

the eye should be taken into consideration in the design of a visual instrument, and the limitations of photographic emulsions should be a major factor in establishing the requirements for a photographic instrument.

Since *Instrumental Optics* was published in French in 1946, this insistence on a close relation between the performance of an instrument and the capability of a receiver tends to reduce the book to the status of a text of historical interest only. For example, the over-all performance of some photographic systems today is established by fundamental limitations set by the optics, in contrast to Professor Boutry's assumption that the photographic emulsion is the bottleneck. In the same vein, present-day use of photoelectric receivers in place of the eye imposes new and different requirements on optical instruments.

Professor Boutry has covered his subject in four major steps, following which he devotes the last third of his book to discussion of representative types of optical instruments. Nowhere, however, does he come to grips with the very real problems of tolerances, ease of construction, etc., which are of real concern to the manufacturer of instruments.

The first section of the book is a presentation of the principles of geometric optics. The second is an analysis of the aberrations of images formed by centered systems (including discussions of objectives and of eye-pieces), and the third is an analysis of the performance of prisms and of cylindrical systems. The performance of the eye, its relation to optical instruments, and the subject of ophthalmic correction are treated in the fourth section of this text.

Unfortunately the treatment of this material is not such that one can recommend the use of *Instrumental Optics* as a reference book. Provided one's teaching methods are such that one requires a text in which every step of a geometric or trigonometric proof is set down in detail, the book could be recommended. However, it is this reviewer's opinion that such wealth of detail tends to confuse rather than aid the student.

Introduction to Space Dynamics. By William Tyrrell Thomson. 317 pp. John Wiley & Sons, Inc., New York, 1961. \$11.50. Reviewed by Jacques E. Romain, *General Dynamics/Fort Worth*.

AT the intermediate or graduate level of instruction, this book provides a good introduction to the practical problems of space dynamics. This is achieved by emphasizing techniques directly applicable to actual dynamical situations and showing the general lines of approach to such situations.

At variance with more elementary books (such as Berman's), in which the emphasis is on physical principles illustrated by a wide variety of topics, the present book assumes previous knowledge of the physical principles and is restricted to technical dynamical problems of space flight. Since full solutions to the most advanced problems cannot be given in a 300-page book,

the author deals with simplified versions of problems representative of the field, in which the treatment is elaborate enough to bring about a thorough exposition and discussion of the underlying principles and mathematical techniques involved.

The book begins with a short introduction to basic concepts of kinematics and coordinate transformations (good enough as a reminder, but certainly too sketchy as an introduction to elementary dynamics). The chief topics studied in the main part of the book are point particle orbits (including their determination and perturbation), dynamics of rotating bodies and gyroscopic applications, motion and propulsion of space vehicles, and optimization problems. The last chapter is devoted to an introduction to Lagrangian dynamics and its application to space problems. Moderate use is made of matrices, dyadics, calculus of variations, and Laplace transformations. Short appendices give a rough outline of the first three of these techniques; the same might usefully have been done for Laplace transformations.

The exposition is clear and didactic. Numerous very good illustrations and a few charts are a real help. Quite a few worked-out representative examples and many proposed problems of physical interest (unfortunately without answers) are included. Bibliographical references are given both at chapter ends and in a general bibliographic index.

A few misprints should be corrected: for instance, the second half of Sect. 6.4 is none too clear, apparently because of a mislabelling of axes; in Sect. 9.4 the same angle is differently designated in the text and in the illustration.

Gmelins Handbuch der anorganischen Chemie (8th Revised Ed.). *Barium*: Suppl. to Syst. No. 30; 569 pp.; \$88.50. *Lithium*: Suppl. to Syst. No. 20; 525 pp.; \$81.50. *Mercury*: Sect. 1, Syst. No. 34; 466 pp.; \$71.00. *Oxygen*: Sect. 4, Syst. No. 3; 366 pp.; \$56.00. *Strontium*: Suppl. to Syst. No. 29; 306 pp.; \$49.00. *Sulfur*: Part B, Sect. 2, Syst. No. 9; 758 pp.; \$116.50. Verlag Chemie GmbH, Weinheim, Germany, 1960. Reviewed by H. A. Liebhafsky, *General Electric Research Laboratory*.

