The Whirlpool Galaxy, shown here with its irregular companion galaxy NGC 5195, is M51, the fifty-first of about one hundred nebulous objects that the astronomer Charles Messier (1730–1817) observed and recorded. *The Messier Album* by John H. Mallas and Evered Kreimer (248 pp.; Sky Publishing Corp., 1978; $9.50) contains photographs, drawings and descriptions of each of the Messier objects. Owen Gingerich introduces the volume with a biographical essay.

readers interested in science and its history. It is weak, however, in conceptual analysis and, in my view, the book fails to give a satisfactory overall picture of "Galileo's scientific career." In fact, Drake is a much better translator than interpreter of Galileo's writings. His preconceptions often lead him to misread his own usually accurate translations. Among Galileo's notes on motion, for example, Drake thinks perfectly clear and correctly translated remarks about motion along different lengths of a single vertical are about motion along differently inclined planes (pages 115–116). As another example, although folio 85v does not contain the term *gradus,* Drake interprets the passage as if it does, even while correctly omitting it from his translation (pages 98–99, 114 and 125). Only rarely do his misconceptions lead to actual mistranslations, but one is worth mentioning. In translating folio 138v (pages 111–112) Drake omits a whole paragraph that contains three instances of an expression he claims did not occur on that page as originally composed. Also, he supposes the term *equale* to be a later addition to the last paragraph, which it is not (see the National Edition of Galileo's *Opere,* volume VIII, page 372, where Antonio Favaro, the editor, accurately indicates all additions and corrections on this page of the manuscript).

What lies behind a number of such misreadings may be various fixed ideas such as one that dominates much of Drake's discussion of motion: the belief that Galileo's central conceptual problem in the development of his new science was coming to believe that velocity in free fall is continuous from rest. Much evidence indicates that Galileo came to realize this earlier than Drake supposes and that later preoccupation with continuity of motion from rest stems from the problem of formulating an adequate mathematical treatment of it. Drake's interpretation runs into particularly conspicuous difficulties in his discussion of Galileo's so-called "paradox of speed," where Drake conflates three related but nonetheless distinct problems: continuity of motion from rest; the relation between uniform and accelerated motion, and the relation between accelerated motions along differently inclined planes. (See pages 81 and 124–25 and compare Galileo's discussion of the "paradox" in Drake's own translation of the *Dialogue Concerning the Two Chief World Systems,* 2nd revised edition (University of California, Berkeley, 1967), pages 23–27, and especially remarks by Salviatti appearing at the bottom of page 25.)

Drake's interpretations of other fundamental conceptual developments in Galileo's mechanics also raise doubts, and his preconceptions concerning Galileo's method seem to lead to misunderstandings, both of other secondary discussions of this topic and of crucial passages in Galileo's own works, including the old *De motu* (written about 1591), the early *Cosmografia* (written probably before 1600), the somewhat later *Discourse on Bodies in Water* (first published in 1612), the published *Two New Sciences* (1638) and some related correspondence. Fewer difficulties appear to arise in Drake's treatment of Galileo's astronomical work and the various controversies in which he was involved. However, the reader should be warned that even here some of Drake's interpretations are at least moot.

Misinterpretations of manuscript notes and other texts can, of course, lead to errors in dating them, and, consequently, to wrong reconstruction of the development of Galileo's work. Thus, Drake's choice of a strictly chronological order of exposition makes his book particularly vulnerable to such errors. Any biography, of course, may follow either a strict chronological or a thematic order, and Drake chooses the former, claiming that it is the best way to understand how Galileo's thought actually developed. But for the nonspecialist particularly, this method makes it more difficult than it should be (despite an unusually good index) to follow Drake's account of the development of any particular line of work and to evaluate the evidence for his reconstructions. Nonetheless, the cautious reader will find *Galileo at Work* to be rich with rewarding details concerning a scientific personality of perennial interest.

