cists of the utility and permanence of a geometrical approach to gauge fields. Modern geometrical counterparts of Weyl's and Wigner's group-theoretical manifestos remain to be written; in the meantime those wishing to learn the material must rely on specialized accounts, like the excellent article "Gravitation, gauge theories and differential geometry" by T. Eguchi, P. Gilkey and A. Hanson in *Physics Reports*.

ROMAN JACKIW
Massachusetts Institute of Technology

Science and Industrialization in the USSR

R. Lewis
211 pp. Holmes and Meier, New York, 1979. $34.50

It is important to understand what this book, which covers its subject from 1917 to 1940, is and is not about. Despite its title, it does not discuss Soviet science. Soviet physics and mathematics, the strongest fields in Soviet science, are not discussed at all. The travails of Soviet biology are also omitted. Even in fields of engineering, which come much closer to the book's subject, the originality and quality of Soviet work are not assessed, nor are particular Soviet innovations analyzed in any detail.

What, then, is the book about? It presents the best description and analysis presently available of the organization and budgeting of Soviet industrial research in the prewar years. It impressively documents the unsuccessful Soviet search for a central directing body for industrial research and development (this section of the book alone wins it a secure place in the literature on the subject). To be sure, the description of the multitudinous coordinating committees leads to such a labyrinth of abbreviations and acronyms that all but the most hardy followers of Soviet organizational charts will be somewhat daunted, but underneath all this detail is an important point, which Lewis correctly emphasizes: Despite much talk in the West about Soviet planning, the Soviet Union has never had a truly centralized industrial research establishment. Furthermore, the Soviet Union has been plagued by an inability to get the greatest return from its investment of resources in industrial research and development. Soviet engineers perform well in a few high-priority fields, among which aviation and space are leading examples. Outside those areas, they have often failed to apply even those theoretical innovations that were first developed in the Soviet Union until after Western firms have done so. The engineers and scientists in the Soviet research network often, as Lewis so aptly puts it, "see papers and reports rather than products and processes as the final goal of their work."

Why is this so? Lewis points to a number of factors inhibiting the rapid application of innovations: administrative and geographical barriers between research institutes and the enterprise (many research institutes are hundreds of kilometers from the factories they serve); too much emphasis on research and not enough on development; fear by factory managers of taking risks by introducing innovations; concentration on gross output as the main criterion of plan fulfillment; the importation of foreign technology and the frequent assumption that such technology is superior to anything that can be produced domestically; and a traditional bias against applied work in favor of theoretical research that can be traced to before the Revolution.

All this is helpful and sound. Anyone seeking an understanding of the Soviet industrial research establishment can gain much from reading the book, especially if it is complemented by two other recent works: Kendall Bailes' *Technology and Society under Lenin and Stalin* (Princeton University Press) and Bruce Parrott's forthcoming volume (MIT Press) on Soviet policy for technological development.

All these works concentrate on Soviet performance in industrial applications, and the evaluations that they present are not very positive. It is worth noticing that the situation in theoretical physics and mathematics is very different. Someone seeking an evaluation of Soviet performance in these fields might wish to read the Kaysen Report of the National Academy of Sciences (1977), which points to the long traditions of Soviet excellence in these areas.

LOREN GRAHAM
Massachusetts Institute of Technology

Quantum Physics: A Functional Integral Point of View

J. Glimm, A. Jaffe
417 pp. Springer, New York, 1981. $16.80

The attitude of practicing theoretical physicists toward their more mathematical colleagues has been, or certainly should be, fundamentally modified by recent developments. The remarkable success renormalizable local quantum field theories had in describing the strong, electromagnetic and weak interactions has brought attention to the problem of proving the existence and the construction of such theories in general. Because these are gauge theories, they incorporate a rich geometrical structure. In fact, highly nontrivial topological concepts have contributed to the analysis of solitons, magnetic monopoles and even the ground state of such theories. Because the strong interactions are necessarily involved with nonperturbative phenomena, the development of analyses (in particular, methods of regularization and renormalization) that lie outside the perturbative framework is essential.

