tinuous and logically integrated. The first eight chapters, making up the first part, are a course in linear differential equations with emphasis on time invariant systems and their solution by Laplace transform methods. The second part, Chapters 9 through 14, is a course in complex variables, leading, on the one hand, to the complex integral inversion of the Laplace transform and, on the other, to engineering applications of conformal mapping. A chapter on Gibbs vector analysis, one on numerical analysis, and an appendix covering selected topics in algebra and calculus complete the book.

The text is one that could be used for self-study. The style has classroom informality, without being verbose, and a running account of all manipulative steps in proofs and derivations is provided which is adequate to guide an unsophisticated reader. The text is illustrated by many worked examples, and the student is offered a wide and graded selection of problems for solution. Few of the examples or problems are formal exercises. Most of them illustrate both a mathematical point and a potential application by means of a problem drawn from, or at least in the language of, some branch of engineering.

The author should be commended on maintaining a high standard of mathematical precision, without sacrifice of readability or heuristic explanation.

The book is well made, well printed, and liberally illustrated with excellent diagrams.

The selection of material seems generally good. Omissions in a work of some 600 pages can scarcely be criticized. The reviewer has a serious disagreement with the author concerning the importance of the impedance concept, however. In particular, the author's last sentence on page 95 is simply wrong. This difficulty could be resolved by a transfer of much of the applicational material of Chapter 4 to a point following Chapter 6, expanding the horizon to include analyses of transient behavior by calculation of impedances.

The reviewer would like to make a general comment on selection. The linear mathematics of engineering is a forest which, in all works known to him, is completely obscured by trees. These works, including the present one, are botanical catalogues; each needs at least one chapter on ecology.

In fact, throughout the linear field, one is dealing with a relatively small number of basically geometric concepts. Admittedly, the emphases and the details, in the specific instances of ordinary differential equations, boundary value problems, etc., are varied and essentially so. This, however, is no reason for concealing from the student an underlying unity which does exist. A good introduction to the *geometry* (not the formalism) of finite dimensional vector spaces could provide the language and intuition needed here, but to this reviewer's knowledge no such introduction has yet been made accessible to engineering students. It is his belief that adequate coverage of these ecological, or at least morphological, topics could simplify later presentations to a point where a net saving in bulk might result. The reviewer would, in any case, include the ecology even at the expense of omitting botanical items from the catalogue.

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The Role of Engineering in Nuclear Energy Development. Proceedings of the Third Annual Oak Ridge Summer Symposium, August 27–September 7, 1951. N. F. Lansing, compiler. Distributed by Office of Technical Services, Department of Commerce, Washington, D. C. 509 pp. $1.40.

The material covered in this volume will be of great value to administrators as well as to research men in engineering schools who want answers to the questions: Just what should be the background of a nuclear engineer? What type of courses should be taken? What are the problems involved in reactor technology and the problems for the practicing engineer in the atomic energy program?

The symposium is divided into four parts. In the first part, T. K. Glennan deals with general problems in engineering and the objectives of the Atomic Energy Commission. This is followed by C. J. Suits discussing some economic aspects of atomic power. L. R. Hafstad describes the atomic energy reactor program, and, finally, J. A. Lane considers the contribution of engineering to nuclear energy development. The second part covers the scientific background, starting with basic concepts of nuclear physics (A. H. Snell). A simplified approach to reactor calculations by A. V. Masket will certainly be valuable for the engineer who wants to become familiar with the problems involved in reactor calculations. This is followed by standards of radiological protection and control, by K. Z. Morgan. This information will be of great interest to the practicing engineer, as well as to anyone organizing a nucleonics program.

Part three covers the engineering aspects. J. A. Swartout discusses chemical problems in the development of nuclear reactors. This is followed by the problems of separation of stable isotopes, materials of reactor construction, heat transfer problems in nuclear reactors, instrumentation in control of reactors, nuclear radiation shielding principles, and disposal of radioactive waste material. This section should be of great interest to the industrial and sanitary engineer.

M. M. Mills, of North American Aviation, presents a discussion of hazards of low power research reactors—a subject for careful consideration by all educational institutions and research laboratories building a small reactor. A survey of reactor types by N. F. Lansing is well illustrated with schematic drawings and photographs of the declassified existing reactors.