HE who has passed a camel through the eye of a needle might next attempt the harder task of reviewing adequately a single volume of Gmelin. After scanning the six volumes under consideration here, this reviewer will merely repeat that "the virtues of the work continue unabated" (*Physics Today*, August 1960, p. 42) and then try to select from each volume a little sampling that might attract physicists to this impressive storehouse of knowledge.

The *Barium* volume concludes with a treatise (pp. 536-569) on the oxide-coated cathode, that important electron emitter which continues, hopefully in diminishing degree, to be temperamental and enigmatic. The section on the preparation of such cathodes is introduced in a way that can serve as a model for any complex, important, and predominantly empirical field.

NUCLEAR ENGINEERING

MS or PhD in Nuclear Eng., Nuclear Physics, or related fields.

ORSORT desirable. 7-10 years exp. in nuclear field. To work on new or advanced reactor concepts in the following fields:

NUCLEAR ANALYSIS—Determine core physics design and configuration. Analyze core loading and control parameters to meet lifetime requirements. Analyze shielding requirements. Interpret experimental data.

THERMAL ANALYSIS—Responsible for designs dependent on, or related to, thermodynamics, fluid mechanics and heat transfer. Develop original methods of analysis. Initiate and follow R & D programs.

OPERATIONAL ANALYSIS—Analyze entire plant performance including the reactor. Includes hazards analysis and reactor kinetics. Help prepare functional test procedures and operating manuals.

MECHANICAL ENGINEERING

BS in Mech., Eng., or equiv. Over 7 years exp. with broad knowledge mech. design in nuclear field. Assignments available in the following fields:

STRESS ANALYSIS—Work directly with Design Engineer on analytical or

design problems related to stress in fuel elements, handling equipment, reactor internals, drive lines and vessels. Responsible for initiating and following all R & D in this area.

MECHANICAL DESIGN—Responsible for full range of activities from conceptual design to final field erection and service on fuel elements, control rod drives, vessels and internals, casks and handling equipment.

