about by the change, the understanding of the people, and the character of the change that has to take place"—and that in particular "the growth and improvement of the private sector of our economy are increasingly limited by non-technical, social factors."

The Chinese and the Soviet writers, even the most objective among the latter when expressing their thoughts publicly, maintain that even when such problems are scientifically analyzed, these nontechnical, social factors in general and the ownership relations in the United States economy in particular will prevent their solution in the interest of the broad sections of the population of the United States, and will thus act to prevent the development of science and its utilization. One can adduce a certain amount of evidence confirming this point of view, even from the proceedings of this seminar—for example, that so far the government has done nothing to influence directly one way or another the research activities of enterprises connected with the civilian needs. But this would give only one, and a smaller, part of the picture. First of all against all such evidence one can accumulate much more of a contrary kind showing that in recent times in the United States the social institutions and relations of production, including the question of definition of "ownership" of means of production, has undergone consistent change in the direction of a wider social approach. Furthermore, the problem of developing civilian technology and innovation is becoming a social problem through the influence and the activities of numerous research policy workshops like this Columbia seminar. Finally there is as much awareness in the United States as there is in the U.S.S.R. of the importance of success in the research race. The national importance of not lagging in this race is a very vital factor causing the leaders of all institutions, including business, to take a realistic appraisal of national problems, including the problem of science and civilian technology. It seems to me that in policy workshops like the Columbia seminar the United States has an extremely powerful weapon for the solution of the problems basic to the research race.

STEVAN DEDIJER
Department of Sociology, University of Lund, Lund, Sweden

Communications Systems: Current Research and Reviews

Advances in Communication Systems: Theory and Application. vol. 1. A. V. Balakrishnan, Ed. Academic Press, New York, 1965. x + 316 pp. Illus. $11.50.

This book is the first volume in a new series designed to provide a record of significant current research and critical reviews in the broad field of communication systems. "The emphasis of the series is upon criticism. The purpose of each contributor is to place each new theory in its proper perspective within the overall scientific schema." I feel that there is a need for such a series and that the stated goals are appropriate. However, the first volume is rather uneven, and the goals are only partially attained. The book consists of six independent articles that will be reviewed in the order in which they appear.

A. V. Balakrishnan's "Signal selection theory for space communication channels" (31 pp.) is in two equal parts. The first half, consisting of a general discussion of mathematical models of the Gaussian channel and a description of the signal selection problem, is poorly written. There are misstatements (for example, that the limiting noise due to zero-point fluctuations in optical systems is white Gaussian). There is also considerable undefined notation and imprecisely defined concepts. The second half contains an interesting direct proof of the optimality of the simplex configuration. The paper contains only four references, and no reference is made to many classic works in the field (for example, Shannon's 1959 paper on bounds on communication performance). In no sense are the results placed in "proper perspective within the overall scientific schema."

David Braverman's "Theories of pattern recognition" (23 pp.) is a concise well-written description of the communication theoretic aspects (largely adaptive decision theory) of pattern recognition. It is primarily of an introductory nature indicating the various approaches taken and illustrating these by simple examples.

In contrast to the first two papers, which discuss general theories, R. W. Sanders's "The digilock orthogonal modulation system" (16 pp.) describes an actual system "which has found practical application," but unfortunately none of the applications are mentioned. Neither theoretical results nor performance data are given, and the references are rather inadequate. Although the paper is generally well-written, it is rather compressed, surprisingly so since one purpose of the series is to remove "the space limitations of the journal format."

J. C. Springett's "Telemetry and command techniques for planetary spacecraft" (50 pp.) seems closest to the stated goals of this series. It describes the communication system for the Jet Propulsion Laboratory's planetary probes, with particular emphasis on the use of pseudonoise codes for synchronization. The phase-lock loop receivers are described, a simple theory outlined (references are given to more complete theories), and performance data given. Publication here is welcome because much of the material has been available previously only in the laboratory's reports.

Rudolf A. Stampfl's "Communication from weather satellites" (95 pp.) also describes specific systems (Tiros and Nimbus), but here the emphasis is on the complete satellite system rather than on only the communications. Engineering information is provided, not only on the television and infrared sensing systems and the frequency modulation telemetry, but also on orbits and coverage, attitude sensing, antennas, and system operation and performance.

The final paper, "Information theory of quantum-mechanical channels" (82 pp.) by H. Takahasi, contains considerable new and significant results not previously published. A quantum analysis of a "four-port" in which the input consists of a source and an external system and the output contains a receiver and an absorber is presented. Assuming only linearity between input and output, Takahasi derives (among many things) the probability distribution of the receiver output considering signal and noise input. The results are applied not only to lossy channels but also to ideal amplifiers. This is not easy reading (a quantum mechanics background is assumed and the reader must be prepared for statements such as "the well-known matrix form of the annihilation operator . . .") but may well become essential reading for those interested in theoretical quantum elec-

tronics. Although an information theory of quantum mechanical channels is *not* presented, the theoretical foundation for such a theory may well be contained in Takahasi's stimulating paper.

