periods of occupation of the sites. Appendix C is a descriptive register of the 867 sites plotted in the surveys. References and notes are admirably copious and detailed.

It is unfortunate in such a large book that the notes to the tables in the text are reduced to such minuscule proportions. The same must be said about the otherwise finely produced maps and figures which illustrate the settlement and irrigation patterns. The numerals indicating the sites are unnecessarily tiny and difficult to read. It would have been more helpful to the reader if all the known site names were included in the index. As it is they are listed in the site register only numerically. But these are minor details which detract not from the overall excellence of this pioneering study.

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Soviet Geography

This book by Roy E. H. Mellor, **Geography of the U.S.S.R.** (St. Martin's Press, New York, 1965. 418 pp.; text edition, $8.50; trade edition, $12), should be a most welcome addition to the relatively small number of textbooks currently available in English on Soviet geographic conditions. The book, which examines the U.S.S.R. on a topical basis, may be divided into sections on the physical environment, the people and governmental administration, and the economic system.

The first part of the opening chapter deals briefly with the physical relief and geologic structure of the Soviet Union as a whole. This discussion precedes a rather detailed description of the landforms, including the geomorphology, of the major physical regions —the European plain, the west Siberian lowland, the central Siberian uplands, northeastern Siberia, southeastern Siberia, and the mountain systems. The Arctic islands and the country's rivers, lakes, and seas are treated in the last few pages of the chapter. In the second chapter the author considers the characteristics of the climate, soils, and vegetation. To facilitate description, the country is divided into nine climatic regions and ten soil-vegetation regions. The remainder of the book progresses from a discussion of the growth of the Russian state to the geographical exploration; population distribution and ethnic composition; town, village, and territorial administration; and finally a treatment of the individual topics of agriculture, fuel and minerals, industry, and transportation. A few notes and a number of references for further study of specific topics appear at the end of each chapter.

The book's 59 maps and 24 tables are well planned, free of unnecessary detail, and are effectively integrated into the text. The 34 pages near the back of the text contain an appendix, glossary, bibliography, and illustrations. The appendix lists the 1959 population of Soviet towns of 50,000 or more as well as the former names of many of the towns. The short glossary is helpful, but its value could have been greatly enhanced if all of the italicized terms that appeared in the book had been listed. The five-page bibliography includes a list of general and regional textbooks, atlases, periodicals, and statistical handbooks from both English and Russian sources. These references are mainly (there are a few repetitions) supplementary to those given at the end of each chapter. The 32 photographs are printed on glossy paper and are of high quality. Unfortunately, they are not keyed into the text nor are they cited in the textual materials. Only two photographs are dated.

Geography of the U.S.S.R. has a few faults, but they are minor in view of the book's quality and usefulness. The text conveys a remarkable amount of information in a style that is easily read and understood. No doubt it will become an important reference and textbook.

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Mathematics and Logic

In **Symbolic Logic and the Real Number System: An Introduction to the Foundations of Number Systems** (Harper and Row, New York, 1965. 237 pp. Illus. $7.50), A. H. Lightstone has two primary objectives: to set forth "the impact of symbolic logic on mathematics" and "to develop the real number system on the basis of ordinary arithmetic." This exposition should lead the reader to a real feeling for the concepts of logic rather than merely an ability to manipulate; for example, the use of a contrast between $p = q$ and p iff q could well tend to clarify a hazy area. Material on sets, functions, relations, operations, and so on leads to a discussion of mathematical systems. The ordered-pair approach used is sometimes burdensome, particularly in the notation for examples of mathematical systems; moreover, in the definition of isomorphism the all-important property is concealed in the notation. Illustrative examples are used effectively.

The development of the real number system proceeds from the Peano postulates through the systems of natural numbers, integers, rational numbers, and real numbers. Many parts of this (for example, the thought sequence leading to a definition of "less than") require considerable sophistication on the part of the reader. The real numbers are developed from the rationals by using sequences of decimal fractions, since the author believes that this is more natural than either the Dedekind cut or Cauchy sequence approach. The operations which this requires are simple enough as entities, but when they are combined the effect is not always clear. I question whether the intended simplicity is attained.

Some typographical errors may cause difficulty in reading, though most are evident. The proof (indirect) of Theorem 5.4.2 contains an example which appears to be an illustration; however, the contradiction obtained for the example turns out to be the theorem contradiction, no explanation of this unusual procedure being offered. A lemma (p. 125) includes uniqueness, but there is no mention of proof. Corollary 4.1.1 follows Theorem 4.1.14 rather than Theorem 4.1.1, hence back reference is not as easy as it could be.

Lightstone concludes his interesting exposition with a discussion of the properties of real numbers.

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Impact of Big Science

In April 1965, Purdue University sponsored a symposium on the general theme of "Science and Public Policy: Evolving Institutions." The principal papers presented on that occasion are brought together in **Science**

and the University (Columbia University Press, New York, 1966. 219 pp., $5.95), edited by Boyd R. Keenan of the Purdue political science department. Like all collections of papers, this one is characterized by a variety of points of view, diverse concerns, and some repetition. Indeed, the volume has more to say about the research and development plight of the Midwest than about the impact of "big science" upon universities. Yet at the same time the papers as a whole represent another useful contribution to the discussion of the interaction of science and society.

