centers are built they should whenever possible be located near and identified with universities. There is some discussion of relative priorities—$1.5 billion a year for basic research out of a total of $15 billion per annum for research and development—suggesting that "it is the intuitive assessment of many authorities that the expenditure on basic research is too low in the light of our goals in development."

The authors discuss the difficult question of priorities within the budget for research and development. "What kind of machinery can be developed to evolve systems of priorities? Shall we have some system of representative government for science?" We have the same problems in Britain, perhaps even more acutely. There is fairly general agreement that we ought, without straining our resources, to be able to satisfy the needs of important, small-scale, fundamental science. The remainder of the funds available might then be distributed among the contenders for big science and adjusted to resources by adjustment of a scale—the number of space probes or satellites to be launched a year, the energy of the next generation of nuclear accelerators, the diameter of the next generation of radio telescopes.

An account is given of the Atoms for Peace Program, as part of which 26 research reactors have been provided for overseas countries. No critical evaluation of their use is given.

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Source Book on Mathematics

Mathematics: Its Contents, Methods, and Meaning. vols. 1–3. A. D. Aleksandrov, A. N. Kolmogorov, and M. A. Lavrent'ev. Translated from the Russian edition (Moscow, 1956) by S. H. Gould, T. Bartha, and K. Hirsch. M.I.T. Press, Cambridge, Mass., 1964. 1126 pp. Illus. $30.

It seems most appropriate to have a book like *Mathematics: Its Content, Methods, and Meaning* reviewed in *Science*, for the book was, in fact, especially designed for the readers of such a journal. As one well-known American mathematician recently said, "Whether a physicist wishes to know

what a Lie algebra is and how it is related to a Lie group, or an undergraduate would like to begin the study of homology, or a crystallographer is interested in Fedorov groups, or an engineer in probability, or a scientist in computing machines, he will find here a connected, lucid account."

This three-volume work was originally the result of three of the best-known Russian mathematicians, in a systematic collaboration with others. Their goal was "to acquaint a sufficiently wide circle of Soviet intelligentsia with the various mathematical disciplines, their content and methods, the foundations on which they are based, and the paths along which they have developed." This they were able to accomplish so well that it seemed appropriate for the American Mathematical Society to spend considerable time and energy in preparing a thoroughly well-done and precise translation. The present set is the result; it was originally published by the Society, but now is made readily available, in its new format, by the M.I.T. Press.

The Russian writers undertook a difficult job, and fortunately were able to carry out their self-assignment with great success. As the Editor of Translations for the Society, S. H. Gould, says in the foreword, "In recent years many popular books about mathematics have appeared . . . but for the most part they have contained little serious mathematical instruction, and many of them have neglected the twentieth century, the undisputed 'golden age' of mathematics. They have not undertaken the ultimate task of mathematical exposition, namely, the large-scale organization of modern mathematics, in such a way that the reader is constantly delighted by the obvious economizing of his own time and effort. Anyone who reads through some of the chapters in the present book will realize how well this task has been carried out." I would agree completely.

The work is a mathematics work, not volumes about mathematics. They assume little more than some acquaintance with the differential and integral calculus to read the early chapters, but complete understanding of all volumes will require not only further reading in other books, but also the use of the exceptionally well-chosen and uniformly good references listed at the end of each chapter, together with a relatively good mathematical background.

The topics covered are (i) analysis including differential equations, calculus of variations, real and complex variables, and functional analysis, (ii) geometry including differential, non-Euclidean, and projective, as well as topology, and (iii) algebra covering linear algebra, number systems and prime numbers, and groups and other algebraic systems, as well as (iv) the theory of probability, approximation methods, and computing machines and techniques.

This edition presents a well-balanced and unified view of mathematics today, and it will prove to be a most useful reference source for good undergraduate and graduate students in all fields, as well as for mathematical specialists.

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Kinetics

Experimental Methods in Gas Reactions. Sir Harry Melville and B. G. Gowenlock. Macmillan, London; St. Martin's Press, New York, 1964. viii + 464 pp. Illus. $17.

It has been more than 25 years since the first edition of this book, by Farkas and Melville, appeared, and it has been out of print since shortly after World War II. During that period the *field* of kinetics has made substantial progress, at least as regards the realization of the high quality of data now demanded for developing and testing theory. The advent of new techniques and the improvement of old ones make this revised edition extremely useful to all workers in the field. Every research student beginning work in kinetics should study it carefully, and experienced workers in the field will find it invaluable as a reference and an aid to memory.

The first chapter, "Kinetic theory of gases," gives an excellent summary of facts and equations which we wish we could remember but never quite do. It will be extremely useful to the person trying to write papers.

The second chapter, "Apparatus for control of pressure," covers pumps, valves, seals, pressure gauges, and various kinds of manometers. Although the research man often finds that he must either devise his own methods or revise old ones, the chapter will serve as a very useful guide to the various types of apparatus. The same may be said for the chapter on the measurement and control of temperature.

Chapter 4, "Preparation of gases and volatile compounds," and chapter 5, "Analysis of gases," give a large amount of useful information, much of it about methods unknown 25 years ago. The section on chromatographic methods is particularly valuable.

Chapter 6, "Photochemical techniques," is perhaps not as good as some of the others, although it will be extremely useful to the beginner in the field. This chapter might lead one to infer, for example, that Beer's Law is very useful, without special care, in the gas phase. In fact, for most photochemical systems, truly monochromatic light is unattainable, so that not only is Beer's Law not obeyed but the character of the principal absorption may change with pressure. The pitfalls encountered here and in mixtures of two absorbing gases could well have been discussed more fully.

The last chapter, "Further features of apparatus assembly and techniques in gas reactions," contains a lot of useful hints and is well worth reading.

This little book is, therefore, an extremely useful addition to the field of reaction kinetics. I can only express the regret in retrospect that something equally good for its day was not available when I began work in the field.

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Protozoology

Protozoa: The Simplest of All Animals. Richard P. Hall. Holt, Rinehart, and Winston, New York, 1964. 122 pp. Illus. Paper, $1.28; cloth, $2.50.

This book, which is directed primarily at high school students, is divided into four main chapters: "Structure of protozoa," "How protozoa live," "How protozoa reproduce," and "Protozoa as members of communities." To these chapters, an outline of classification is appended. The running text is easy to read and informative. The section on nutrition of protozoa includes some interesting and rather recent findings apparently not other-