

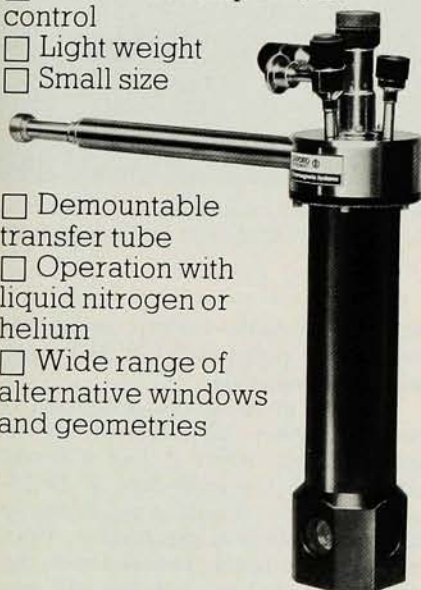


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Lorentz. There is also no mention that thermal noise had not only been observed by J. B. Johnson, but also by others, using sensitive galvanometers. In the chapter on radioastronomy, the 21-cm line of atomic hydrogen is barely mentioned, although its study was for many years the main activity and even the main *raison d'être* of some radioastronomical centers. One more example: On page 144, reference is made to papers by N. E. Alekseevskii and Yu. P. Gaidukov, and by J. Yahia and J. A. Marcus, on the magnetoresistance of pure single crystals at low temperatures. These papers appeared in 1959. But even larger effects were found around 1930 by Aleksei V. Shubnikov and Wander J. de Haas, who studied very pure crystals of bismuth. The book is a reliable source of information on what went on at Bell Labs. It is not—nor does it claim to be—a history of the subjects treated, although in many cases the research at Bell Labs is a major part of the history.

The shortcomings mentioned—perhaps I should call them unavoidable limitations—are, to a certain extent, compensated by the "Overview" preceding each of the two parts. The overviews are written by Albert Clogston and William Slichter, respectively. And, as a proud summary of summaries, we find on page 18 a table listing "Contributions to Communications Science and Technology Growing out of Physics Research at Bell Laboratories." The extensive lists of references at the end of each chapter should also be mentioned. They will be most useful to readers who want to study a topic in greater detail.

In the foreword, N. Bruce Hannay, vice-president for research (now retired), sets forth the basic principles on which Bell Labs have been operating. It is well worth reading, the more so because we are living in a period in which research budgets are under heavy pressure almost everywhere and a lot of talk about research planning and management is going on. Hannay emphasizes that the Bell Labs have a clearcut mission, namely to develop new communications technology and to allow the Bell System to provide better and cheaper communications services. But this mission is interpreted in a broadminded and farsighted way. There are many possibilities for personal initiative and individual preferences, and no attempt is made to measure the value of each particular piece of research in terms of ensuing commercial profits. I should like to quote several passages, but I restrict myself to one.

Stability and continuity in Bell Laboratories support for research have been essential to its health. Sufficient resources have been

placed at its disposal to allow it to do what was needed to stay at the forefront of knowledge. And understanding of the peculiar nature of the research environment and needs of research people has characterized the institution. Part of the reason for the success of Bell Laboratories research is that the research managers understand these things; they themselves have all risen from the research ranks, but only after they have demonstrated a superior ability to do research themselves. People of this kind are most able to maintain the respect of and successfully guide an outstanding research staff.

In short, this is a valuable book. Few physicists will feel tempted to read it in one stretch from cover to cover, but many will turn to it again and again because of the wealth of information it contains. I think it should—and I hope it will—be carefully studied by all those dealing with research management and research funding.

Empire of Knowledge: The Academy of Sciences of the USSR (1917–1970)

Alexander Vucinich

482 pp. University of California Press,
Berkeley and Los Angeles, 1984.
\$29.95

Alexander Vucinich's study is essentially a history of the conflict in the USSR between the views that science develops on the basis of the practical needs of society and that science develops according to its own inner logic—a conflict between the Communist Party and the scientific community seeking autonomy in its domain.

Vucinich is a historian of science at the University of Pennsylvania. His major work has been on science in Czarist Russia, but he has extended his research into the Soviet period as well. He tends to blame the political structure of the USSR for the controversies that arise, ignoring, for example, that in the US every request for major research expenditures must be supported with arguments about the ultimate practical consequences of the research without references to needs of the inner logic of science.

