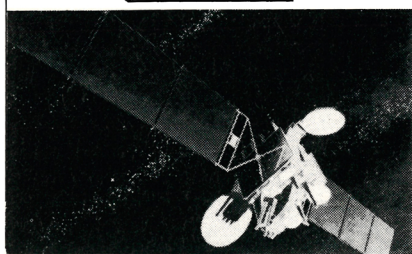


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years. One of my junior collaborators, who is German, told me he learned his trade from the German version, and he was very complimentary. This confirmed my own positive impressions—this is a text I would consider adopting.

The book's main material is contained in 460 pages and is divided into four parts. After an introduction reviewing relativity, quantized fields, the Dirac equation and definitions of cross sections, nine chapters cover quantum electrodynamics. In part 3, a discussion of strong interactions leads to quantum chromodynamics and a first exposure to nonabelian gauge theories. The fourth part covers the standard electroweak model. The book's aim is to introduce the standard model as completely as possible. Only a few pages at the end allude to grand unification, strings and some other speculative extensions. Appendixes cover over 50 pages and list a wealth of facts about spinors, traces, color factors, the Feynman rules for all pieces of the standard model and more. Each chapter ends with a list of problems, and solutions to a selection of these are given in the back.

The book emphasizes particle physics rather than field theory and concepts rather than computational techniques. The discussions are clear and very systematic, and no paragraph is redundant. The essential ingredients of every topic are enumerated in a logical and concise fashion. This characteristic style is exploited to cover a large range of topics, larger than in similar texts such as *Introduction to High Energy Physics* by Donald Perkins (Addison-Wesley, Reading, Mass., 1983), *Gauge Theories in Particle Physics* by Ian Aitchison and Tony Hey (Adam Hilger, Bristol, UK, 1982) and *Quarks and Leptons* by myself and Alan Martin (Wiley, New York, 1984), just to name a few I happen to be familiar with. These texts, designed to help the student to perform explicit computations at the earliest possible stage, introduce Feynman diagrams with little or no formal Lagrangian field theory. The approach is based on Feynman's pioneering book *Theory of Elementary Processes*, now 30 years young.

Nachtmann does not take any shortcuts but takes the traditional road via Lagrangians, second quantization and the Wick expansion. This spirit permeates the book: For example the QCD discussion is based on Lagrangians, anomalous dimensions and the like. This is to be contrasted with the very phenomenological paths travelled in the texts previously

referred to: the color symmetry of the baryon wavefunction, radiation of gluons, analogy with Weiszacker-Williams and so on. This is not just a difference in taste. Unlike the older texts, which were written before the weak intermediate bosons were discovered and which are permeated with the excitement of the experimental verification of the different pieces of the standard model, this book takes the standard model as dogma and is thus able to develop its implications in a logical and concise fashion. The immediate advantage is that a more complete list of topics can be covered in a similar number of pages: To mind come good old-fashioned topics like strong interactions, the interactions of electrons with matter and C , P and T symmetry.

The final judgment of this book will very much depend on taste. It will probably have the edge when the teacher or student happens to be a theorist. Although Nachtmann presents the ideas in a clear and systematic way, I suspect that the student who uses this book will find performing the calculations in a systematic fashion more challenging than would the student who uses the book I coauthored with Martin. But if you have a group of talented beginning graduate students, I recommend trying this book out—if you can afford the price!

FRANCIS HALZEN

University of Wisconsin, Madison

Reversing the Arms Race: How to Achieve and Verify Deep Reductions in the Nuclear Arsenals

Edited by Frank von Hippel
and Roald Z. Sagdeev

Gordon and Breach, New York,
1990. 432 pp. \$40.00 hc
ISBN 2-88124-436-X

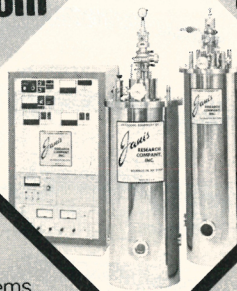
As the world grows accustomed to the *glasnost* era, shaky as it may be, cooperation between Soviet and American scientists on arms control issues no longer seems to be as newsworthy as it once was. However, the initiation of a series of joint studies in 1987 and the journal *Science and Global Security* in 1989 by the Federation of American Scientists and the Committee of Soviet Scientists for Peace, Against the Nuclear Threat (known as CSS) marked a significant development in the arms control process, and it continues to be viable today. This group of "nongovernmental" scientists is led by Frank von

BOOKS

Hippel of FAS and Princeton University and by Roald Sagdeev of the CSS and the Soviet Academy's Space Research Institute and the University of Maryland (and also a member of the Soviet Congress of Deputies). All too often the governments of the two superpowers have limited useful arms control proposals, not wishing to trade relative advantages. The FAS-CSS research has become a public-sector "back channel" of information, which has made positive but asymmetrical impacts on the arms control process, influencing the Soviet positions at Geneva much more than the US positions. The US has been much more cautious, accepting only the proposals suggested in this book that did not impinge too greatly on its strategic plans.

