# History of Science

## Thoughts and Attitudes

**Science in Russian Culture.** A history to 1860. Alexander Vucinich. Stanford University Press, Stanford, Calif., 1963. xvi + 463 pp. $10.

Before discussing what this book is, it may be useful to say what it is not. It is not a history of science in the usual English sense of the word—that is, it does not deal exclusively, or even primarily, with scientific thought and discovery. The author employs the word "science" in the broad sense conveyed by the German *Wissenschaft* or the Russian *nauka*, a sense that probably can be better rendered in English by "learning." Within its purview come not only the empirical sciences, but also the social sciences and some of the humanities, insofar as they employ methods of inquiry acceptable to the natural scientist.

In the second place, as the title of the book correctly implies, it is less concerned with learning as such than with its cultural function. Vucinich is interested most of all in ascertaining what impact learning has had on Russian thought and attitudes, as they are reflected in the role of the scientist in society and society's relationship to him. He devotes, therefore, a great deal of attention to the history of Russian higher and middle education. For, although school curricula and admissions policies do not belong to the history of science strictly interpreted, they are significant in the broader cultural context as channels or impediments to scientific ways of thought.

In short, what we have before us is an ambitious effort to trace the effects of the scientific spirit on Russian culture from earliest times to 1860, when the "formative" period came to an end and the creative one got under way in earnest.

It must be said at the outset that this approach suffers from a certain vagueness of definition. On occasion, Vucinich uses the term "science" as if it were synonymous with "rationalism"—for instance, early in the book, in the brief section devoted to the 15th century rationalizing religious heretics known as the "Judaizers." At other times, he extends it further to mean something like "Enlightenment" or "Westernization." He devotes, for example, a lengthy section to Novikov. Now Novikov, a contemporary of Catherine the Great, was indeed an enlightened man who, through various educational and philanthropic institutions that he created, tried to raise the general cultural level of the country. But he was also a leading Free Mason and a religious mystic who adhered to the doctrines of Saint Martin; he despised rationalism and the *philosophes*, and by no stretch of the imagination can he be cited as an example of a scientifically-oriented individual. One may also ask why, for example, historiography is included in the discussion, but not law? Why is Schelling's impact on Russia treated at length, although his system of thought (even if called *Naturphilosophie*) represented an extreme example of idealism, while Montesquieu, the father of modern sociology, is mentioned only in passing? Undoubtedly, this terminological and conceptual vagueness ought to trouble the author less in what is hoped will be a second volume dealing with the period when science and learning become easier to define.

The most informative of the three parts of the book is the second, in which Vucinich describes the emergence of Russian universities and the Academy of Sciences in greater detail than has ever been done in English. He brings out clearly the preponderant role played in these twin pillars of Russian scholarly endeavor by foreigners, particularly Germans. The original roster of the St. Petersburg Academy of Sciences (in 1725) listed not a single Russian, 13 of its 16 members being Germans and the remainder Swiss or French. As late as 1840, only one Russian and two Ukrainians were admitted to full membership in the 28-member Academy. The author lays particular stress on Euler's contribution in founding the great Russian school of mathematics. These facts need retelling because Soviet historians, from a misguided and often naive sense of national pride, have all but obscured the foreign origin of Russian learning.

One of the most striking features of the subject is the favorable environment in which Russian science enjoyed its development in the 18th and 19th centuries. For one thing, by the time science came to the country, neither the church nor religious conviction could effectively impede its progress. The power of the church, perhaps the most conservative in Christendom, was broken by the great schism of the 1660's and the religious policies of Peter the Great. The deep anti-intellectualism of the Orthodox religion precluded its offering any philosophical challenge to the scientific spirit, as did both the Catholic and Protestant religions.

Furthermore, the monarchy, from the 16th century on, saw in science and technology a powerful and indispensable instrument of statesmanship. As Vucinich's account of the reign of Nicholas I (1825–1855) brings out, even when the state pursued extremely conservative policies in matters of politics and education, it kept on actively promoting learning and the pure sciences. It was then that Wilhelm Struve founded the great Pulkovo Observatory from which Russian astronomy derives, and Lobachevskii, the great Russian mathematical genius, carried on his original investigations concerning the possibility of a non-Euclidean geometry. In this reign, too, young Russians were sent abroad, at government expense, to carry on studies in most of the branches of learning. The parallels with Soviet conditions are obvious. Relatively unhampered by religion and supported by a powerful state, science flourished in Russia during the 18th and 19th centuries much more vigorously than the country's backward condition would lead one to expect.

Vucinich's book offers a wealth of carefully sifted information. One may quarrel with him over certain generalizations bearing on Russian historic conditions. One may also wish that he had relied less on the opinion of others in evaluating scholarly and scientific achievements and had told us more

concretely in his own words what is their significance. This reticence is especially noticeable in the sections devoted to historiography, where the author is too ready to accept the word of someone else that a given historian was "scientific" (which neither Tatishchev nor Karamzin, prominently featured in the book, really were). But one must be grateful to him for having given us a judicious and informative account of a complicated and often obscure story.

