to solid-propellant boosters as "accelerators" or "300-stage" is puzzling. Perhaps "zero stage" was misread by a typist.

Once one gets through this initial thicket, the text improves considerably, although one is still occasionally puzzled by a term. The sections dealing with Soviet flights seem authoritative, and there are many interesting and new color photographs. The tables of U.S. and Soviet manned space flights and the descriptions of lunar trajectories, nuclear propulsion, planetary research, and applications satellites are excellent. The sections on European programs and international cooperation are well done. The lack of credit lines for the photographs is disappointing; sources are simply listed in the back of the book. In summary, *The Encyclopedia of Space* emerges as a remarkably all-embracing work and a dandy family or V.I.P. Christmas gift.

Above and Beyond costs about three times as much and is about three times as long. The 14 volumes are in a large format with an average of 185 pages. Aviation and space flight are covered about equally. All articles are signed. Each volume contains hundreds of photographs, mostly in good color, with source credits. An index of 114 pages in volume 14 has been carefully prepared, together with a listing of contributors. Many prominent U.S. aerospace writers are noted. Cross-referencing appears to be very good.

Two aspects of note are the careful historical treatment (of World War I aircraft, Lindbergh, the Wright brothers, and the Zeppelin, for example) and the inclusion of several hundred biographies of significant flyers, engineers, and scientists, living and deceased. All astronauts and cosmonauts are included. Each biography is illustrated with a line drawing of the person.

My test search for particular subjects gave indication of good coverage with one notable exception—the U.S. Navy NC-4. I could find no mention of this historic craft, which in 1919 made the first transatlantic crossing by heavier-than-air craft. The Alcock and Brown and R-34 flights are mentioned, however. The article on Rockets and Rocketry is lengthy and well illustrated; there are some minor errors. The article on Rocket Propulsion contains a few strange statements, such as that "only very low specific impulses have been obtained to date with electric rocket motors," and a diagram of an electric rocket engine that is weird, but otherwise it covers the subject in a generally satisfactory fashion. Pilot training and private flying are treated substantially, as well as military aviation. Basic scientific subjects such as "electricity" and "atoms" receive individual treatment.

Each volume has a fine cloth binding with heavy protective coating. *Above and Beyond* should find wide acceptance in schools and libraries.

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Democratizing and Producing

The Human Organization. Its Management and Value. RENSIS LIKERT. McGraw-Hill, New York, 1967. xi + 258 pp., illus. $7.95.

Despite this book's apparently narrow focus on business firms, few works could be more relevant to many of the central problems of our times. It should have something of interest to say to Charles de Gaulle, Andrew Cordier, Pope Paul, "Danny the Red," and anyone else concerned with how to design an organization or society which is efficient and well coordinated as well as democratic and solidary.

The author, professor of psychology and sociology and director of the Institute for Social Research at the University of Michigan, seeks to describe and extol the "System 4" (or "Participative Group") approach to improving the management of human organizations. System 4 is characterized principally by participatory decision-making, close and supportive interactions, and extensive communication between and across all organizational levels. According to the studies Likert reviews, when coupled with competent management and high performance goals these factors promote greater motivation and loyalty as well as better products and higher profits than systems which would be characterized by lower scores on these core factors (such as System 1 or 2—"Exploitive Authoritative" and "Benevolent Authoritative"). The image of the System 4 approach that emerges is of a conglomerate of vertically and horizontally overlapping group linkages such that, for example, the superior in each group is a subordinate in one at the next hierarchical level. (Perhaps unfortunately, the organizational structure does not come full circle—the top levels are not then subordinates in the lowest levels.)

It is important to see Likert's work in the context of the development of organizational theory. Two major traditions can be identified: the classical sociological tradition (including the work of Marx, Weber, Michels, and the post-Weberians) and the "scientific management" tradition (including Taylorism, the human relations approach, and the group dynamicists). Essentially, while the classical tradition was working "down" from a concern with freedom and power at broad societal levels to the internal organizational structure, the managerial tradition, starting from a concern to enhance worker productivity, has worked its way "up" from material conditions and physiological levels, through individual feelings and attitudes and small-group situations, to aspects of organizational structure. Although Likert is one of the leading exponents of the group-dynamics tradition, his book may also be seen as part of this convergence: it is founded on a clear recognition of the importance of motivational forces and small-group interaction, but an effort is made to take into account the systemic nature of the enterprise and to articulate its formal and informal aspects.

I think the work should be taken as a tentative diagram. The evidence supporting many of the notions is rather slight or open to serious methodological criticisms (such as that direct, independent measures of organizational efficiency and effectiveness are lacking). Even if there were no problems of this kind, however, I would still have serious reservations. For one thing, the work tends to be atomistic, in that the focus remains largely on small-group interaction: the organization is treated primarily as an aggregate of small groups, and characteristics of the more emergent organizational levels are not developed. For another, the attention of these studies is largely centered on management: (i) Managers and lower-level supervisors provide almost all the information by which organizations are characterized; one wonders whether those supervised share these feelings and perceptions. (ii) It is never made sufficiently clear on what basis the workers participate in decision-making and what would happen if they became disagreeable. Little notice is taken of how a managerial monopoly of "facts" and "expertise" can affect such group decision-making. (iii) It is not clear what is open to discussion and participatory decision-making. "Goals" are referred to, but it is dubious that in actuality decisions concerning organizational goals (products to be produced

or profit margins to be sought), the allocation of resources, personnel promotions, and so on are shared or could feasibly be shared by all organizational levels in a significant fashion.