This useful book has two main proposals: what can be achieved in nuclear arms control treaties and how to verify such agreements. The first two chapters discuss the enhanced stability that can be obtained from a "finite deterrence" force of nuclear weapons that emphasizes missiles with single warheads located in basing modes that are less vulnerable than the fixed silos in which most intercontinental ballistic missiles are now kept. Sagdeev and Andrei Kokoshin of the Soviet Institute of US and Canadian Studies conclude "that strategic stability would be maximized if each side possessed approximately 600 small, single-warhead ICBMs—some in fixed silos and some on mobile launchers." The Soviets also point out that "in terms of battle effectiveness there is no difference between the Soviet ICBM and the American 'Trident' [submarine-launched ballistic missiles]." Their American counterparts, Harold Feiveson and von Hippel, consider a somewhat higher figure of 2000 warheads, divided among the triad of Midgetman, Trident and B1 bombers. The authors show that the finite deterrence force structures are much more stable in both first-strike and nuclear-war-fighting scenarios than the mix of weapons that will result from the START treaty. To gain the goal of a finite deterrence after the START treaty, it will be necessary to trade the 154 remaining Soviet SS-18 missiles for the 50 US MX missiles and "something else" to even the bargain. Simple logic would suggest making the "something else" either part of our Minuteman-III ICBM system (three warheads of 335 kilotons each) or refraining from building the hard-target Trident-II SLBMs (eight warheads of 475 kilotons each), while retaining the Trident-I SLBMs (14

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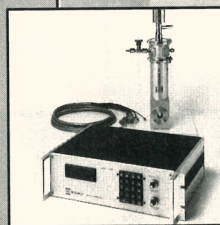
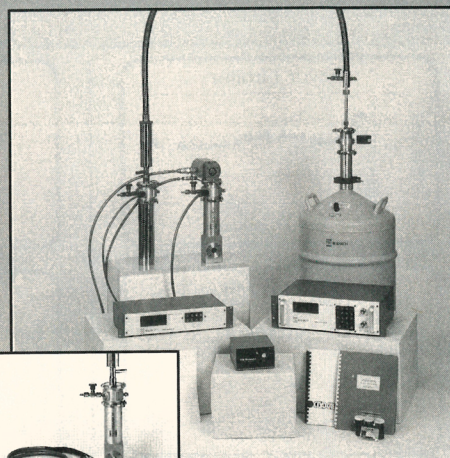
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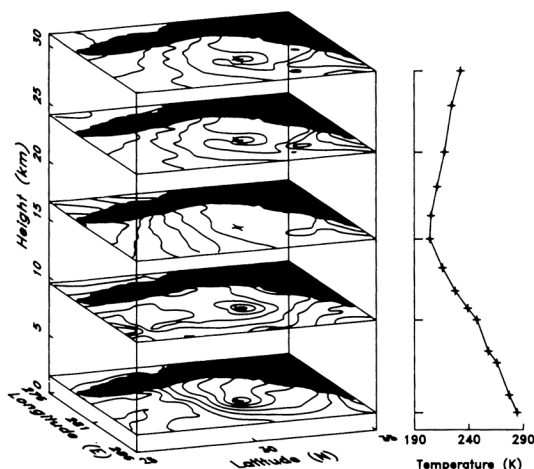
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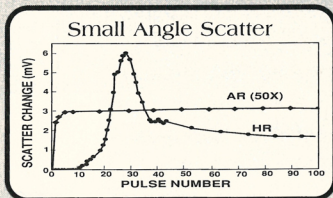
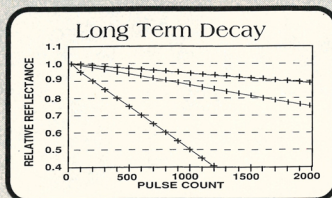
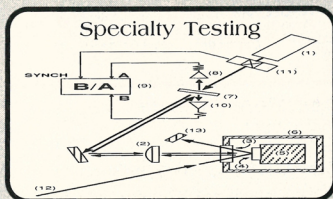
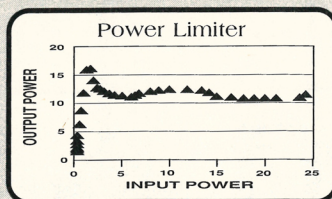
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warheads of 100 kilotons each).

The book contains a number of chapters on various technical approaches for monitoring that go beyond the START treaty. During the ratification proceedings, senators on both sides of the issue will remind the Executive Branch that START will not destroy warheads, but merely move them from launchers to other places. The calculations by these authors show some promising approaches for monitoring the dismantling of warheads, as well as submarine-launched cruise missiles and air-launched cruise missiles; the constraining of warheads on multiple independently targetable re-entry vehicles; and a cutoff of the production of fissile materials. These technical approaches can be complemented with data exchanges that can be verified by on-site and challenge inspections.

Beyond these technical considerations, the FAS-CSS research has signaled broader, more procedural results. Of course, the measurement in July 1989 of neutrons and gamma rays from the Soviet cruise missile on the SLAVA in the Baltic Sea could have been masked with shielding, but the SLAVA experiment showed a greater truth: the willingness of the Soviets to allow very intrusive inspections. This kind of "cooperative measure," coupled with data exchanges that give the number and location of cruise missiles, could greatly enhance the ability to "trust but verify" the agreed number of cruise missiles in a START II treaty.

The US and Soviet Union are often constrained from looking very far from the status quo on arms control issues. It would be wise for the two countries to examine the results of the FAS-CSS group when they consider their bargaining positions for a START II treaty.

DAVID W. HAFEMEISTER

California Polytechnic State University

Organic Superconductors

T. Ishiguro and K. Yamaji
Springer-Verlag, New York,
1990. 288 pp. \$59.50 hc
ISBN 0-387-51321-3

The discoveries of the ceramic superconductors—with transition temperatures above 100 K—have overshadowed in large measure another remarkable series of discoveries: the discovery of superconductors synthesized from nonmetallic, organic compounds. These organic compounds have superconducting transition temperatures in the teens, but the rate at which new compounds with higher transition temperatures and remark-