Books

External Properties of Atomic Nuclei. Vol. 38, Part 1 of Handbuch der Physik. Edited by S. Flügge. 471 pp. Springer-Verlag, Berlin, Germany, 1958. DM 118.00 (subscription price DM 94.40). *Reviewed by Herman Feshbach, Massachusetts Institute of Technology.*

THIS volume of the new *Handbuch der Physik* is, for the most part, concerned with the properties of the ground states of atomic nuclei. Of course not all properties are included in the discussion since in fact most experiments must involve some features of the stable or nearly stable nuclei. The main focus of this volume is on mass, radius, spin, and magnetic and quadrupole moments, although the mean square charge radius and compressibility are also briefly mentioned.

The first article by A. H. Wapstra on nuclear masses opens with a brief review of the various experimental methods employed for their determination after which a complete table of nuclear masses is presented. The remainder of the article is primarily devoted to an analysis of this table as contained in the semiempirical mass formula, in the systematics of α and β decay and finally in nucleon binding energies.

Microwave methods for the measurement of nuclear mass is the subject of the article by S. Geschwind. These methods employ the isotope shift in the rotational spectrum of molecules, which in turn is a consequence of the dependence of the moment of inertia of molecules on the mass of the constituent atoms. There is a discussion of the theory for diatomic and polyatomic molecules including such effects as anharmonicity and the contribution of the electrons to the measured moment of inertia. A brief description of the experimental techniques is followed by a table of relative masses obtained in this way together with a discussion of the errors in each of the measurements.

Magnetic moments and spins make their appearance in the next article by F. M. Kelley which describes the determination of these quantities by (1) magnetic hyperfine structure of atomic spectra, (2) atomic beam method, and (3) relative intensity of rotational lines in the spectra of homonuclear molecules. The theory which leads one from the experimental data to values for the spin and magnetic moment is reviewed. A brief description of the experimental methods is also given.

The isotope shift in atomic spectroscopy can be a result of the reduced mass effect and of the finite size of the atomic nucleus. It is the latter which is of major interest in the article by L. Wilets. Entering into this discussion are not only the gross nuclear volume effect but also the nature of the nuclear charge distribution, the compressibility and deformation of nuclei. These effects among others are discussed and compared with experimental material.

By far the longest and most detailed paper in this volume, 256 pages in all, is that by G. Laukien on nuclear magnetism. The various molecular beam methods are described. The underlying theory including relaxation theory as well as an exhaustive treatment of experimental methods and errors is given. Because of its pivotal position much attention is paid to the absolute measurement of proton magnetic moment. This paper concludes with a table, 40 pages in all, of the measured values of the magnetic moment and spin, including the various measurements which have been made by different authors, and the method employed by each as well as the experimental uncertainty.

The last paper in this volume, on nuclear quadrupole moments, is written by C. H. Townes. Besides discussing the various electromagnetic methods and the related theory, the determination of "q" etc., this article also includes a discussion of the effects of the asphericity of atomic nuclei on electron scattering, on nuclear rotational energy levels, on neutron scattering and absorption, and on the grant (γ, n) resonances of nuclei. A table of the measured values together with a brief discussion of their systematics concludes the article.

Transport Processes in Statistical Mechanics: Symp. Proc. (Brussels, Aug. 1956). Edited by I. Prigogine. 436 pp. Interscience Publishers, Inc., New York, 1958. $10.00. *Reviewed by George Weiss, Weizmann Institute of Science.*

ALTHOUGH the outstanding questions of statistical mechanics are not substantially different from those, say at the beginning of the present century, the methods and choice of specific problems have reflected the passage of years. A somewhat abbreviated summary of current trends in transport processes as of 1956 is presented in the volume under review.

A currently favorite problem is the derivation of Boltzmann's equation from Liouville's equation. This is the subject of papers by Kirkwood and Ross, M. Green, and Brout. Little of lasting interest seems to be reported by these authors (this is not to belittle their efforts, but the difficulty of giving a rigorous derivation without resort to dubious approximations is too well known to require special comment). A major piece of work has been reported on by Alder and Wainwright in their article "Molecular Dynamics by Electronic Computers". They study the transport properties of a gas of hard spheres by following the trajectory of each particle, obtaining results which are remarkably free from fluctuations considering that their gas consisted of about 100 particles. As important as this work is as an "experimental" test of existing transport theories, it is also important in demonstrating that substantially better results in this direction can only be obtained by computers that are many orders of magnitude faster

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than the present IBM 704. Another interesting computer investigation is reported on by Pekeris who reduces the solution of certain special cases of the Boltzmann equation to the solution of an ordinary differential equation. Although this method was anticipated by Boltzmann himself, little progress could be expected without at least present computing facilities. Another interesting set of papers, one by Van Hove and one by Ono relates to recent work in the development of perturbation theory to general order. The most significant applications of this approach have only more recently been given by Gell-Mann, Brueckner, and others. There are many other papers in this collection, on developments in the statistical basis of Onsager's relations for irreversible processes in solid-state transport phenomena, on an application to nuclear fission, and on diffusion processes.

