Zinn performed the first experiment in neutron optics on 14 July 1944. They took a collimated thermal beam emerging from the Argonne CP-3 reactor and reflected it from flat metal surfaces at grazing angles of incidence. In that experiment they successfully demonstrated that neutrons suffer external total reflection by most materials, and they used the value of the critical angle to determine, via the neutron optical index of refraction, the coherent bound-neutron scattering length for various materials.

By now neutron optics has bloomed into an active field, and practitioners have gained a wide range of practical experience with many different types of neutron optical devices and instruments. The experimenter now has such devices as lenses, focusing mirrors, diffraction gratings and zone plates at hand. A notable present-day application of neutron optics follows directly from the work by Fermi and Zinn. At many modern high-flux research reactors, neutron-guide tubes operating on the principle of total reflection direct intense neutron beams away from the reactor. These guide tubes permit many more experiments to be done simultaneously then the old reactors, with which one could exploit only those beams that emerged directly from the reactor beam ports.

Central to the description of these phenomena is the concept of the neutron refractive index, which is directly related to the neutron optical potential: The neutron, entering the sample, interacts with the neutron optical potential and thus its direction of propagation is changed. If the component of the neutron momentum orthogonal to the surface is too small to overcome the neutron optical potential, the neutron suffers external total reflection. A certain experimental drawback stems from the fact that this neutron optical potential is very small, typically five orders of magnitude smaller than the energy of thermal neutrons. Thus some of the most beautiful neutron optical experiments have been performed with neutrons of low energies emerging from cold sources in some nuclear reactors.

A striking phenomenon occurs at very low energies: Neutrons can be too slow to overcome the neutron–optical potential barrier and thus they suffer external total reflection at all angles of incidence. This phenomenon, also predicted by Fermi, makes storage of neutrons in bottles possible. Such stored neutrons are then useful for a number of fundamental experiments, particularly those aiming at precise determination of neutron properties such as lifetime and charge. One of the most interesting applications is the on-going search at the Institut Laue–Langevin in Grenoble and at the Leningrad Nuclear Physics Institute for an electric dipole moment of the neutron. An electron dipole moment, predicted by various unified theories, would be by its mere existence further evidence for the violation of time-reversal symmetry in nature.

The book by Sears is a comprehensive review of the theory of neutron optics. It puts particular emphasis on the rigorous theory of dispersion and on dynamical neutron diffraction and neutron interferometry. The book therefore complements the various existing texts that cover the crystallographic and materials science aspects of neutron scattering. Sears nicely illustrates the theoretical results with experimental findings. However, the reader might like an even broader illustration of experiments in neutron optics. The book is written on a level appropriate for the graduate students and it is a very useful introduction into the field of neutron optics. It is also a must for anybody working on the development of new facilities or new experimental methods with cold or thermal neutrons.

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Beamtimes and Lifetimes: The World of High Energy Physicists

Sharon Traweek
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This study by Sharon Traweek of the high-energy physics community belongs to the school of descriptive or anecdotal anthropology. The author's goal is to describe "how high-energy physicists see their own world, how they have forged a research community for themselves, how they turn novices into physicists and how their community works to produce knowledge." Traweek did her field work at the Stanford Linear Accelerator Center in California, the National Laboratory for High-Energy Physics (KEK) in Tsukuba, Japan, and Fermilab in Illinois over a five-year period starting in 1976; she had previously worked part-time in SLAC's public information office from 1972 to 1975. It is not clear how much time she spent at each laboratory, but the primary focus is on SLAC.

Traweek's description of the hierarchy of high-energy physicists—from graduate students to postdocs to group leaders and "science statesmen"—will be familiar to most scientists. A special feature of high-energy physics, however, is the need for large groups (consisting of 20 to 40 people in the 1970s), to construct and operate the complex detectors required for frontier research. The author describes and contrasts the organization of these research groups at SLAC and KEK. The groups at SLAC are described as having an authoritarian structure: "Each decision is made by the group leader, who then informs the group of how it is to be implemented." Postdocs find themselves in a double bind: The experiment demands teamwork, but their seniors value an aggressive, individualistic and highly competitive style. In Japan, on the other hand, consultation, consensus and interdependence are the characteristic mode of operation.

Traweek observes that women high-energy physicists are subject to "subtle and severe dress codes" and almost never wear skirts! She also finds a "sharp division in labor among men and women physicists," based upon traditional sex roles, although no examples are given. After reading these statements I find it difficult to believe that Traweek was at SLAC at the same time as such prominent women physicists as Lina Galtieri, Gail Hansen, Vera Luth and Helen Quinn. And although she interviewed numerous male physicists and had discussions with the wives of 50 physicists, she does not report any interviews with female physicists. In fact, Traweek's attitude towards women is quite condescending.

Erroneous statements are numerous, and include the following:

▷ [Research groups] cannot take over equipment from other groups no matter how useless the materials may have become to their owners. The same holds true for computer software. I found this to be true in Japan, at Fermilab, CERN and SLAC."

▷ European experiments are "designed to collect precise measurements of phenomena first identified elsewhere, in more innovative and flexible detectors."

▷ "Japanese physicists work at one detector all their careers."

These and other misstatements are frequently attributed to informants. However, one expects that an anthropologist will compare the views of informants with her own independent observations. Some inaccuracies may be due to the author's credulity. Thus one suspects that the remarks that led Traweek to conclude that experimentalists avoid and denigrate theorists were actually tongue-in-cheek.

Beamtimes and Lifetimes is a disappointing work. It describes detectors and organizational structures, but the core activity is missing. Did Traweek ever take a shift in the experiment control room or sit in on a working meeting? Apparently not. We never see high-energy physicists at work; nor do we gain any insight into the dynamics of group research. Yet the dynamics of group research are of increasing interest as the individual investigator is replaced by the multi-institutional collaboration, not only in physics but also in molecular biology.

Traweek tells us how high-energy physicists at SLAC viewed themselves and their field in the 1970s when the US dominated high-energy physics. But although SLAC produced a series of dazzling discoveries in that decade, the book gives no sense of the excitement that gripped SLAC and the entire community of particle physicists at that time. In 1990, the US shares leadership in particle physics research with Western Europe, and the 40-member experimental teams of the 1970s have expanded to several hundred members to match the increasing scale and complexity of detectors. These teams have written constitutions, and for high-energy physicists the "horseback" or "cowboy" style of research is passing into history.

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Fundamentals of Statistical Mechanics: Manuscript and Notes of Felix Bloch

Edited and Completed by J. D. Walecka
Stanford U. P., Stanford, Calif., 1989. 302 pp. $39.50 hc ISBN 0-8047-1501-7

Equilibrium Statistical Physics

M. Plischke and B. Bergersen
Prentice Hall, Englewood Cliffs, N.J., 1989. 356 pp.$46.00 hc ISBN 0-13-283276-3

Since the development of the renormalization group by Ken Wilson in the early 1970s there has been an explosion of research activity in sta-