Vucinich divides the history of the Academy into four stages. From 1917 to 1928, the ideological influence was "fragmentary and without clear direction." The second and third stages, from 1929 to 1945 and from 1946 to 1956, were dominated by a massive effort to make the unity of science and ideology a strategic component of national unity through purges of nonconforming scientists, attacks on scientists

such as Einstein, Bohr, and Heisenberg, and distortion or abolition of a number of sciences to eliminate any obstacle to the dominance of dialectical materialism as the prevailing philosophy of science. The fourth stage, from 1954 to 1970, coincided with the criticisms of Stalin, the downfall of Lysenko and, under the stimulation of the scientific and technological revolution, the loosening of bonds between philosophy and ideology. Dialectical materialism developed in directions compatible with the realities of science; the work of non-Marxists, including philosophers of science, was viewed more positively; and the Marxist philosophers lost their monopoly on discussions of the logic of scientific inquiry. Progress was made toward recognition of the "paramount role of the internal impulse in the development of science."

Vucinich seems unaware that the desire to promote a particular philosophical approach in science is not unique to the USSR. In a widely used textbook, David Halliday commented that "in all branches of physics, a unified viewpoint is desirable," and for 20 years most physics textbooks in the US reflected the view to which he referred (logical positivism). Vucinich does note that the members of the Academy were unanimously opposed to the revolution of 1917 led by Lenin, and to the dialectical-materialist philosophy associated with his name (Marxism-Leninism). Vucinich has difficulty separating the discussions on the substance of the ideological disputes from the coercive and repressive methods used in the Stalin period against real and imagined opponents of any kind.

In contrast to Loren R. Graham's illuminating study, *Science and Philosophy in the Soviet Union* (Knopf, 1972), Vucinich gives superficial descriptions of the philosophical-scientific disputes. He considers any movement in the direction of dialectical materialism as bad, any movement in the opposite direction as good. I think he is mistaken in viewing the increasingly frequent publication of translations of non-Marxist philosophers of science as a convergence of dialectical materialism and "Western" philosophy rather than a reflection of a more relaxed atmosphere resulting from an increasing degree of ideological cohesiveness among Soviet intellectuals.

Vucinich's partisanship leads him to ignore the most important development in the USSR in dialectical-materialist scientific methodology—the elaboration of the role of "generalized categories" (the building blocks of philosophical thought) and of the specialized categories of the individual sciences. These developments, over some 50 years, provided the basis for

much of the work now being done in the Soviet Union on the structure of scientific theory, especially in connection with the application of systems-analysis methods to scientific research.

Also ignored by Vucinich are the disputes over the category "contradiction." The essence of the dialectical method is to investigate contradictory tendencies within a system. The relationship between logical and dialectical contradictions has polarized Soviet and other Marxist philosophers of science

since the 1960s, with philosophers of natural science inclined to support one position and philosophers of the social sciences tending to support an opposing view. These discussions have led to new approaches in a number of fields by Marxist philosophers of science in the USSR and other countries. For example, the interrelationship between coexisting dynamic, stochastic, and probabilistic aspects of the microworld are stressed without invoking violations of formal logic. Vucinich

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concentrates instead on disputes between logicians working within dialectical materialism and those working outside it.

Vucinich is best in his introductory chapter dealing with the history of science in Czarist Russia, the subject matter of his previous books. If one is already familiar with the Soviet scene and is able to exercise judgment as to where the author's biases are likely to condition the presentation of the material, a good deal of interesting information can be gleaned from the present book.

ERWIN MARQUIT
University of Minnesota

Quantum Fields

N. N. Bogoliubov and D. V. Shirkov
388 pp. Benjamin-Cummings,
Reading, Mass. 1983.
\$39.95

N. N. Bogoliubov and D. V. Shirkov are famous Soviet physicists whose *Introduction to the Theory of Quantized Fields* was first written in 1957. At that time both the foundations of the subject and a discussion of recent topics could be contained in one volume. However, a glance at the contents brings home the fact that the only successful field theory at that time was quantum electrodynamics. Weak interactions were not discussed. After all, parity violation had just been discovered. Strong interactions were treated using unitarity and dispersion relations. Yang-Mills gauge fields were not mentioned. For many years perturbative quantum field theory remained unpopular because it did not seem to be relevant for the study of the strong interactions. However, the fantastic successes of gauge-field models for the weak and strong interactions necessitated major revisions, leading to the publication of the third edition of Bogoliubov and Shirkov's book in 1976.

Quantum Fields was originally written in 1980 and is clearly an offspring of the previous work. It is designed as a textbook for a one-year course for beginning graduate students. The book is divided into nine chapters that deal with basic concepts, free classical fields, the quantization of free fields, interacting fields, the scattering matrix, Feynman rules and diagrams, the evaluation of integrals, the removal of divergences and a description of real interactions. Nine appendices introduce the reader to the isotopic spin formalism, Dirac matrices, continuous groups, transformations of operators, singular functions, momentum-space integrals, kinematic relations for vertices, Feynman rules for gauge fields and the renormalization group. Final-

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