

fishing vessel *Lucky Dragon No. 5* to radioactive fallout from the US H-bomb test at Bikini in March 1954 and the death of one crewman caused by radiation that provided the political impetus for the government to accept a special responsibility for the thousands of A-bomb survivors, with promulgation of the A-bomb Victims' Medical Care Law in 1957.

The book begins with a survey of the physical damage caused by the blasts and their aftereffects that incorporates some new information from Japanese sources. The discussion of prompt radiation, responsible for the most serious human radiation exposures in the two cities, is out of date as a result of the revised dosimetric estimates recently made by US physicists. These new results indicate that radiation from the two bombs was quite similar and neutron exposures were much lower than those given in this chapter. The interpretation of neutron-induced residual radiation in the vicinity of the hypocenters (the locations immediately under the detonations) which may also have to be reevaluated, is significant because of the controversy surrounding the radiation exposures of "early entrants" (the thousands who came into the cities within 2 km of the hypocenter in the two weeks after the explosions); it is interesting in view of the recent reevaluation to learn that the neutron-induced radioactivity in the soil and in the bones of human victims measured soon after the bombing indicated clearly that the neutron fluxes for the two bombs were not greatly different.

The second part of the book, the longest, deals with injuries to the human body. The number of casualties produced by these very primitive bombs will probably never be known precisely, but the most recent and authoritative estimates indicate that about one-third of the people in Hiroshima were killed outright, and well over half of those within 2 km of the hypocenter were dead by the end of November 1945. The toll in Nagasaki was less, mainly because severe damage was confined to the Urakami valley by the relatively high hills on either side. Out of the 600 000 people in the two cities at the time of the bombing, total fatalities through the end of 1945 numbered well over 200 000, and probably another 200 000 were injured to various degrees. This proportion of dead and injured greatly exceeded that resulting from incendiary bomb raids previously carried out with even hundreds of planes.

The book continues the overemphasis on leukemia as a radiation-induced cancer that has typified the ABCC-RERF position, even though by 1974 it was obvious that other cancers, including nonfatal cancers, are much more



Ruins of the Sei Hospital and the Atomic Bomb Dome located directly beneath the epicenter. This photograph by Shigeo Hayashi appears in *Hiroshima and Nagasaki*.

numerous. The analysis of data relating radiation dose and cancer response presented here will also have to be reevaluated in the light of the new dosimetric information. Although radiation-induced cancers are far fewer than early deaths and injuries, the psychological impact of these long-deferred consequences of the bombs should not be underestimated.

The third part of the book provides much new information on the bombs' impact on society and daily life. These chapters document the breakdown of the social and community services and the extent of casualties among health professionals and city administrators. A somewhat incongruous section on the economic cost of the destruction of property follows. Subsequent sections describe the bombs' long-term psychosocial effects on survivors, including their work experience, economic status and marriage, and the problems of those who lost their families.

In a chapter on the psychological impact of the bombing, the detailed clinical evaluation that is characteristic of earlier chapters gives way to a more subjective exposition. Although the information here consists of a re-

stricted number of summaries of personal histories, the evidence vividly depicts the psychological ordeals of the survivors, individual and collective.

The final chapter in the book describes the development of citizens' groups concerned with the special problems of survivors, such as the microcephalic children irradiated *in utero*, or the "A-bomb maidens," women with disfiguring keloid scars of the face, and the governmental or administrative responses to these problems. The book describes the evolution of groups devoted to abolition of nuclear weapons, sometimes split apart by cold-war politics active in the world at large. Finally, it recounts the efforts of citizens' groups to provide educational materials for presentation in schools, with often discouraging lack of success, even in Japan.

Today, as the Reagan Administration prepares to "modernize" our arsenal of nuclear weapons—incomparably more destructive than the two small bombs dropped on Hiroshima and Nagasaki—and as the Russians deploy their nuclear missiles, these weapons seem to have a malign life of their own, not subject to rational control. For physicists, who invented nuclear weapons and continue to "improve" them, this book—even though it is technically detailed and its material is sometimes confusingly presented—should be required reading. The voices of the A-bomb survivors remind us vividly that a nuclear war today would probably end civilized human life.

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Many-Particle Physics

G. D. Mahan

1003 pp. Plenum, New York, 1981. \$85.00

The Physics of Elementary Excitations

S. Nakajima, Y. Toyozawa, R. Abe

332 pp. Springer, New York, 1980. \$49.80

Condensed-matter physics is regarded by many, particularly theorists, as the study of interacting many-particle systems. Vigorous development of the field in the last three decades has yielded so many concepts, phenomena and theoretical techniques that graduate students who are about to specialize in condensed matter, or their instructors, face the problem that it is easy to overlook something important. Help has appeared in the form of two new

books written by authors who have made important contributions to a broad range of research topics.

Gerry Mahan has chosen to cover as wide a range of topics as possible. He introduces field theoretic techniques and applies them not only to electron gas and liquid helium, two subjects which have become *de rigueur* in many-body texts, but also to polarons, to transport properties and to optical properties in insulators and semiconductors, as well as to metals.

