In Chapter 6, the authors present a careful discussion on the Faraday effect for the diamagnetic case. The approximate summation of perturbation terms is again emphasized. However, some important features (for example, interpretation in terms of A, B and C terms) reported in the literature are missing. (See A. D. Buckingham and P. J. Stephens, *Ann. Rev. Phys. Chem.* **17**, 399, 1966). Finally, the authors do not give detailed references that may have been useful for advanced workers in this field.

Nevertheless, this book presents a complete detailed description of all the fundamentals of optical activity theory and a very careful analysis of the main features of rotational strength and correlations between the theory and experimental results. I believe that this book will be very useful for graduate students and researchers who are interested in optical activity theory.

TAI YUP CHANG
Ford Motor Company
Dearborn, Michigan

Rotational Structure in the Spectra of Diatomic Molecules.

Istvan Kovacs

American Elsevier,
New York, $16.75.

Since the early 1920's, before the discovery of quantum mechanics, the analysis of the rotational structure of diatomic molecules has been an active field of investigation. Istvan Kovacs has played a significant role in the area for the past 25 years. This monograph is a summing up of the great mass of work in this speciality.

The inevitable question is: "What does this book contain that is not in Geshard Herzberg's book, *Spectra of Diatomic Molecules,*" published in 1950?" Although the fundamental theory of molecular fine structure was worked out in the 1920's and 1930's, a great deal of elaboration, systemization and collation of results has taken place since 1950. In fact, about half the references in Kovacs's book are to papers published since 1950.

The intention of this book is to "be useful to both theoretical and experimental research workers who want complete and unified information concerning the rotational structure in spectra."

It opens with a section on the foundations of the theory of diatomic molecules, which applies angular momentum and perturbation theory in considerable depth to the subject of diatomic molecules. A strong knowledge of quantum mechanics is presupposed on the part of the reader. A section on multiplet term formulas considers fine structure due to spin or rotational uncoupling of orbital angular momentum in Hund's cases *a*, *b* and *d* and in intermediate cases in exhaustive detail. Similarly, the intensity of transitions between multiplets is considered in a wide variety of cases. Finally an account is given of the theory of perturbations of molecular fine structure levels.

In a field as mature as the theory of diatomic molecules, it is difficult to write a truly comprehensive treatise. Each monograph must, of necessity, stress certain topics to the exclusion of others. Kovacs's treatise is based on a tradition of optical spectroscopy that goes back many years. The emphasis is on the theory of fine-structure levels and the effect of these structures on optical spectra.

The author's emphasis on optical spectra is chosen at the exclusion of topics of interest to microwave and radiofrequency spectroscopy. The topics of hyperfine structure, Zeeman and Stark effects, with the concomitant discussion of interaction of nuclear and molecular moments with each other and with external fields, are omitted entirely. Furthermore, the theory of molecular interactions that produces fine structure is usually reduced to a parametrization, which can be used to fit experimental data. The origin of these parameters in angular-momentum theory is treated extensively. The relation of these parameters to molecular structure and molecular wave functions is not given. Thus this work will be of interest largely to workers in the field of diatomic molecules, especially those who are interested in optical spectroscopy.

WILLIAM LICHTEN
Yale University

Quantum Theory of Many Particle Systems

A.L. Fetter, J. D. Walecka

601 pp. McGraw-Hill,
New York, 1971. $19.95

In the past it has been rather difficult to find textbook material to help second- and third-year graduate students bridge the gap between general graduate courses in quantum mechanics and the extentive literature devoted to the many-body problem. The most widely used existing texts, for example Aleksi A. Abrikosov, Lev P. Gorkov and I. Ye. Dzyaloshinski's *Quantum Field Theoretical Methods in Statistical Physics* and Leo P. Kadanoff and Gordon Baym's *Quantum Statistical Mechanics* cover some of the possible topics in great detail but leave out some very im-

portant areas completely. Furthermore, the two books mentioned above often have a level and style of presentation which is very difficult for graduate students.

Alexander L. Fetter and John D. Walecka have written a textbook that does an excellent job of filling in most of this gap. Their work contains a good introductory presentation of the field-theoretic techniques that have been developed for application to zero temperature and finite temperature problems in many-particle systems. The diagramatic and Green's function formalism is described in precisely the right amount of detail so that the novice can learn what is being done and how to do it himself. To aid the student in understanding the relationship between formalism and applications, the discussions move up and back between general theory and applications to particular cases.

The kinds of systems studied include the electron-gas weakly interacting system, degenerate Fermi and Bose systems, nuclear matter, the electron–phonon system, superconductivity, superfluidity and the atomic nucleus. Each case is considered as an illustration and application of the formalism. For this reason, the discussion of the physics of these diverse systems seems slightly superficial at times, especially in comparison with the relatively sophisticated level of formal technique. Hardly any experimental facts are presented. This text teaches the theory that underlies the calculational methods; it is not intended to give a full explanation of the physical picture of the different many-particle systems.

In short, the book is singlemindedly devoted to its job of educating potential many-particle theorists. Students will profit from the especially clear and direct presentation and from the inclusion of useful references and problems. For these reasons, *Quantum Theory of Many Particle Systems* deserves to become the standard text in the field.

LEO P. KADANOFF
Brown University

The Nature of Ball Lightning

S. Singer

169 pp. Plenum, New York, 1971.

The existence of ball lightning (Singer mentions) was recorded by Posidonius in the first century, BC but naturally Posidonius did not know its nature. Lord Rayleigh studied ball lightening early in this century and at that advanced date he was still unable to explain it. (Rayleigh made cutting note of the contempt of savants for the experiences of others, citing meteorites and ball lightning as instances. Meteorites ("thunderstones") were dismissed as pagan superstition until the 19th century. Ball lightning is just becoming respectable in our time.) And now at last Singer gives the best collection of ball-lightning observations, references and theories I have seen; but he does not tell us what ball lightning is either, for the title of this book is quite at odds with its contents.

Ball lightning. This is one of the few pictures of ball lightning. From Singer's book on the subject which is reviewed here.

I don't think anyone knows what ball lightning is. Maybe the truth lies somewhere between the dc discharge model James Powell and I worked on, and the rf one of Pyotr Kapitza, with several hundred joules stored in the ball and a few hundred watts flowing through it. Radiofrequency electric currents are suggested by some observations, but where could they come from? And while dc is provided copiously by thunderclouds, there is no ready explanation of how it can get into metal aircraft.

If it were a matter of biology the present inability of physics to cope with the phenomenon would be customary, hence tolerable. But ball lightning looks like a gaseous discharge (although Michael Faraday thought not) and we should be able to deal with it at least qualitatively from fundamental principles. We can't, and it's getting embarrassing. Nor is the reputation of science much improved by our again denying the existence of what we cannot account for.

Knowing what ball lightning is may not help much with our other problems, but it is a charming and long-standing puzzle in its own right; and while Singer is undercritical when he is presenting the many attempts at ball-lightning theories, and his prose sometimes verges on the bureaucratic, I doubt if anyone else has such grasp of the history and literature of ball lightning. He makes a great deal of work more available to us all. There is even a certain piquancy in the contrast between the lively whimsi-