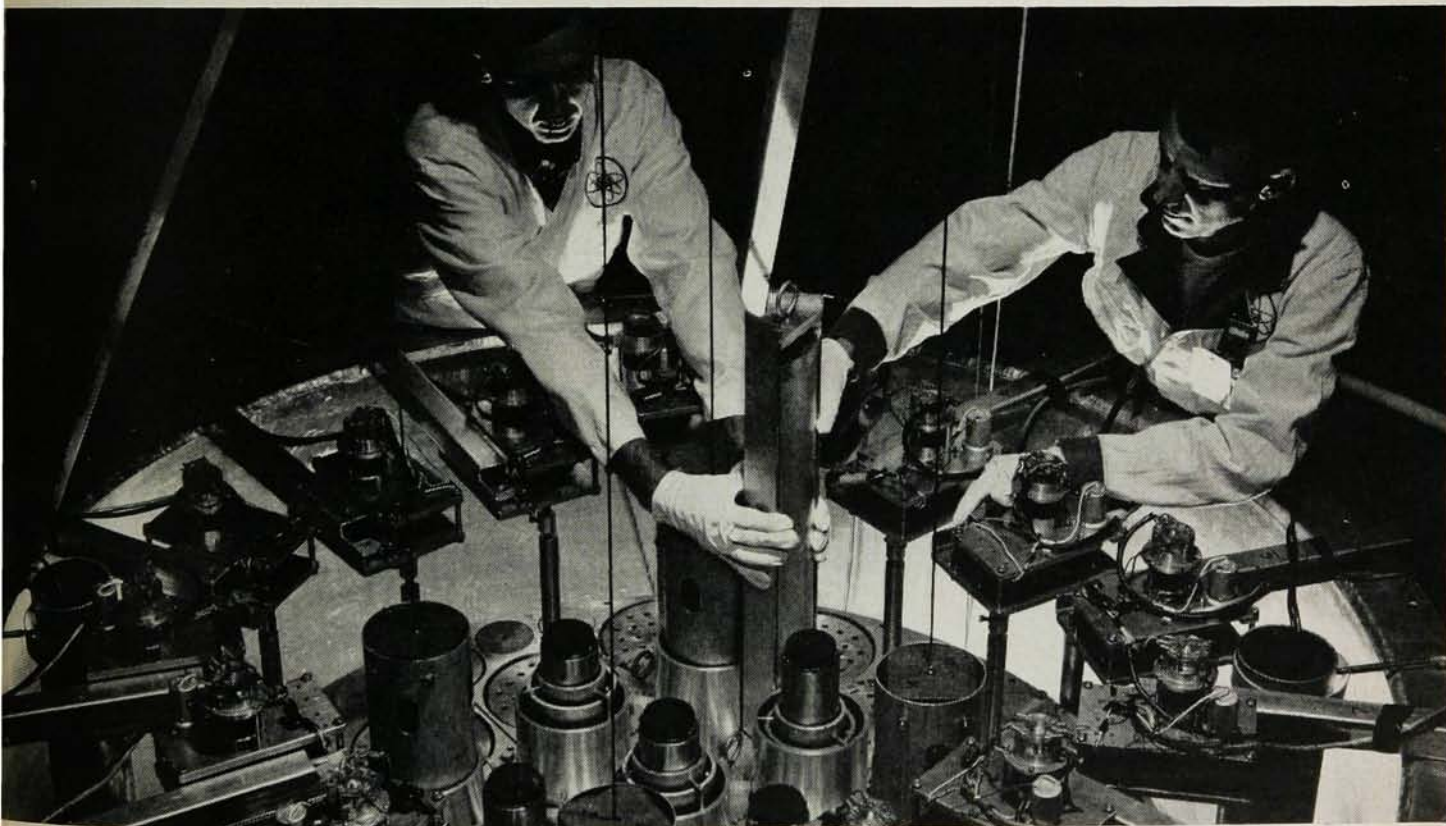
REACTOR PHYSICS

MS or PhD in Physics with strong nuclear background. 5 or more years in nuclear power or related fields. To work in our Critical Experiment Laboratory in these areas.

THEORETICAL PHYSICIST—Develop new theoretical methods in reactor theory, experiment planning and analysis of experimental data. Typical areas: slowing down of neutrons, resonance escape probability, reactor kinetics control theory, transport theory, and stochastic methods.

EXPERIMENTAL PHYSICIST—Plan and perform individual research programs. This requires the execution of complicated jobs demanding extensive research and precision in their performance. Act as a consultant for laboratory research problems.

If you qualify professionally...



Our advanced nuclear facilities can help you grow faster.

If you're interested, we'll pay your expenses here to look over our complete critical experiments laboratory, research reactor, high speed computers, and engineering prototype facility.

Equally important, you'll get the feel of our highly professional at-

mosphere. And the pleasant surroundings of Lynchburg, Virginia.

We can also talk about how our ambitious growth plans offer you interesting opportunities for your individual growth. And benefits?

Our generous program even includes paid tuition and travel allow-

ance to nearby universities.

Why not write a short letter to William Porter, personnel director of our Atomic Energy Division in Lynchburg, Va.

An equal opportunity employer

Babcock & Wilcox

After descriptions of the various kinds of cathodes and of their physical properties—notably their electrical properties—have been given, and after the processes occurring in them have been discussed, the treatise concludes with a listing of 334 patents that were examined in preparing the material. (In this listing, the patents of The General Electric Company Ltd, and of the General Electric Company are combined. If this is an oversight, it is the first this reviewer has noticed in any volume of Gmelin.)