As indicated by the above discussion, this volume contains a wide variety of material, some of which was interesting and stimulating, and some of which fell far short of expectations. I expect that most readers will have similar mixed feelings.

IRA JACOBS
Electromagnetic Research Department, Bell Telephone Laboratories, Inc., Whippany, New Jersey

History of Science

Michael Faraday. A biography. L. Pearce Williams. Basic Books, New York, 1965. 547 pp. Illus. $12.50.

It is indeed unfortunate that this extremely readable and comprehensive biography, obviously the product of painstaking scholarship, should have its many virtues seriously jeopardized by the basic point of view from which it was written.

The following items suggest the positive accomplishments and characteristics of the biography. First, Williams has attempted to consider essentially the whole scope of Faraday's investigations and to place them within their scientific context. Second, he has selected creatively from a diversity of primary sources including published and unpublished notes, notebooks, letters, diaries, and journals, as well as *Faraday's Diary* and the published papers of Faraday and other investigators. Third, the biography makes liberal and effective use of long citations from the primary sources. Fourth, Williams has been able, frequently, to succinctly and clearly present a complex situation in either Faraday's personal life or his experimental work by developing a skillfully chosen representative aspect of the situation. In short, Williams has written some very good history in these instances. Fifth, he has forcefully conveyed Faraday's profound commitment to the idea of the "convertibility of forces."

In tracing Faraday's theoretical achievements, Williams has attempted a grandiose synthesis. Thus, he insists on a single, hidden basis for essentially all of Faraday's theory construction during his most productive 25-year period. Williams states (pp. 77–78) that "Although he did not publicly announce his commitment to the [Boscovich] theory of point atoms until 1844, Faraday worked within this framework from his earliest productive years." Subsequently Faraday's acceptance of Boscovich's theory is dated at 1823 (probably), his commitment to it at 1826, and the early indications of his break with it at about 1848. In presenting the theoretical component of a number of Faraday's contemporaneous investigations, Williams implies, without convincing demonstration, that to make a given investigation intelligible it is *necessary* to accept Faraday's commitment to Boscovich's theory. Each of these presentations follows an exceedingly simple pattern. By conjecture Williams depicts Faraday as (i) basing his reasoning, more or less directly, on Boscovich's "point atomism," (ii) developing a clear set of concepts which, then, (iii) suggest an experimental confirmation.

Williams's rich and provocative consideration of the discovery of electromagnetic induction exemplifies several of the above comments. In his view (p. 161), Faraday used Ampère's ideas as a touchstone in such manner that "his concepts became clearer and clearer until he was led by them to the discovery of electromagnetic induction." By plausible reasoning which is grounded, ultimately, in Boscovich's "point atomism" and which, admittedly, "contains a good deal more conjecture than is desirable" (p. 169), Williams represents Faraday as *expecting* those two transient pulses, the detection of which constitutes his discovery. However, the relevant published literature suggests that the transciency surprised Faraday and that he subsequently invented his undetected "electro-tonic state" as a steady interpulse "response" thus eliminating the transiency. The other instances of Williams's contention of Faraday's adherence to Boscovich's "point atoms" are similarly not indispensable.

It thus remains useful to consider Faraday as having been openly committed to general qualitative ideas, such as the "convertibility of forces," and further to study the clarification of his concepts as occurring *with* his experimental results and not necessarily as a prior condition for them.

J. BROOKES SPENCER
Oregon State University, Corvallis

Theology and Social Progress: A Cargo Cult

Road Belong Cargo. A study of the Cargo Movement in the southern Madang District, New Guinea. Peter Lawrence. Humanities Press, New York, 1964. xviii + 291 pp. Illus. $6.50.

The cargo cults that have swept the area of Melanesia for the past several generations have been, since World War II, of increasing interest to scholars and public administrators. They are perhaps the most gaudy of all the varieties of revitalization movements that spring up, characteristically, among peoples who have lost faith in their own old traditions. Such intensively emotional movements as these, in the remaining colonial areas of the world, in the independent but underdeveloped countries, and among the underprivileged in advanced countries, are of considerable importance to all concerned with policy and the application of policy in foreign and domestic affairs, for they are the milieu in which intergroup relations must be carried on.

The cargo cults and related movements of Melanesia have been the subject of several excellent recent studies, some of them already reviewed in the pages of *Science*: Margaret Mead's *New Lives For Old* and Theodore Schwartz's *Paliau Movement*, which are intensive studies of a single movement; P. M. Worsley's survey, *The Trumpet Shall Sound*; and several others. Peter Lawrence's book *Road Belong Cargo* is a welcome addition to this library, for it combines intensive field study of the cults of a region with careful attention to historical process. Lawrence spent about three years in the field in the Madang area of the Trust Territory of New Guinea, studying not just a single tribal group but a region. The historical and regional survey aspects of the study are important, for, now that there are numerous examples of individual movements in particular tribes, it is important to proceed to an understanding of how the endemic cargo idea spreads and evolves in a whole area, with movements flaring