could command a reviewer's assent on every point of interpretation. Taken as a whole, *Empire of Knowledge* is an outstanding work, admirably researched and carefully balanced. Anyone interested in Soviet science can read it with great profit.

BRUCE PARROTT
Johns Hopkins School of Advanced International Studies, Washington, D.C. 20036

A Non-nuclear Agenda

Weapons and Hope. FREEMAN DYSON. Harper and Row, New York, 1984. viii, 341 pp. $17.95. A Cornelia and Michael Bessie Book.

The author's purpose in writing this book is twofold. He wishes to offer some new ideas for overcoming the risk of nuclear annihilation, and, unlike many others committed to this task, he intends to pursue his goal by trying to bridge the gap between those who "look on the peace movement as a collection of ignorant people meddling in a business they do not understand" and those who "look on the military establishment as a collection of misguided people protected by bureaucratic formality from all contact with human realities." He accomplishes both tasks with impressive results, although his message sometimes tends to be concealed in a variety of personal reminiscences, family tales, metaphoric extemporizing, and reflections on the course of history in general.

Dyson's basic message is that the world must move away from nuclear weaponry toward defensive and non-nuclear weaponry. This implies arousing humanity against weapons of mass murder "as we roused mankind against the institution of slavery a hundred and fifty years ago," negotiating international agreements, first to reduce deployments of nuclear weapons and later to eliminate them, and pursuing further the development of non-nuclear defensive systems to enhance the stability of a non-nuclear world.

This message may seem simple, yet Dyson does not evolve and justify it in a simple way. In fact, almost the entire book is devoted to a careful examination of alternatives and a cautious evaluation of all the complexities surrounding the design for the abolition of nuclear weapons. Dyson elucidates every aspect of the subject with insights that combine first-rate expert knowledge and refreshingly unorthodox approaches. For instance, when discussing antiballistic missile systems, Dyson sums up the familiar arguments against ABM and then presents a number of rebuttals of these arguments. After thoughtful discussion he finally reaches the conclusion that his verdict on ABM is "neither guilty nor innocent." He even recommends the development of a non-nuclear ABM that in a defense-dominated world may be a good tool because in such a context ABM becomes more and more stabilizing as one moves further toward the reduction and elimination of offensive forces. Likewise, the large-scale construction of shelters will be stabilizing in a world where the principle of stable deterrence has been replaced by a defensively oriented equilibrium. As far as verification is concerned, Dyson argues against the doctrine holding unverifiable agreements to be worthless—all depends on circumstances, he says. He points to the 1975 convention banning biological weapons; although compliance with the ban is clearly unverifiable, the convention is valuable because it imposes an important constraint—"without the convention, the friends of the victims would not even have legal grounds for protest and inquiry."

This judgment is illustrative of the attitude of pragmatism and unbiased hope that characterizes the book. At one point the author drily remarks: "Our choice is not between imperfect agreements and perfect arms control agreements; it is between imperfect agreements and none at all." Examining his key proposal for a non-nuclear world with the same passion for sober-mindedness and optimism, he is aware of the innumerable requirements and consequences implied by a radical shift from the present system of assured destruction to a non-nuclear defensive system. Some of the requirements and consequences may still need further elaboration, particularly those referring to the political situation in Europe. One may agree with Dyson that the development of precision-guided munitions and of dispersed mobile forces capable of destroying tanks and airplanes offers a realistic substitute for tactical nuclear weapons in the defense of Europe against invasion. But still a concerned European might have some doubts about whether a potential aggressor might not find this kind of defense a calculable and possibly tolerable risk. And he or she would hardly feel comfortable with regard to the nonviolent use of force, that is, the potential for power projection, subtle blackmail, and "Finlandization" in peacetime.

Yet such second thoughts merely show how stimulating Dyson's arguments are. They offer an enormous number of new and creative ways of looking at the world's most burning problem. No doubt, this book will have an impact.

DANIEL FREI
Department of Political Science, University of Zurich, CH-8001 Zurich, Switzerland

Creativity

The Social Psychology of Creativity. TERESA M. AMABILE. Springer-Verlag, New York, 1983. xvi, 245 pp. $26.90. Springer Series in Social Psychology.

Most of those who study creativity focus on individual performance. They try to figure out how and why some people are able to do things in ways that are more original than what people are generally capable of doing. These researchers take a naturalistic approach—they assume that an original contribution is caused by some exceptional quality within the person who makes it and postulate the existence of creativity, a cognitive process.

Others have pointed out that there is no compelling reason for postulating any difference between a creative mental process and one that is not, or between a person who is creative and one who is not. These researchers take an attributional approach to the study of creativity—they try to understand under what conditions certain works will be deemed creative, by whom, and for what reasons.

The epistemological assumptions of Amabile's monograph are naturalistic, though her methodology favors a position intermediate between the naturalistic and the attributional camps. Amabile recognizes that "social and environmental factors seem to play a crucial role in creative performance" and that "there has been a concentration on the creative person, to the exclusion of 'creative situations'—i.e. circumstances conducive to creativity" (p. 5), but she does not question whether performances and persons are creative independent of social consensus. This reification of the phenomenon under study makes the conceptual foundation of the volume somewhat shallow, although not unusually so in a field that is all too ready to take an unquestioning stance toward its subject matter.