The *Lithium* volume shows how short a step it is from nuclear physics to inorganic chemistry. In part because nuclear physics has made lithium isotopes important, the demand for the metal has grown, and the space devoted to its preparation and technology in this supplementary volume (pp. 126–142) had to be greatly increased over what sufficed in the parent volume (pp. 18–20), which was issued in 1927. Further, the new volume warns us (pp. 136 and 156) that the lithium salts now on the market are radically reduced in ^6Li content. The section on physical properties (pp. 143–199) will repay inspection by any physicist interested in what Gmelin has to offer him. He will find there in minimum space all the information available prior to 1950 on all the physical properties of lithium, and many references to work by scientists such as Bethe, Born, Coulson, Heisenberg, Kapitza, Saha, Sommerfeld, H. A. Wilson, Zener, and Zworykin.

No one is immune to poisoning by mercury. Nowhere is one likely to find a more complete, concise, and comprehensive summary of this important problem than on pp. 169–180 of the *Mercury* volume. The most impressive demonstration of its importance occurred at sea on “The Triumph” in 1810. Liquid mercury spread through the ship, and 200 persons suffered acute poisoning within 3 weeks. Two of these died after losing all their teeth, and none of the animals on board survived.

The present *Oxygen* volume, the fourth devoted to this element in the Eighth Edition, treats air, active oxygen, and ozone. It is unusual in that it is actually closer to physics than to chemistry. This situation arises because only the mechanical properties of air needed treatment here, and because active oxygen and ozone are so closely associated with electrical and photochemical processes.

Gmelin has been anticipating the space age by the comprehensive way in which the occurrence of elements is discussed. The *Strontium* volume begins with the occurrence of the element in the stars and their atmospheres, goes on to its cosmic abundance, next to its occurrence in meteorites, and then settles down to treat its complex geochemistry. Britain continues to be the main source of supply—is this not a unique situation? The grim current significance of one strontium isotope enhances the value of the information in Gmelin on strontium in the biosphere and on its behavior there relative to that of calcium.

Sulfur has had a Part A (3 volumes) to itself alone, and the present volume (758 pages) is the second section of Part B, Part B being devoted to its compounds.

Note that this section deals only with one family (the oxo-acids) among the acids of sulfur, and that the description of sulfurous acid alone necessitated working over some 5000 original publications. The physicist can gain from this volume an inkling of the volume of information that forms the chemist's stock in trade. The physicist may be pardoned a feeling of relief that this important volume is of little direct concern to him.

On March 4, 1961, West Germany increased the value of the mark by 5%. On the next day, the dollar prices of the Gmelin volumes increased by 5%. They continue to be worth what they cost.

Time and the Physical World. By Richard Schlegel. 211 pp. Michigan State U. Press, East Lansing, Mich., 1961. \$7.50. Reviewed by R. B. Lindsay, Brown University.

“WHAT, then, is time? If no one asks of me, I know. If I wish to explain it to him who asks, I know not.” So St. Augustine is supposed to have delivered himself on this mysterious mode of grouping sense impressions. His perplexity about the subject, though shared by many, has not prevented philosophers and scientists through the ages from succumbing to its fascination and writing voluminously to try to convince themselves and others that they really understand the nature of the concept. Professor Schlegel's book is one of many recent attempts to come to grips with the subject.

It should be stated at the outset that the chief interest in this book lies not so much in the presentation of the more or less standard review of the nature of the concept of time as used in physics, as in a certain ingenious point of view of the author with respect to the relativistic interpretation of time. He distinguishes between what he calls Lorentz processes and Clausius processes. The former are those in which a physical system is in interaction with an observer, as for example, an electron whose mass while in motion the observer is attempting to measure. These are the systems to which he would have the Lorentz transformation equations apply. On the other hand, there are processes which do not obviously involve interaction with an observer, or so the author implies. An example would be the internal physical process which makes a clock go. To this he would not apply the Lorentz relativistic transformation equations. Here apparently a careful distinction must be made. The *reading* of a clock by an observer involves direct interaction and is therefore subject to the transformation equations, but the *internal* processes in the clock are not so subject. In general, in the author's view, macroscopic thermodynamic processes are time-invariant; whence the appropriateness of attaching the name Clausius to them.

There will doubtless be some argument about the value of this speculative hypothesis, but, as the author points out, it does have one interesting consequence. If it is accepted, the so-called “clock paradox” will disappear. It will be recalled that this refers to the twins,