Also, in the description of phase transitions, powerful techniques based on renormalization-group ideas have proved immensely successful. The renormalization group, originated in quantum field theory, also proves to be the key to uncovering the nature of the strong interaction. This is one example of the remarkable cross-fertilization between quantum field theories and equilibrium statistical mechanics that arises from their essential mathematical identity. (This identity, formally simple, yet profoundly mysterious, calls out for a simple physical explanation—see, for example, the discussion in *Quantum Mechanics and Path Integrals* by Richard Feynman and Albert Hibbs. Could it have something to do with the thermal radiation seen by accelerated observers?)

Finally, recent very impressive computer work has created a whole new discipline—experimental quantum field theory. By computer methods physicists can test conjectures numerically, for example, the confinement of quarks in QCD and the triviality of ϕ^4 theory in four dimensions, and gather data from regimes inaccessible to weak-coupling perturbation theory.

In short, we live in a remarkable time when theoretical physicists can present mathematical physicists with well-formulated, challenging problems touching their central concerns. Conversely, it appears that the mathematical apparatus necessary to address, or even formulate, certain central problems of theoretical physics is becoming more extensive.

Quantum Physics, by James Glimm and Arthur Jaffe, is an important contribution toward establishing communication between the two communities. The connection between quantum field theory and statistical mechanics is made early and used extensively throughout. A major portion of the book is devoted to the construction, with mathematical rigor, of nontrivial quantum field theories. This construction, although limited to super-renormalizable theories, is a milestone in mathematical physics. Other topics treated in some depth include correlation-function inequalities, phase transitions (especially the ϕ^4 critical point), the cluster expansion and scattering theory. The use of functional integrals as a tool is a unifying theme throughout.

The authors, grand masters of mathematical physics, invented many of the techniques and results they treat here. The exposition is exceptionally crisp and clear. Theoretical physicists interested in learning the subjects treated need look no further. Mathematicians interested in the current problems of physics would need to supplement this book with other reading (such as the book by Feynman and Hibbs or Sidney Coleman's Erice lectures).

FRANK WILCZEK
*University of California
Santa Barbara*

Between Science and Values

L. Graham
449 pp. Columbia U.P., New York, 1981. $19.95

Between Science and Values is not a book for people looking for heroes nor one for those hoping to find scientists glorified or vindicated, or, for that matter, castigated. Instead, Loren Graham, exploring the relationship between science and values, gives a good example of the kinds of analysis we desperately need as our subjective belief in our objectivity increasingly makes fools of us all and our civilization rolls on wheels of science toward disaster. Graham helps us to pose the important questions intelligently; he doesn't bully us with arrogant claims to have finished with them once and for all.

But readable, intelligent, and honest as the book is, each time I rounded the corner from one chapter to the next, I felt some disappointment. There is certainly a lot of very good material here, including case studies with very humane descriptions of such scientific revolutionaries as Albert Einstein, Niels Bohr and Werner Heisenberg, and of such overachievers as Edward O. Wilson, who produce volumes of ahistoric material of questionable value in an effort to emulate the true revolutionaries. Most important, Graham provides a coherent framework. He defines categories of problems, breaking up the issue into reasonable chunks for analysis; no question concerning science and values falls entirely outside his framework. Everything for a respectable—even an exciting—book is here. Why it isn't exciting is because Graham's framework just doesn't do.

Graham works from the premise that there are restrictionists and expansionists. The restrictionists try to act as if science is in a world of its own—a hope at best, and, as Graham argues, a dead hope at that. The expansionists, on the other hand, reject that science can be separated from the rest of life. Thus, for them, facts, inventions and technology are part of the context of value decisions; scientific style and intellectual success can affect what we consider rational and convincing, and even what we mean by "know"; and there can be scientific theories on the nature of values themselves. These three aspects of expansionism give us a framework to talk about the effect science has on values.

If Graham's book fails, it is because this framework is not really adequate. But the failure of a good framework is still something to learn from. Graham's three aspects of expansionism do not serve our needs when we try to come to terms with the effects that values and society have on science. Graham's framework forces us to look at relationships between science and values as if much about science were not already the result of social values.

To be sure, Graham discusses the Lysenko affair, eugenics, Nazi biology,