It is interesting to read this volume as a progress report on current work. However it does suffer the defect of containing papers too short to convey an adequate summary of work. Further, it seems that the editor was either too efficient in cutting down the discussion sections, or the participants were especially laconic. In either case the discussion adds little to the papers.

Germanium: Supplement. System No. 45 of Gmelins Handbook of Inorganic Chemistry (8th Revised Edition). 576 pp. Verlag Chemie, GmbH., Weinheim, Germany, 1958. Clothbound $80.88; paperbound $79.68. *Reviewed by H. A. Liebhafsky, General Electric Research Laboratory.*

A CHEMIST naturally feels at least mild misgivings about introducing physicists to *Gmelin*, the Bible of the inorganic chemist. Fortunately, this is an introduction not to the whole of this Bible—only to the supplementary volume on germanium, to which the physicists have made major contributions.

Because germanium is the first of the two elements that are making history as semiconductors, the book under review deals mainly (pp. 132–454) with solid-state physics. Let us turn first to electrical properties. For germanium free of barrier layers, the topics discussed are: intrinsic semiconduction, defect conduction, impurity band conduction, and surface phenomena. Still under electrical properties, we have for germanium with barrier layers: the rectifier, transistors, and diode and transistor technology. The photoelectric properties are given similarly complete treatment. When the table of contents for the 62-page "Hauptband" was prepared, the importance of germanium to the physicist was unknown. The corresponding table of the 576-page "Ergänzungsband" has had to accommodate the new material in the old format, and the result is a little puzzling at first sight.

Physicists may be surprised at the completeness with which *Gmelin* covers the relevant literature, a quality chemists have come to take for granted. One gets a feeling for this completeness by looking through the volume for the Purdue Semiconductor Research Reports, of which there are a good many. The literature of chemistry is covered to the end of 1953; that of physics to the end of 1954; occasional references are as late as 1957.

Reviewers of the many earlier *Gmelin* volumes, which are devoted mainly to chemistry, have worn out the obvious superlatives. The present volume is a fit companion of the others. Two of my physicist colleagues, expert in the field of semiconductors, share my high opinion of the work. Let us simply say with Marlowe: "Infinite riches in a little room." Of course, riches thus assembled are costly and demand the exercise of good judgment for their proper use.

The Gmelin-Institut für Anorganische Chemie und Grenzgebiete seems with this volume to have adopted solid-state physics as a "Grenzgebiet". Be that as it may: the present volume is evidence that an enforced unification of disciplines is upon us. Consider germanium. The inorganic chemist charged with preparing it pure may see in his mind's eye a pile of unpromising dirt that contains traces of the element. He is profoundly thankful that germanium tetrachloride can be purified by distillation, and makes this the key step in his process. At the other extreme, the theoretical physicist charged with understanding germanium as a semiconductor sees the element as a congregation of nuclei with each of which are associated 32 electrons. He is profoundly grateful that this many-body problem can be discussed as the interaction of an electron with a one-dimensional crystal lattice. The present volume is a connecting link between the work of two such men.

Let us hope that physicists will adopt this volume. It may prepare them for the future, which is likely to bring even more extensive volumes on silicon and on the various semiconducting compounds. If the day of organic semiconductors ever comes, Beilstein,* forbidding even to many chemists, looms ahead!

Soviet Research in Crystallography. Chemistry Collection No. 5. Translated by Consultants Bureau, Inc. Vol. 1, 394 pp., paperbound $100.00; Vol. 2, 236 pp., paperbound $30.00. Consultants Bureau, Inc., New York, 1958. 2-vol. set $115.00. *Reviewed by R. A. Pasternak, Stanford Research Institute.*

RECENT Soviet achievements in many areas of technology are undoubtedly accompanied by similar progress in basic research. This reviewer, therefore, approached Consultants Bureau's translation *Soviet Research in Crystallography*, which contains articles published during the period 1949 to 1955, with considerable curiosity and expectations. His disappointment could not have been greater. Apparently Consultants Bureau gives a very broad meaning to the term "crystallography". Many articles were included in the collection merely because they dealt with crystalline substances and, one might suspect, because they were available

* Beilstein's *Handbuch der Organischen Chemie*, Springer-Verlag, in about 100 volumes and far behind the current literature.