There is a very long chapter on exactly soluble models. The analysis of many such models, extremely thorough, forms an excellent foundation for the study of interaction physics. The reader who dismisses these exercises as trivial would miss a mine of information that hitherto has been either struck with haphazard blows or explored in darkness. Step-by-step solutions demonstrate the power of several different techniques: canonical transformations, the Baker-Hausdorff theorem and Green's functions for noninteracting particles. Mahan spares no opportunity in milking all possible physical conclusions from these mathematical developments. From these, the reader can gain an understanding of a range of phenomena and concepts: electron-impurity scattering, resonance states, the Frank-Condon effect, charge- and spin-density waves in a model electron gas and polaritons, to name a few. Later chapters, in which interaction effects play an indispensable role, show the value of understanding these soluble models. For example, thorough discussions of "independent Boson models" prepare one well for Holstein's small-polaron theory and the features in the x-ray spectra of metals.

The treatment of the interaction physics is thorough in all facets: in the use of simple models to draw out important physical features, in minute discussions of all associated physical ideas, in careful explanation of sophisticated methods and in consideration of exact relations such as conservation, symmetries and Ward identities. This is best illustrated by the section on the x-ray spectra in metals. First, we are treated to an account, by the originator himself, of how term-by-term consideration of the excitonic effect in a metal leads to a sum with an unusual singularity at the adsorption edge. Then, Mahan shows the effect of Anderson's orthogonality catastrophe on the spectra. Finally, he provides a thorough treatment of Nozière and deDominicis' exact solution of the problem. One can also easily trace all these characteristics in the treatment of the small polaron.

The flaws of this book are entirely minor. One might wish for a more

systematic treatment of the second quantization, particularly the relation of the wave function representation of the state to the number representation. There could also be a linkage of the Fermi liquid theory to the properties of metals.

The impossibility of treating modern many-particle physics comprehensively is nicely illustrated by the fact that, despite the length of this book, many topics are untouched. I suspect that it really does not matter. Anyone willing to study this book thoroughly will be well equipped for research and for further reading of the many excellent monographs available on such topics as superconductivity, the renormalization group and Landau-Fermi liquid theory and of research papers. It is hoped that the length and price of the book will not deter the serious student from using the book: studying the first four chapters thoroughly, solving the set of problems and then reading a selection (if not all) of the rest of the topics. It is also a useful reference book for those already familiar with the many-body formalism who wish to look up some applications in condensed matter.

As the title indicates, *The Physics of Elementary Excitations*, has a unified theme. Many of the observations on the condensed state deal with excited states, which may be described in relation to weakly interacting quasiparticles, as Landau described liquid He^3 and He^4 . These quasiparticles are called the elementary excitations in this book. Although this approach eliminates the consideration of some important questions of the ground state, such as cohesion and structure, it does encompass a wide range of phenomena. Thus, the condensed-matter physicists can happily hunt for their own particles: phonons, magnons, excitons, polarons, polaritons, defectons and so on, without further particle-envy toward the high energists. The latter would undoubtedly insist that, though all particles are elementary, theirs are more elementary than others!

Behind the name of each particle is an important physical concept: phonon for lattice vibrations, magnons for spin "oscillations," excitons for bound electron-hole pairs. This book leads the reader directly and succinctly to a wide range of important concepts concerning elementary excitations. Then it goes on to the relations of these excitations to physical phenomena. Such discussions as those of phase transitions and elementary excitations are particularly interesting.

Although a knowledge of second quantization is assumed, many-body techniques are introduced as needed, so that the illustration of the technique and the treatment of the system or

phenomenon at hand are accomplished simultaneously. The treatment is briefer than in Mahan's book. Sometimes the reader is fed just enough to whet the appetite. After the authors introduce an extremely interesting idea, the defecton, they say only that it plays an important role in nuclear spin relaxation in solid He^3 but provide no details. However, for a student who wishes to gain relatively quickly a range of important concepts in condensed-matter physics, this book gives an excellent introduction. It equips students for studies of further details elsewhere and, indeed, for further development of their own theories.

To the question of what is the best way to study condensed matter as a many-body system, these two excellent books, starkly contrasting, provide perhaps the answer that all roads lead to Rome equally well, provided that they are paved by good cobblestones.

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Particle Physics and Introduction to Field Theory

T. D. Lee

865 pp. Harwood, New York, 1981. \$59.50 cloth, \$19.50 paper

This excellent book evolved from lectures on particle physics that T. D. Lee first gave in Beijing in 1979. It is the first in a new series called *Concepts in Contemporary Physics* that is "addressed to the professional physicist and to the serious student of physics." With its authoritative and lucid presentation of the whole gamut of modern particle physics, this book will serve as an indispensable reference for researchers in particle physics.

Lee's approach is pragmatic and includes many of his own recent research contributions to the basic problems of modern particle theory. The first six chapters are a self-contained and straightforward introduction to standard quantum field theory, with QED quantized in the Coulomb gauge. Next comes a substantial chapter on solitons that includes a discussion of their quantization. Lee completes the first half of the volume with a set of nine chapters describing symmetry considerations in particle physics. He develops the discrete symmetries—P, C and T—and the continuous ones— U_1 (in QED), isotopic spin and SU_3 —and analyzes their important physical applications (mass formulas, the $K - \bar{K}$ systems, and so on). This part concludes with a discussion on symmetry breaking and the role of the vacuum as a source of the asymmetry that serves as the bridge to the discussions of the most recent progress