workers, it will be valuable because of its compactness. It may serve as a stimulating introduction to the problems of selenology for readers with a general scientific education.

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Plasma Physics

Those who choose their books from a catalog should take care not to confuse this book, **Elementary Plasma Physics** [Blaisdell (Ginn), New York, 1965. 198 pp., $2.25], by Lev A. Arzimovich, with another of the same title, *Elementary Plasma Physics* by C. L. Longmire. The latter is really an introduction to the mathematical theory of plasma physics, first rate but quite hard.

So, Arzimovich's *Elementary Plasma Physics* is truly an elementary text, put together with signs of much forethought, by a definite authority in the field and, let me add, by quite a personality (glints of this personality can be seen here and there in these pages, even in translation).

Arzimovich defines the electron volt unit of temperature commonly used in plasma physics, but unfortunately uses it but little in the text. It is true that astronomers seem to manage very well in talking of millions of degrees, but I find 9 kev temperature much more informative (type of radiation, energy levels of excited state involved, and so forth) than 102 million degrees.

In the chapter where he introduces the Maxwell distribution, I would like the concept of 1/2 kT per degree of freedom brought out more than that of mean energy, but this is perhaps a matter of taste.

The important but difficult topic "Plasma in a magnetic field," chapter 7, is treated with great didactic skill.

Controlled fusion is apparently Arzimovich's main activity these days; he is the author of a book on that subject. He directs the Plasma Physics Division of the Kurchatov Institute in Moscow and is believed to wield some authority over the whole of the highly regarded U.S.S.R. controlled fusion project which absorbs a substantial fraction of the best physics talent in Russia. I like their work very much. So when he gets around to chapter 8, "Controlled fusion," one prepares for a feast. Alas!

What is it about controlled fusion research that causes perfectly respectable physicists to take leave of their senses? Perhaps Plato was right when he said that "only matters without utility are proper objects for contemplation by a philosopher." I always thought, myself, that this was a most mischievous remark. But there it is. We see that practitioners of controlled fusion research build great expensive machines, which, so far as approximation to thermonuclear reactors is concerned, would make better refrigerators. I too, in spite of the monumental difficulties, am quite confident that a thermonuclear power producing reaction is not far off: however, I doubt that it will take place in anything resembling those big machines.

After seven chapters on plasma physics handled with impeccable scholarliness, what would one expect to learn about controlled fusion? Since the aim of controlled fusion is to achieve a net output of energy, one must discuss the energy balance of thermonuclear reaction yield versus plasma losses, by bremsstrahlung, diffusion, magnetic radiation, and magnetic bottle maintenance. Is this done? Never mentioned. The above considerations lead to a vital criterion for power production in a thermonuclear reaction—that temperature being high enough, there exists a minimum value of density × time ($n\tau$). Never mentioned. The ability to trade off density for time which this criterion confers, leads to various important conclusions about thermonuclear reactors. Never discussed. The hopes for a positive power balance from a thermonuclear reaction hang on the fact that the fuels are hydrogen isotopes which radiate very little. Never mentioned.

So much for what he omits: Now, what does he say? He says: "This means that 1/10 second represents a satsfactory retention of particle in the plasma. This result was achieved by M. S. Ioffe in the Department of Plasma Studies of the Institute of Atomic Energy of the USSR and is the major achievement in the development of controlled thermonuclear reactions in recent years."

Do we hear the horns of propagandaland faintly blowing? Well, perhaps a bit, but never mind: Everybody has admired Ioffe's achievement, and it has been widely copied. It is a triumph of principle but not a confinement duration record.

For if you want to boast of Ioffe's achievement in terms of confinement time τ (which I believe to be irrelevant), it is greatly exceeded in that respect by the Oak Ridge DCX experiment (70 seconds). If you want to rate it in more meaningful terms $n\tau$, it is exceeded greatly by the Los Alamos Scylla θ-pinch plasma. So he boasts for the wrong reasons.

He goes on to say ". . . a number of premature reports that this has been achieved, in reality nobody has succeeded in maintaining pure hydrogen plasma at high ion temperature in a magnetic trap for more than a few tenths of a microsecond." Simply not true. The Scylla plasma maintains 4×10^{16} ion/cm^3 (a very high density) at ion temperature of > 5 kev (a very high temperature) for three microseconds at a purity level which radiates bremsstrahlung at 2 × theory (a very high degree of purity). But there we go again. My own Sherwood syndrome is perhaps speaking.

In conclusion: To teach the fundamentals of plasma physics to readers with a high school education—the book is excellent and recommended. However, for information on the application of plasma physics to controlled fusion—the book is partisan and inaccurate.

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Geochronology

The art and science of nuclear age determination on rocks has been summarized and reviewed in a few chapters of books on broader subjects during the past decade or so, and the three or four books and booklets on geochronology have been published in the Soviet Union. We have here the first full-length book on the subject written in English.

Applied Geochronology (Academic Press, New York, 1965. 283 pp., $10), by E. I. Hamilton, with a chapter on comparative geochemistry by L. H. Ahrens, is a book crammed with information on theory, technique, and interpretation of all kinds of nuclear age measurement. The geochemistry of the principal radioactive elements and their decay products is presented meticulously but all too briefly in the introduction by L. H. Ahrens. There follow 12 chapters by the principal author: one a historical introduction, eight on the various methods of age determination, and one each on sediments, meteorites, and the geologic time scale. The author's efforts to include everything that he found in the literature, from the latest word to the wholly obsolete, produced a vast list of references (about 700 titles), but his unwillingness to sift and evaluate severely detracts from the general utility of the compendium. In Craig's immortal phrase, this is another *clerical* review.

