

The Top Secret Life of a Soviet Physicist

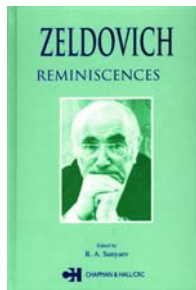
Zeldovich: Reminiscences

Edited by R. A. Sunyaev
Chapman & Hall/CRC, Boca
Raton, FL, 2004. \$94.95 (360 pp.).
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Reviewed by Gennady Gorelik

A physicist who had a chance to attend Yakov Zeldovich's weekly seminars on astrophysics at Moscow University's Sternberg Astronomical Institute could hardly forget their wonderful atmosphere of truth seeking and their blend of passion, honesty, bravery, ingenuity, and generosity. The seminars set an excellent stage for the new sciences of relativistic astrophysics and physical cosmology that emerged in the 1960s. Before the new astrophysical era began, Lev Landau said "Astrophysicists are often in error, but never in doubt." While Zeldovich introduced the aphorism into international scientific lore, he did a lot to invalidate his own statement that "the science about the past of the universe is infinitely more interesting than the past of the science about the universe."

Zeldovich: Reminiscences, edited by Rashid A. Sunyaev, director of the Max Planck Institute for Astrophysics, presents a plethora of anecdotal firsthand accounts of the physicist in "Astrophysics and Cosmology," the book's largest and best part. Most interesting is the mosaic of recollections by Andrei Doroshkevich and Igor Novikov, Zeldovich's first associates after he left the world of top-secret, hydrogen-bomb physics for the wide-open secrets of the universe. Kip Thorne's vivid portrait of Zeldovich against the backdrop of black-hole radiation is surpassed only by the one presented in Thorne's own book,



Black Holes and Time Warps (W. W. Norton, 1994).

However, beyond the pure astrophysics, I am afraid the book is more likely to generate puzzling questions about the Russian scientist. In czarist Russia, Westernizers clashed with Slavophiles around poet Fyodor Tyutchev's lines: "You can't access Russia by reason and measure it with a common yardstick. Russia is so special that you can only take it on faith." Those lines were much more relevant for Soviet Russia, a country sometimes referred to as a riddle wrapped in a mystery. Apparently, the Russian contributors were writing for their colleagues and did not care much about explaining Soviet realities. Although the translator tried, in short footnotes, to explain some aspects of Soviet lifestyle, much more detail is needed to understand the real human (or inhuman) impact of Soviet peculiarities, such as the "propiska," an official permit required to work, get married, gain access to education, and so forth—a tangible vestige of serfdom in Soviet socialism. A

better guide to the Soviet world would be the novel *The Master and Margarita*, by the great Mikhail Bulgakov, in which Mr. Woland (better known as Satan) comments on the Soviet Muscovites as being "ordinary people... only the housing problem has corrupted them." What was extraordinary is that despite such corruption, some Soviet people were doing excellent science.

The original Russian contributions for *Zeldovich* were written during the time of glasnost, and the memorial seems to be the first one from post-Soviet Russia that was not overwhelmed by the old dictum "Say nothing but good about the dead." Some contributors dared to touch on difficult and controversial questions about Zeldovich. No wonder it was hard to answer them—that is, if the reader keeps in mind how relevant the notion of the event horizon was to Soviet spacetime, and especially to the closed subjects of nuclear weaponry and the Communist Party's control over science.

But it is a pity that more than 10 years after the original 1993 Russian edition, the contributions were just translated rather than elaborated in

order to assimilate newly declassified and disclosed information. For example, Semyon Gershtein, with his richly detailed and warmly personal recollection, challenged Andrei Sakharov's surmise that the idea of Zeldovich's Tube project for the hydrogen bomb was based on intelligence information. Today, Sakharov's guess is a well-established fact: A piece of material evidence—Zeldovich's handwriting on an intelligence report in January 1946 and signed by the infamous KGB physicist Yakov Terletsky—is presented in my book *The World of Andrei Sakharov: A Russian Physicist's Path to Freedom* (Oxford U. Press, 2005), translated by Antonina W. Bouis.