Of the participants whose papers are included in this volume, five spoke as representatives of government (Donald F. Hornig as Assistant to the President for Science and Technology, Leland J. Haworth of the National Science Foundation, Harvey Brooks as a member of the President's Science Advisory Committee, and congressmen J. Edward Roush of the House Committee on Science and Astronautics and John Brademas of the House Committee on Education and Labor). Six others spoke as associates of independent, nonprofit research institutes (I include the Argonne National Laboratory here despite its administrative attachment to the University of Chicago). Two others from such institutions made little if any reference to their own organizations. Only two persons, Frederick Seitz and Edward Teller, spoke as university men, and Teller addressed his remarks to the imbalance between "pure" and "applied" science as he perceives it in the university today. The roster of contributors is completed by Sir Eric Ashby of Cambridge University and Kenneth W. Thompson of the Rockefeller Foundation.

There are at least four somewhat different subjects considered in the book. First, there is a review and status report on the involvement of the federal government in support of scientific research and development. Hornig's observations are most helpful in providing a current perspective. The federal government is supporting 75 percent of all university research and 90 percent of all research in the biological sciences. It directly supports about one-third of all graduate students in the natural sciences and probably supports another one-third or more indirectly. It supports 90 percent of all research and development in the aerospace industry and 75 percent of research and development in the electronics industry. It supports almost no research and development in the chemical, textile, metals, and automotive industries. Again and again it is pointed out that government research and development interest is primarily mission- or problem-oriented and that it is concentrated in the fields of national defense and its related concerns, atomic power and space. Health-related research, at least, doesn't need a defense justification.

Second, there is the subject of the relation of the federal government to universities. Inevitably, in a symposium held a few months after Berkeley, there is some intimation that universities have put their research role ahead of their instructional role and even a suggestion that research laboratories apart from universities have some obvious advantages (the absence of students). The whole subject of scholarship in its instruction and research components needs more thorough exploration than it receives here, as does the subject of the interrelationship between undergraduate and graduate education.

Third, there is the inevitable concern about whether the Midwest is being disadvantaged in current federal science policies and programs. Congressman Brademas says yes. Philip Abelson of the Carnegie Institution and this journal places much of the blame upon Midwest business leadership. Hornig implies that the fault, if any, is a lack of aerospace and electronic industries in the Middle West.

Finally, some little attention is given to the vague but exciting matter of the interrelationship which may exist among research, technological development, and economic growth. Here is a social and political concern which deserves its own careful research.

Science as an emerging social institution, as a major political concern within the traditional framework of our political processes, as an important segment of the federal budget, as a university activity, as a contributor to national security and economic growth —in other words, science in its social, political, and economic context as well as in terms of its intellectual commitment—needs systematic attention. This little volume provides some of the insights upon which the necessary synthesis of our thought and action must eventually be founded.

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Conference and Symposium Reports

Incompatibility in Fungi. A symposium (Edinburgh), August 1964. Karl Esser and John R. Raper, Eds. Springer-Verlag, New York, 1965. 132 pp. Illus. Paper, $6. Twelve papers: "Heterogenic incompatibility" by K. Esser; "Incompatibility in yeasts" by M. Ahmad; "The function of the mating-type locus in filamentous Ascomycetes" by G. N. Bistis; "The genetics of tetrapolar incompatibility" by P. R. Day; "Somatic recombination in Basidiomycetes" by A. H. Ellingboe; "Somatic recombination in the Basidiomycete *Coprinus radiatus*" by N. Prud'homme; "Incompatibility and nuclear migration" by P. J. Snider; "Short communication: Results of electron microscope work on *Coprinus*" by P. R. Day and R. M. Giesy; "Physiological aspects of tetrapolar incompatibility" by S. Dick; "Genetic investigation into the mode of action of the genes controlling self-incompatibility and heterothallism in Basidiomycetes" by Y. Parag; "The natural history of recombination systems" by J. H. Burnett; and "The genetical interest of incompatibility in fungi" by K. Mather.

Instruments and Measurements: Automatic Control. Proceedings of a symposium (Stockholm, Sweden), September 1964. Birger Qvarnström, Torgny Schütt, and Vera Runnström-Reio. Academic Press, New York, 1965. 191 pp. Illus. Paper, $12. Fourteen papers.

Pulse Radiolysis. Proceedings, International Symposium (Manchester, England), April 1965. M. Ebert, J. P. Keene, A. J. Swallow, and J. H. Baxendale, Eds. Academic Press, New York, 1965. 321 pp. Illus. $11. Twenty-two papers.

Sensitivity Methods in Control Theory. Proceedings of an international symposium (Dubrovnik, Yugoslavia), August–September 1964. L. Radanović, Ed. Pergamon, New York, 1966. 456 pp. Illus. $13.50. Thirty papers on the following topics: Basic Approaches (6 papers); Sensitivity Functions (11 papers); Compensation of Parameter Variations (6 papers); Synthesis of Insensitive Structures (3 papers); and Sensitivity and Optimality (4 papers).

Tokyo Summer Lectures in Theoretical Physics, 1965, pt. II, *High Energy Physics.* Gyo Takeda, Ed. Syokabo, Tokyo; Benjamin, New York, 1966. 127 pp. Illus. $5.75. Ten papers: "Nuclear democracy, Regge poles and the analytic S-matrix" by G. F. Chew; "Bootstrapping with the Regge boundary condition" by G. F. Chew; "The S-matrix at very high energy" by L. Van Hove; "High energy behavior of the forward scattering amplitude" by Toichiro Kinoshita; "Present status of weak interactions" by R. E. Marshak; "Parity-SU_3 mixing for mesons" by R. E. Marshak; "Algebra and symmetries: Unitary spin and its dynamical extensions. Generalized algebraic methods in particle physics" by Y. Ne'eman; "Electromagnetic properties of the baryon (hyperfine structure of hydrogen)" by Y. Nambu; "Hidden symmetries and the question of massless particles" by S. A. Bludman; and "Mass formulae in $SU(3)$ and $SU(6)$" by S. L. Glashow.