The last fifty pages of the symposium are devoted to a panel discussion of the problems in nuclear engineering education. Experts in nuclear technology from Oak Ridge (A. Weinberg and F. C. Vonder

Lage), and university educators (Dean Boelter, Dean Ernst, and Clifford Beck) attempted to clarify the problems of engineering education for reactor technologists or nuclear engineers. Educators as well as nuclear technologists seem to favor experimentation with various types of curricula: a special nuclear engineering program, a solid basic foundation in physics and chemistry, with appropriate courses giving the fundamentals of nuclear physics, tracer techniques, elementary reactor theory, nuclear instrumentation, and radiochemistry. And, as Weinberg emphasized regarding establishment of nuclear engineering courses in engineering curricula: "This can only be attained if each engineering school makes a temporary sacrifice by sending one or two faculty members to an atomic energy installation or industrial organization engaged in atomic energy development to get firsthand experience with the effort."

The engineer as well as the educator will certainly benefit by this summary of the engineering aspects of the atomic energy program. We hope new developments, as they become declassified, will be presented to keep the material up to date.

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The Planets: Their Origin and Development. Harold C. Urey. New Haven, Conn.: Yale Univ. Press, 1952. 245 pp. $5.00.

The Silliman Lectures at Yale University have in the past led to the publication of two outstanding volumes in the field of astronomy—W. W. Campbell's *Stellar Motions,* based on a 1910 series of lectures, and E. P. Hubble's *Realm of the Nebulae* (1935 lectures). The Urey book is a worthy addition to this distinguished pair. It is a volume written by a competent physical chemist, thoroughly conversant with the relevant areas of astronomy, geophysics, and geology and obviously a master in mathematical and practical physics. It is a book that deserves to be read and studied by everyone who is even remotely interested in the physics and chemistry of the moon and planets as they are today and as they may have been in the past.

Harold Urey has written a book that cannot be read and digested in one or two evenings, since much of the material in it is of a technical nature. In the introductory chapter the author reviews current theories on the origin and development of our solar system. Here he leans primarily on Kuiper's modification of von Weiszäcker's theory, according to which our system of planets came into existence as a result of the collapse of a turbulent solar nebula with a total mass of the order of one tenth that of our sun.

According to Urey's picture, our solar dust cloud was in the earliest stage a small, dark nebula, a globule, not unlike the globules one sees even now projected in abundance against the bright background supplied by diffuse gaseous nebulae—surprisingly most frequently against certain conspicuous, extended, and highly ionized diffuse nebulae. The globule is supposed to have collapsed gradually to become a proto-star, and as the sun was formed there would then remain behind sufficient matter for the formation of a cool disk of gas and dust, the solar nebula. Since the temperatures in the solar nebula are low at the start, most of it—with the exception of H, He, and Ne—would presumably be in a solid stage. The disk would rather promptly break up into large masses, the largest of them pretty far from the sun.

In a way, Urey's theory is a 1950 version of the planetesimal hypothesis proposed more than 50 years ago by Chamberlin and Moulton, also of the University of Chicago. Urey sees the lunar craters as of meteoric origin and—in agreement with most recent writers on the subject, notably Baldwin—he therefore rejects the volcanic theory for the origin of lunar craters. Accompanying the volume is an excellent composite map of the moon. With this map as a guide, the author analyzes many of the surface features of our moon in terms of planetesimal bombardment. Even the lava-flow features on the moon's surface are assumed to have arisen as a consequence of the melting of the planetesimals themselves.

Urey follows in detail the probable development of the terrestrial planets. After the formation of the sun, the first proto-planet stage is one of low temperature—close to freezing for the earth—with methane gaseous and not condensed in the disk to well beyond the range of Pluto, and with the terrestrial planetesimals largely composed of silicates, water, and ammonia. Ne, H, and He would not be bound and should already have largely escaped from the proto-planet at this early stage. The stage that comes next is one in which the interior temperature of the proto-planet is raised through adiabatic compression. Silicates will be reduced and volatilized, and a large fraction of the gases will escape from the proto-planet, thus increasing the proportion of iron phase in planets like our earth. With the departure of most gases from the proto-planet, the opacity should decrease, and the surface temperature will then begin to drop again. The temperature should then remain at a fairly low value, and this would hardly be changed by further gradual accumulation of mixtures of iron and silicate. The final stage is now approached with, for our earth, 45 per cent metallic iron and 55 per cent silicates, and with the iron gradually sinking to the core.

Urey considers it most likely that the moon was formed from a secondary nucleus within the earth's proto-planet, although he does not rule out entirely the possibility of wholly separate formation of earth and moon and subsequent capture. Under any circumstances, it does not seem likely that the moon has passed through a high-temperature stage. The more volatile solids, which escaped from the earth's proto-planet, have probably been retained by the moon. The moon has mostly silicates and some small admixture of metallic iron, and its composition still may be close to that of the original dust cloud.

The virtues of Dr. Urey's book are many. It repre-