Another contributor is the late Lev Feoktistov, who worked under Zeldovich during the time of the Third Idea (the Soviet equivalent of the Teller-Ulam design). A few years after the Russian edition of *Zeldovich* was released, Feoktistov, in his article "The Hydrogen Bomb: Who Betrayed Its Secret?," expressed the view that the Soviet designers were not independent. I disagree with his view, but I do believe the controversy reveals important things about the relationship between Sakharov and Zeldovich. Zeldovich played an enormous role in Sakharov's scientific life. Even some time after Sakharov's dismissal from "special physics," the codename used in the USSR for weaponry physics, he considered Zeldovich his only friend. Sakharov's human-rights activity eventually broke up their friendship. Although the book contains some material on that matter, it is very far from a clear picture.

Another unclear issue in the book is the Zeldovich-Landau relationship. Even though Landau had written a reference letter (which is included in the book) to nominate Zeldovich for election to the Soviet Academy of Sciences, and Zeldovich greatly revered his sponsor, Landau broke off the friendship in the early 1950s because of Zeldovich's effort to involve him in special physics more than he wanted. What was behind this insensitivity of Zeldovich's? The book does not provide a clue. And what was behind the nonelection of Zeldovich to full academician rank in 1953, after Joseph Stalin had died and the all-too-

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powerful Igor Kurchatov, the scientific head of the Soviet nuclear project, had written a reference letter (also included in the book) for Zeldovich? Again, the book reveals no clues.

I regret that the title of the original 1993 Russian edition, which translates into *Familiar Unfamiliar Zeldovich*, was replaced by a less colorful English one. While Zeldovich's science is a great joy for readers to familiarize themselves with, his social personality is still mysteriously unfamiliar.

Fundamentals of Seismic Wave Propagation

Chris Chapman
Cambridge U. Press, New York,
2004. \$75.00 (608 pp.). ISBN 0-
521-81538-X

The universe of seismic wave propagation is divided into overlapping worlds. Scientists who approach the problem from the low-frequency (30 seconds to an hour) global-Earth perspective naturally adopt a formalism based on normal-mode theory in a spherical Earth. Their formalism is well suited for studying part of the wave field containing surface waves and, more generally, long-period waveforms. For those interested in studying the propagation of high-frequency (10 seconds to several tens of hertz) elastic-body waves, a more suitable framework is ray theory, which allows for natural geometrical definitions of seismic phases and expedient computations of their travel times, in realistic media, in Cartesian (flat-layer) or spherical geometry.

Although nearly all introductory seismology textbooks and even most advanced ones aim to describe the entire observed wave field, and therefore cover the basics of both worlds, they do so at the expense of in-depth, consistent, and comprehensive presentation of the state of the art in either approach. In recent years, researchers have made significant advances in the development of numerical methods that are becoming a powerful tool for accurately reproducing observed seismograms in a complex, three-dimensional Earth. However, the methods remain computationally intensive, and seismologists will need to continue to use approximate methods that provide not only faster results but also insights into wave-propagation physics.

Fundamentals of Seismic Wave Propagation by Chris Chapman covers the mathematical development of asymptotic ray theory for seismic waves. It focuses on the specific case of Cartesian geometry as related to local and regional wave propagation on Earth and particularly for situations relevant to the petroleum industry. The author invokes only briefly Earth's flattening approximation as a means to convert from one reference system to the other. But to show the broader applications of the developments presented, the only realistic example that Chapman illustrates—no doubt intentionally—concerns core phases, a global problem that requires spherical geometry.

Chapman's book represents a synthesis of his life's work in theoretical ray seismology and attempts to present, in a consistent mathematical fashion, the status of a field to which he has made many original contributions. In this elegant framework, the author successively builds the fundamentals of asymptotic, kinematic, and dynamic ray theory; boundary conditions and their consequences at medium reflection and transmission interfaces; and the response of stratified media in the frequency and wavenumber domain. He also presents several methods—ranging from the classical Cagniard-de Hoop and

the WKBJ (named after physicists Gregor Wentzel, Henrik Kramers, Marcel Louis Brillouin, and geophysicist Harold Jeffreys) techniques to more practical spectral approaches—to recover the wave field in the time domain.

The mathematical developments in the text are first presented in the simplest

case, usually that of acoustic media, and are then repeated for the general case of anisotropic elastic media and the particular case of isotropic media. This progression allows readers to first grasp the principles before gradually building more sophistication.

The first four chapters can be studied independently from the book's core material as they provide a good reference to the seismologist's basic theoretical tool kit. Chapters 2, 3, and 4 include a simple and clear layout of the basic ray-related concepts, a discussion of the mathematical tools used—principally transforms—and a review of continuum mechanics and elastic waves. Although the material presented in the bulk of the book concerns the simple situation of stratified media, chapter 10 is devoted to tech-

