

pact. It has none of the color drawings and photographs that take up so much space in current introductory texts. Vector differential and integral calculus are used extensively. The text discusses solutions of the Laplace equation with various boundary conditions. A teacher will have to examine it carefully and decide whether to use it as the only text or as a supplementary text in an introductory course.

These are classic books, and anyone planning to include biophysical examples in a calculus-level course should study them carefully. The authors are to be congratulated for their work, and I commend AIP Press and Springer-Verlag for making the books available again.

Statistical Physics: Statics, Dynamics, and Renormalization

Leo P. Kadanoff
 World Scientific, River Edge, N.J., 2000. \$78.00, \$38.00 paper (483 pp.). ISBN 981-02-3758-8, ISBN 981-02-3764-2 paper

Even though I had few standards by which to gauge graduate students, it was clear that Leo Kadanoff, one of my first students, was special. No subject—from the mathematical properties of coherent states, which he studied with Roy Glauber, to the heating of nose cones, on which he consulted for a local defense contractor—was too abstract or too applied, and no calculation was too daunting. He took pride in finding answers speedily and cleverly. Spelling was not his forte, but there were few words between his equations. His talent and eclecticism were apparent, but the clear, elegant, economical, and idiosyncratic style that marks his lectures and writings was not yet evident.

With Gordon Baym, Kadanoff published his first book on statistical physics, *Quantum Statistical Mechanics* (Benjamin), in 1962. His recently published *Statistical Physics: Statics, Dynamics, and Renormalization*, is strikingly different. It is hardly surprising that books on statistical physics written almost 40 years apart should have little in common or that the newer of the two should be more inclusive or general.

In the most abstract sense, statistical physics encompasses all natural phenomena. Every process obeys the laws of physics and no system can be described with arbitrary precision. But this observation has no conse-

quence. The significant fact is that the statistical mechanical techniques that were primarily used to explain the properties of gases and crystals fifty years ago, are now being widely applied to “squishy” matter (polymers, gels, and biomaterials), to living things, and even to such “unnatural” phenomena as financial systems and computational networks.

Readers of *Quantum Statistical Mechanics* might infer that microscopic dynamics and macroscopic thermodynamics are tightly linked and that techniques for calculating the static and dynamic behavior of complex systems are not beyond reach. Readers of *Statistical Physics* will immediately appreciate, from Kadanoff’s provocative allusions to glasses, turbulent fluids, chemical reactions, and vortices in superconductors, that (1) the links between thermodynamics and both hydrodynamics and microscopic dynamics are often very tenuous, and (2) the construction of relevant dynamical models is an art. Models that have no apparent connection with the underlying equations for fluid flow may be relevant both for turbulent flows and for stock price fluctuations.

The piquant hors d’oeuvres in the introduction to *Statistical Physics* may raise the expectations of some readers excessively. Apart from an interesting discussion of multiplicative random processes that explains why Gaussian distributions drastically underestimate the frequency of rare events, the ingredients of the main course are relatively conventional. The subjects, derivations, and examples that appear in the text (as distinct from the reprints)—in the half of the book that covers general statistical mechanics—are old friends: ensembles, Gaussian distributions, diffusion, Langevin and Fokker–Planck equations, conservation laws and hydrodynamics, correlations and fluctuations in systems at or near equilibrium, and noninteracting Bose and Fermi gases.

Some of these subjects are subtle, and Kadanoff spices his wide-ranging presentation with illuminating observations, illustrations, and instructive problems. The first half of the book concludes with reprints (altogether, reprints compose about 40% of *Statistical Physics*) on diffusion-limited aggregation and self-organized criticality, two “big ideas” on which Kadanoff and his colleagues and collaborators have worked. Readers who haven’t experienced Kadanoff’s classes may well wonder what prompted

the author to bind these reprints to the preceding text, interesting as they both may be. Readers may also lament the absence of what surely would be a valuable exposition of some aspects of the complex natural phenomena to which Kadanoff alludes. How about a second volume, Leo?

In the second half of the book (about 60% of which consists of reprints), Kadanoff discusses second-order phase transitions, an area in which his seminal contributions are legend. After an introductory chapter on mean-field theory, he discusses the phenomenological theory of scaling (a theory that he attributes to Ben Widom but that Kadanoff had developed independently before I referred him to Widom’s papers). Then he deals with fixed points, universality, operator expansions, duality, the Ising model, real space renormalization methods, and systems with two-dimensional continuous symmetries. One still marvels at the beauty and generality of the physical and mathematical concepts and the ingenious calculational techniques Kadanoff introduced during the late 1960s and early 1970s and lucidly reviews here, to say nothing of his work with Jack Swift on mode coupling and lattice hydrodynamics and its relation to the work of others on dynamic critical phenomena!

Nonetheless, should a text on applications of the renormalization group to continuous phase transitions say nothing about upper and lower critical dimensions? And should it dispense in a single sentence (“The most remarkable application of [Wilson’s] theory was the [Wilson and Fisher] development of an expansion about 4 dimensions.”) with the expansion techniques (involving dimension and the inverse of the number of components of the order parameter) that are widely used to calculate critical exponents?

In short, *Statistical Physics* is a collection of valuable essays and papers. Both the text and the reprints display Kadanoff’s ingenuity, imagination, and clarity. They’re worth having and reading, as are most of the classic papers of others, (including Tom Witten and Leonard Sander; Mike Kosterlitz and David Thouless; and David Nelson) that the book contains. Students who took courses in which Kadanoff discussed these papers were very well served.

But students not lucky enough to have heard Kadanoff in person may wonder why some classic materials are not included and wish that Kadanoff had bound the contents together with more pedagogic glue. They’ll also note

that proofreading may still not be very high on Kadanoff's priority list.