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## Commemorative Lectures

**Clerk Maxwell and Modern Science**. Six commemorative lectures. C. Domb, Ed. University of London Press, London, 1963. x + 118 pp. Illus. $4.

James Clerk Maxwell was professor of natural philosophy at King's College, London, from 1860 to 1865, and the six essays in this volume commemorate his tenure there.

Sir John Randall's introductory address, based primarily on the Campbell and Garnett biography and the *Collected Papers*, reviews comprehensively Maxwell's life and work. New to many readers will be the summary of I. B. Hopley's useful study of Maxwell on color and color vision. Maxwell's performance as a teacher is reevaluated; the long-standing assumption that he was a poor lecturer is questioned, and his effort toward making laboratory work part of the physicist's education is stressed. One curious paragraph suggests that it is time to take a "fresh look at the premises and hypotheses" at the basis of electromagnetic theory because considerable confusion concerning electromagnetic theory exists today; presumably this refers neither to the attempts to create non-Maxwellian electrodynamics (Born and Infeld and others), nor to the action-at-a-distance theories (Feynman and Wheeler).

The theorist R. E. Peierls, in an essay entitled "Field theory since Maxwell," begins with passages from Maxwell's 1864 paper on electromagnetic theory. The excerpts indicate that terms referring to the physical model introduced in the previous paper are not to be taken literally, but that energy considerations *are* literal: "All energy is the same as mechanical energy." Peierls, like Randall, speculates on the introduction of displacement current. It would seem reasonable that such speculations should rely only on Maxwell and not on contemporary views. These speculations should not use the basic equations in the symmetrical form common today (due to Heaviside and Hertz); they should use Maxwell's original 20 equations involving the potentials. Peierls convincingly analyzes the change from the 19th-century search for mechanical models of the electromagnetic field to our present disinterest in such models. He then discusses other fields of contemporary physics, the quantization of fields, and the restrictions imposed on measurements of fields (particularly the electromagnetic field) due to quantization, and in so doing summarizes the work of Bohr, Rosenfeld, and Peierls himself. He ends, not surprisingly, by mentioning the troubles encountered in contemporary quantum field theory.

The most interesting paper in the collection may well be C. A. Coulson's "Interatomic forces." Kinetic theory was an early concern of Maxwell; his belief in velocity distributions led him to reject the billiard ball model of molecular collisions and to seek a power law for repulsive force between particles. Underlying this work, and much other work of the period, was the concept of "molecule." Maxwell wondered how a theory could account completely for an unseen world of molecules—"a strangely modern cry to come from an early Victorian," Coulson comments. The passages in which Maxwell reacted to Darwinism are fascinating; his three great papers on electromagnetic theory are roughly concurrent with *The Origin of the Species*, and he shared the interest of his age in evolution. He rejected any evolutionary processes on the molecular level, seeing molecules as eternal and unchangeable, coexistent with nature herself. "No theory of evolution can be formed to account for the similarity of molecules, for evolution necessarily implies continuous change, and the molecule is incapable of growth or decay, of generation or destruction." Coulson concludes with some modern considerations on interatomic forces and shows that Maxwell could not have reached these conclusions without the intellectual equipment of the 20th century.

The last three papers begin with comments on Maxwell, but do not investigate his work directly. Two outline particular areas of science which are based on electromagnetic theory, and the third is concerned with an application of the quantum theory of radiation. Sir Edward Appleton begins his discussion, "Radio and the ionosphere," with the Heaviside-Kennelley layer and proceeds to the experimental studies of the $E$ and $F$ layers by ionospheric sounding devices. E. G. Bowen's interest centers on radio telescopes. He first formulates six requirements for such an instrument, then shows how the Australian 210-foot telescope attempted to meet these requirements, and finally discusses some results obtained with the instrument. R. A. Smith's discussion of masers and lasers takes us even farther from Maxwell, for in this treatment quantum considerations are critical.

One can hopefully view this volume as part of a modest Maxwell "revival." After a long period with little attention, some interest is again being shown. A new biography and other Maxwellian studies now being undertaken may add measurably to our knowledge of the greatest physicist of the 19th century.

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## Darwiniana

**Charles Darwin**. Evolution by natural selection. Gavin de Beer. Doubleday, Garden City, N.Y., 1964. xii + 290 pp. Illus. $4.95.

**Darwiniana**. Essays and reviews pertaining to Darwinism. Asa Gray. A. Hunter Dupree, Ed. Harvard University Press, Cambridge, Mass., 1963. xxiv + 327 pp. $5.

Ever since the centennial year of Charles Darwin's *Origin of Species* (1859), numerous books and papers have appeared on Darwin and on his life and works. With every new publication, this question arises—Why another? Apparently Sir Gavin de Beer felt that he should answer the question, and he did so by calling attention to what is still happening: (i) In London, 240 participants on a television program were asked what names they associated with evolution. One third of them associated no name at all, an-