Amabile's most significant theoretical contribution is her emphasis on the close relationship between intrinsic motivation and what comes to be known as "cre-

ative" (for expediency, I shall adopt the naturalistic convention about creativity). With the help of vivid passages from the writings of Einstein and some contemporary poets, the author argues that creative folks like doing what they are doing, and that when they begin to worry too much about fame and riches their work suffers. Hence "Intrinsic motivation is conducive to creativity, but extrinsic motivation is detrimental" (p. 15), a conclusion that informs the rest of the volume.

Though the idea that there is a link between intrinsic motivation and creativity is appealing, it is accepted too readily by the author. It is not clear, for example, to what extent intrinsic motivation is a necessary or a sufficient precondition of creativity. There are certainly many activities, like sports, in which intrinsic motivation is necessary, yet which are rarely creative. One might agree with the author that placing too much weight on extrinsic rewards will detract from creative performance, but this may not tell us anything specific about the presumptive creative performance. The examples in the book draw exclusively on testimonials by artists and scientists steeped in a post-Romantic culture. If one reads accounts of the lives of the great Renaissance geniuses one is impressed by their constant and insistent carping about how many gold pieces they got or failed to get from their patrons and about the artistic pecking order of which they were a part. Though this almost obsessive concern with extrinsic rewards might have hampered their work, the work is nonetheless worthy of being designated creative.

The central one hundred pages of Amabile's volume are devoted to reporting the effects of various manipulations on "creative" performance in a variety of social-psychological experiments. For example, when children think that their work will be evaluated by adults, they make collages or write poems that are judged to be less creative by experts than the collages or poems they produce when they do not expect to be evaluated. Similarly, children rewarded for their work produce less creative specimens than children who are just allowed to play. Other chapters deal with the effects of social facilitation and modeling on creativity. Though the experiments are reported in professional detail, their findings might not tell us much about creativity unless we are ready to agree that creativity is what expert judges say it is.

In any case, the volume is a serious attempt to cope with a fascinating phenomenon that is notoriously difficult to tackle with precision and grace. In focusing on the role of intrinsic motivation, and on the environmental factors that facilitate or hinder its manifestations, the author has made an important contribution. Those who fear that life would be impoverished if the mystery of creativity were to be unveiled need not worry, however; the solution is still well beyond our sights.

MIHALY CSIKSZENTMIHALYI
Department of Behavioral Sciences, University of Chicago, Chicago, Illinois 60637

A Development in Physics

Masers and Lasers. An Historical Approach. M. BERTOLOTTI. Hilger, Bristol, England, 1983 (U.S. distributor, Heyden, Philadelphia). xii, 268 pp., illus. $29.

This is a marvelous book for anyone interested in the origins of masers, lasers, and coherent optics. Bertolotti has searched the literature and has corresponded and talked with many of the principals in this dynamic field. He expounds the history of the subject with rigorous descriptions of the most important developments, usually with appropriate figures and equations. Arthur Schawlow, in a gracious foreword, suggests that the book could be used as an introducton to the theory of masers and lasers. This is so for persons with a background in quantum and classical physics. Its greatest value will nevertheless be to persons with some knowledge of the theory and an interest in its development.

Following a short introductory chapter, the historical account begins with a chapter on Einstein's 1916 explanation of stimulated emission and the subsequent discussion by spectroscopists of negative dispersion and negative absorption. Chapter 3, on magnetic resonance and optical pumping, is properly entitled "Intermezzo" since only part of it is directly related to the main theme of the book. Chapters 4 and 5 cover the decade of the '50's, when the maser was conceived, demonstrated, and extended into the solid state and the principles of the laser were clearly formulated. Chapter 6, entitled "The laser: further progress," describes Maiman's demonstration of the ruby laser and selected later developments. A final chapter discusses the history and principles of the statistical properties of light.

Biographical data are given for many of the principals, though the data are mostly limited to information on birth, education, and professional career. A notable exception is that the relationship between Bose and Einstein is described in interesting detail.

There is a minimum of the kind of speculation on the philosophical aspects of the subject that one would find in many histories of science. In the chapter on stimulated emission, which is subtitled "could the laser have been built more than 50 years ago?," Bertolotti points out that Ladenburg came very close to building a laser in 1921 and that many spectroscopists, starting with Kramers around 1925, used the term "negative absorption" and clearly understood that a wave passing through a medium with inverted population should increase in intensity. Townes has made much the same point, explaining that it was not until World War II, when physicists worked with radar, that there were persons who understood both the principles underlying this phenomenon and its practical significance. Another puzzle, only indirectly referred to in the book, is why it took so long for the laser to follow the maser when the laser now seems the simpler device. And how could so much of the basis for present quantum electronics have been set in the three or four years following Maiman's demonstration? The book contains many citations from papers and correspondence, so the reader can have fun speculating on these points.

The part of the history known at first hand to this reviewer is recounted accurately and without bias. The contributions of the Nobel laureates are well documented, as is important work by others, in both the West and the U.S.S.R. Especially interesting is the Gordon Gould story, since little of Gould's work was published through conventional channels. The source for the story in the book is apparently the testimony from the patent trials. In the chapter subtitled "further progress" some selection had to be made to keep the book within bounds. The chapter contains reasonable discussions of laser resonator theory and semiconductor lasers, with mention of several other laser types, but important subjects, such as nonlinear optics, ultra-short pulse formation, and spectroscopic applications, are omitted. The free-electron laser is discussed and is properly traced back to the Motz undulator; the controversy about whether it is really a quantum device is not stressed. In contrast, the chapter on laser statistics (one of the author's specialties) seems rigorous and complete and is developed in a most interesting manner.