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Making Waves: Stories from My Life

▶ Yakov Alpert
*Yale U. Press, New Haven, Conn.,
2000. \$30.00 (260 pp.).
ISBN 0-300-07821-8*

"I am not a Soviet man!" That simple declaration was Yakov Alpert's answer in 1980 to my question, "Why do you want to leave the Soviet Union?" How he came to this decision is one of the main threads of his memoir, *Making Waves: Stories from My Life*. His straightforward and touching account of making it in science (radio waves in the ionosphere and magnetosphere) and life (defiance waves in the Sovietsphere) is a well-documented account by a radio and plasma physicist whose unique life path transcends the birth and death of Soviet Communism.

Alpert was born in 1911 into a poor Jewish family in Ivnitsy, near Zhitomir, Ukraine. He warmly recalls his Hebrew school ("Cheder") training, as well as developing "survival strategies" during the violent anti-Semitic pogroms of 1919.

In 1931, with nothing but a high-school diploma in carpentry, and home experience with crystal radio sets, Alpert went to Moscow. Starting as a laborer in construction, he was propelled by his obvious intelligence onto an upwardly mobile science path. In 1934, he learned that the Lebedev Physics Institute of the Academy of Science (PhIAN) was moving to Moscow, and with characteristic chutzpah, or as he calls it "an optimistic temperament," he asked for and was given a technician's job based on his interest in the burgeoning wireless communication, radio. His creative experimental work there under Nikolai Papalexai and director Leonid Mandelshtam ("one of the most distinguished scientists of Russia . . ."), on the velocity and phase structure of radio waves over land and sea using radio interferometry, led to his maturation and a 1939 *kandidat* (PhD) degree. In 1944 he began experimental and theoretical studies of the fine structure of the ionosphere.

Following World War II, when Joseph Stalin's campaign against "cosmopolites" (Stalin's word for Jews) accelerated, Alpert was verbally

abused, and in 1951, finally dismissed from PhIAN for being "unsuitable." However, with characteristic luck, in 1952 he was offered a position ("a brave and noble step") by Nikolai Pushkov at the Institute of the Earth's Magnetism, Ionosphere, and the Propagation of Radio Waves of the Academy of Science (IZMIRAN), where he headed his own department and had his own building. In 1958, he worked with radio data from Sputnik 1, the world's first artificial satellite, and showed that electron density in the ionosphere decreases slowly at levels above its main maximum. He also produced a theory—validated by satellite data—explaining "atmospherics," 50–30 000 Hz electromagnetic signals produced by lightning discharges.

Alpert's attitudes toward the Soviet system abruptly soured following the ruthless invasion of Czechoslovakia in 1968. He resolved to emigrate, and in 1974 he and his second wife, Svetlana Pikova, formally applied for permission to leave the USSR—thereby becoming refuseniks. Svetlana was fired from her job, and he was demoted at IZMIRAN.

Alpert then entered into the activities of the existing community of refuseniks, most of whom had lost their jobs and suffered harassment and terrorization by the Soviet secret police. For support, the refusenik scientists began to hold regular "Moscow refusenik physics-mathematics seminars" at selected apartments, including the Alpert's apartment from 1981 to 1987. These seminars provided moral support, stimulus for continued scientific productivity, and international attention.

Alpert's stories are replete with commentaries on the accomplishments and moral standing of Soviet scientists. He focuses particularly on the courageous people who endured prison, from the earliest dissidents to Anatoly (now Natan) Sharansky, Yuri Orlov, and "the singular saint" Andrei Sakharov. Alpert also discusses (in Appendix C) the craven "mores of Soviet physicists."

Alpert and his wife were allowed to emigrate, and in 1987 they departed for the US, a new life, and continued fruitful research. (Alpert is a research scientist at the Harvard-Smithsonian Center for Astrophysics and was a consultant at Bell Laboratories. His wife is undergraduate studies coordinator in the department of mathematics at Harvard University.)

Alpert has been blessed with good health, perceptive intelligence, an optimistic personality, many friends,

supportive colleagues in the international community, and the love of two wives. As his friend and colleague Lev Pitaevsky notes in his informed "appreciation," a foreword to Alpert's opus on the resonance nature of the magnetosphere, in *Physics Reports* volume 339, page 323, 2001:

Alpert has made pioneering and distinguished contributions to theoretical and experimental investigations in radio and plasma physics and is the author of several excellent books. He was honored by a special URSI (International Union for Radion Science) symposium in 1974 "in recognition of his prominence in this field."

Adding interest and documentation to the story are numerous black-and-white photographs of people and pages of scientific data, scientific journal pages, and letters. Also important are four appendices, two of which deal with his involvement with high-altitude atomic bomb explosions, and a detailed listing of seminars, titles, and international visitors to "The Moscow Refusenik's Physics-Mathematics Seminar."

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Cosmological Inflation and Large-Scale Structure

▶ Andrew R. Liddle
and David H. Lyth
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(400 pp.). ISBN 0-521-66022-X,
ISBN 0-521-57598-2 paper*

In *Cosmological Inflation and Large-Scale Structure*, Andrew R. Liddle and David H. Lyth present a comprehensive overview of inflation, the gravitational growth of density perturbations, and predictions of the properties of the microwave background radiation, all in the context of the standard, hot, Big Bang cosmological model. A few other topics are touched on, but these three key topics are covered in great detail in a superb, rigorous presentation.

Both Liddle and Lyth have been active contributors to important developments in the fields of inflation and large-scale structure for well over a decade. Their depth of knowledge and expertise provide a rock-solid foundation for this book, which is carefully constructed, well-written,