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Principles of Magnetic Resonance, 2nd edition

C. P. Slichter
397 pp. Springer-Verlag, New York, 1978 (first edition, 1963). $24.90

A graduate course given by Charles P. Slichter as Loeb Visiting Lecturer at Harvard was the basis of the first edition of this book (reviewed by John H. Van Vleck, PHYSICS TODAY, January 1965, page 114). In this second edition he includes new fundamental developments in nuclear magnetic-resonance methods and concepts. Three new major chapters, two new appendices, added material to the

original chapters and augmentation of the homework problems comprise an improved introductory book, popular in its first edition for use in graduate courses and for beginning research students. The three new chapters cover the spin-temperature concept, advanced methods and concepts in pulsed magnetic resonance, and the double-resonance method.

Slichter, a professor of physics, and his graduate students at the University of Illinois are responsible for numerous original and significant research contributions that appear in the book. The clarity and style in which the book is written reveals Slichter's research expertise and talent as an excellent teacher and expositor. From sentence to sentence he concerns himself with bringing the reader into a clear understanding of the material in an elementary fundamental style. Yet there is no stinting on rigor, and the necessary formalism soon begins to unfold with liberal use of models, sketches, diagrams and supplementary footnotes. Slichter avoids extraneous supplementary references while the student, preparing himself to cope with the literature, studies the beginning material in the text.

In the style of the first edition, he gives even more examples of applications of density matrix, operator and quantum-mechanical methods to real physical cases. The new material understandably could not include all of the latest significant developments in nmr. Omitted developments are the nuclear magnetism of superfluid He^3, nuclear ferro- and antiferromagnetism studied by the Saclay group, and special effects such as multiple-quantum nmr and rotational tunneling phenomena in nmr.

Anatole Abragam has written his larger and impressive work *Principles of Nuclear Magnetism* (Oxford U.P., 1961) in a style and depth designed as an nmr reference treatise for special topics of this nature. On the other hand, Robert T. Schumacher has designed his book *Introduction to Magnetic Resonance* (W. A. Benjamin, 1970) for undergraduate physics majors. Therefore, Slichter's second edition stands by itself as the choice introductory treatment of nmr at a level suitable for the beginning graduate student.

A considerable body of research contributions by Slichter and his students that appears in the textual material does not detract from the exceedingly conscientious and thorough referencing to works of other investigators. The referencing is so good that certain new priorities in research contributions to nmr appear that were not previously obvious to even veterans in the field. The added new chapters are particularly well done because they are lucid distillations of research papers by Slichter and students over many years dealing with expository and experimental confirmations of new ap-

proaches in nmr. This is particularly the case with regard to the spin-temperature hypothesis of Alfred Redfield, and the double-resonance method. By the latter method, Slichter, with Thomas Carver, demonstrated the Overhauser effect for the first time. The chapter on the spin-flip narrowing method pioneered by John Waugh and Peter Mansfield is characteristically a clear exposition. It begins with a discussion of simple artificial averaging arguments. This discussion leads into the rotational operator-Hamiltonian averaging methods, and shows how unwanted dipolar broadening may be eliminated in solids to reveal hidden chemical shift and exchange-coupling interactions in solids.

Unfortunately, this edition contains too many typographical errors. I find this volume very useful as a primary and reference text in courses not only for nmr, but also in introductory quantum optics, which utilizes the same formal techniques of quantum-mechanical analysis.

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Molecular Vibrations in Crystals

J. C. Decius, R. M. Hexter
391 pp. McGraw-Hill, New York, 1977.
$29.50

The classic treatment of the normal-mode analysis of isolated molecules is *Molecular Vibrations: Theory of Infrared and Raman Vibrational Spectra* by E. Bright Wilson Jr, John C. Decius and Paul C. Cross (McGraw-Hill, New York, 1955). A corresponding analysis for molecular crystals has been long overdue. *Molecular Vibrations In Crystals*, by Decius and Robert M. Hexter, is a welcome contribution toward filling this void. It is a self-contained exposition of the spectroscopic properties of molecular crystals in the harmonic approximation. The authors have spent several decades in this field, and their thorough, systematic knowledge shows. As might be expected from a book that shares one author (Decius) with the earlier volume, the F G matrix method is emphasized, in a k-dependent generalization appropriate for crystal studies.

The book begins with a condensed discussion of symmetry, group theory and the normal modes of molecules, followed by equally brief discussions of one- and three-dimensional lattices. Students without previous exposure to these topics will find it necessary to supplement their reading here. Decius and Hexter discuss selection rules, polarization effects and the nature of wave propagation in a di-