Even more detracting is the steeplechase style, the profusion of factual mistakes, and the far too many grammatical and typographical errors. Some curious notions are presented as fact, and some very distinguished people get their names misspelled, not once, but throughout the book. Most of the dozen or so "original" line drawings have errors. There is a strange sketch of a mass spectrometer tube, which is shaped like a broken reed; a drawing of an ion scource that would never work; and a schema of an electron multiplier with all dynodes connected to the case and a supposed "ion beam" bouncing through. The complicated geologic diagrams tend to obfuscate rather than illustrate the principles in point.

Because of its comprehensive approach and in spite of its drawbacks, *Applied Geochronology* will be useful as a reference. Its stated aim, to "fill the gap" between the analyst and the field geologist, however, has not been realized.

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Momentum Books Series

The three latest additions to the Momentum Books Series fully measure up to the reputation established by the earlier monographs. Each is a slender little volume in paper back, concise, lucid, highly readable, and sufficiently exhaustive. It is the kind of book that the working scientist, the teacher, the inquisitive layman with an energetic mind, and even the professional physicist might slip into his pocket and read with profit and enjoyment on a train journey or during leisure hours. The series is published for the Commission on College Physics. The first general editor for the series was Edward U. Condon, who was ably succeeded by Walter C. Michels. Momentum Books are not exactly light reading, but they afford an easy way of becoming familiar with important and rapidly developing areas in physics.

Radioactivity and Its Measurement (Van Nostrand, Princeton, N.J., 1966. 168 pp., $1.75), by Wilfrid B. Mann and S. B. Garfinkel, is the tenth in the series, and the other two books discussed in this review are respectively 11th and 12th in the series. After a very interesting account of the discovery of radioactivity, Mann and Garfinkle discuss at some length the radioactive transformation series, the interactions of α-, β-, and γ-rays with matter, the energetics of nuclear change, and instrumentation for and standardization of radioactivity measurements. The survey is fairly complete, although the reader might have expected discussion of the biological effects of radioactivity and of the many fascinating applications in areas outside physics.

Plasmas—Laboratory and Cosmic (Van Nostrand, Princeton, N.J., 1966. 154 pp., $1.75), by Forrest I. Boley, deals with a very modern and rather glamorous field of physics. Gaseous plasma in itself is not modern, but the word and the methods of handling it theoretically and experimentally are modern. Laboratory plasma started with the first experiments on electric discharge through gases, and cosmic plasma is as old as the cosmos itself, if not older—is it not another word for the primeval chaos? The four chapters of the book deal with the general properties of a plasma, the plasma as a conducting fluid and wave-propagating medium, laboratory plasmas, and naturally occurring plasmas. The mathematics is a little more advanced than that used in other volumes of this series, but the reader is well rewarded for his effort. The sections on the search for thermonuclear power production and on the recent findings of satellites and space probes make fascinating reading.

A concise and extremely clear presentation of another glamor topic is Ivan Simon's **Infrared Radiation** (Van Nostrand, Princeton, N.J., 1966. 119 pp., $1.50). The topics cover the laws of radiation, sources for infrared radiation (IR), detectors, materials and optics, spectroscopy, and the major applications of IR techniques. One glaring omission is the Michelson interferometer as an IR instrument. The brief paragraph on interferometers deals solely with the Fabry-Perot etalon.

With the frontiers of science advancing rapidly and in many different directions, there is great danger of mutually uncomprehending cultures developing within the scientific community itself. Small and clear monographs like those of the Momentum Series render a great service to the professional scientist by making him familiar with important areas outside his own narrow specialty.

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Wiener Memorial Volume

On 18 March 1964, when Norbert Wiener died, the world lost a great mathematician and thinker. He has left us some 250 papers on matters mathematical, philosophical, cybernetical, and social, as well as ten books. The volume under review, **Selected Papers of Norbert Wiener** (Society for Industrial Mathematics and M.I.T. Press, Cambridge, Mass., 1964. 463 pp., $12.50) contains 12 of Wiener's papers, two sizable introductory articles on his work in mathematics and engineering, and a foreword by his colleagues N. Levinson, Y. W. Lee, and W. T. Martin, respectively. The papers included are:

(1) "Nets and the Dirichlet problem."
(2) "Differential space."
(3) "The Dirichlet problem."
(4) "Generalized harmonic analysis."
(5) "Tauberian theorems."
(6) "Uber eine Klasse Singularer Integralgleichungen."
(7) "The homogeneous chaos."
(8) "The Ergodic theorem."
(9) "Entropy and information."
(10) "Problems of sensory prosthesis."
(11) "Homeostasis in the individual and society."
(12) A factorization of positive hermitian matrices."

Of these papers the first six were published before 1932 and have been hard to get. They are, however, of much interest even now, Nos. 2, 4, 5 being in fact minor classics. As Levinson remarks in his introduction (which, incidentally, is a valuable mathematical exposition of the thread running through Wiener's early thought), these pioneer-