In view of these attributes and the concern to maximize productivity, a cynical critic might dismiss this book as Establishment; but I think that would be unfair and neglectful of the constructive and evolutionary directions implicit in this work. I think Likert is helping to develop in this field, particularly among those who are psychologically oriented, greater sensitivity to the significance of group structure and to the necessity of finding ways of institutionalizing innovation and openness. In the evolution of social science, this may well mark the beginning of important breakthroughs, both in our understanding of human action and in the liberation of new energies in society. The turn of the century saw such breakthroughs in the personality sector, particularly with Freudian theory and psychiatry. The '40's and '50's saw similar developments at the small-group level, with sensitivity training and group therapy leading the way. Perhaps the changes occurring these days in the relationship between students and universities or schools and communities signal the beginning of parallel achievements at more collective levels. The work of Likert and his colleagues should provide one suggestive base out of which may come a sound blueprint for the liberation of men within their organizations and society.

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Radiobiology

Actions Chimiques et Biologiques des Radiations (The Chemical and Biological Action of Radiations). 12th series. M. HAÏSSINSKY, Ed. Masson, Paris, 1968. iv + 340 pp., illus. 148 F.

Six contributions from well-known radiation researchers comprise this 12th volume assembled by M. Haïssinsky. As in previous volumes in this series, the topical material is broad.

The papers are arranged roughly in the order of increasing biological complexity. The influence of water in modulating radiation effects, mainly in microbes, is discussed by E. L. Powers and A. Tallentire; H. S. Kaplan deals with radiation-induced inactivation of bacteria and phage; A. H. W. Nias and L. G. Lajtha discuss the influence of radiation on cell kinetics; J. Read reviews repair mechanisms in bacteria and unicellular organisms; J.-F. Duplan analyzes the immunology of radiochimeras; and M. Tubiana and A. Wambersie are concerned with tumor therapy and related radiobiological findings. The book has an international flavor, since the first four contributions are in English and the last two in French.

For a number of years Powers, Tallentire, and their associates studied the dependence of the killing of bacterial spores on the gaseous environment. More recently their studies have been extended to the influence of water content, and along with their own results they review those obtained with vegetative cells such as bacteria and yeasts, and more complex systems such as plant embryos and brine-shrimp eggs. The extent to which O_2-dependent inactivation is influenced by moisture is impressive and indicates that radical formation and quenching play an important role in wet systems. While it is true that the applicability of the approach of these authors is limited to systems which can survive dehydration, the likelihood that their conclusions may have more general applicability should not be overlooked.

Questions of generality also arise in regard to the departure taken by Kaplan. His underlying thesis is that double-strand breaks, in the DNA of bacteria and two-stranded phage, are the principal cause of radiation inactivation and probably of mammalian cell killing as well. Although radiation produces many single-strand breaks, these are lethal only in single-stranded phage and possibly in those bacteria which lack single-break repair systems. A considerable quantity of data in support of this hypothesis is reviewed; in most instances, but not all, the evidence is internally consistent and impressive, particularly as it pertains to bacteria and phage. For more complex cells, such as somatic mammalian cells, the picture is not at all as clear, although in view of the central position, and therefore the biological amplification, available to the genome of a cell, damage registered therein is very likely to be important. Aside from function, differences in the structure, replication, and means of expression of the genetic material of mammalian cells as compared to bacteria and phage may underlie their differences in response to radiation.

An ultimate relevance of questions of mechanisms comes out in the chapter by Tubiana and Wambersie. These authors address themselves to the real life question of cancer treatment, earnestly seeking ways of improving radiotherapy by means of radiobiological studies. They review the principal findings available thus far—findings which in the main were not known 15 years ago—and identify many of the complexities that face the therapist. The chapter on cell kinetics by Nias and Lajtha complements well these considerations. For scientists and physicians more comfortable with French than English, this chapter in French will be of particular value, since most of the studies reviewed were originally published in English.

In the tradition of annual reviews, Haïssinsky's 12th volume is diverse and timely.

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The Uses of Insects

Insects and Physiology. Essays presented to Sir Vincent Wigglesworth on his retirement from the Quick Chair of Biology and Directorship of the Unit of Insect Physiology in the University of Cambridge. J. W. L. BEAMENT and J. E. TREHERNE, Eds. Elsevier, New York, 1968. viii + 378 pp., illus. $25.

Nature in its bountiful goodness has provided more species of insects than of all other animals and plants combined. This great diversity is not without its uses. For every biological problem there is an insect to serve as the ideal experimental animal. Sir Vincent Wigglesworth, early in his career, discovered the endless potential of insects for biological study. This amazing man soon became the father of modern insect physiology. His knack of asking the right questions concerning the physiological problems into which he delved quickly brought respect from his contemporaries. Sir Vincent in one way or another has inspired many men. It seems that those who have been privileged to study under him have been touched in some special way to make great contributions of their own.

Twenty-three of these scientists pay tribute to Sir Vincent by presenting in this volume a series of essays showing that insects are ideal subjects for elucidation of principles of general biology.