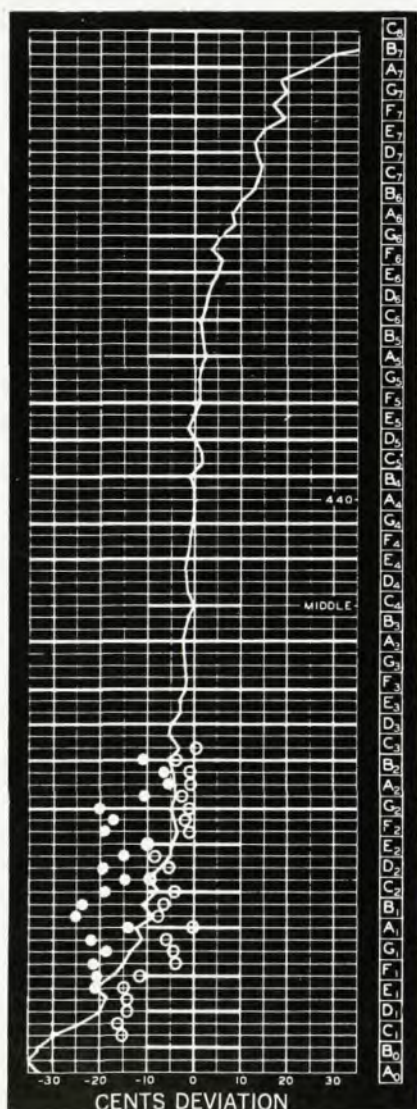


semitone intervals. He will be pleased to note that most musicians will grudgingly admit that this is the only reasonable way to tune a piano, and then he will be shocked to learn later that the piano has abandoned the ratio of two for the octave, the whole scale being stretched so that it is flat at the lower end and sharp at the upper (see figure).

It is in the sections on musical instruments that the book is most fascinating. All of the classical musical instruments, through the process of trial and error, have undergone great refinements over the centuries. (An exception is "that fossil," the bassoon.) A scientific correlation between their physical structure and performance is,



STRETCHED OCTAVES. Data from 16 expertly tuned pianos show flattening in the bass and sharpening in the treble, compared with the tempered scale. One cent is 1/100 of a semitone. (From *The Acoustical Foundations of Music*.)

however, just beginning to take shape. It is remarkable that much of this work has been done only in the last two decades. While Backus's treatment is necessarily abbreviated, he has compiled from the most recent and pertinent research an excellent account of the acoustical principles of each of the major types of orchestral instruments and the piano.

The logical organization of the book is outstanding, the exposition is clear, and references are ample and up to date. The author's sense of humor is unobtrusive and reveals his compassion for the foibles of scientist and musician alike. Those who aspire to be something of both will be most entertained and enlightened by this volume.

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Quantum Mechanics

By Leonard I. Schiff

(3rd edition) 544 pp. McGraw-Hill, New York, 1968. \$12.50

In 1947, when I began the serious study of quantum mechanics, the most generally available books in English were the workmanlike text of Linus Pauling and E. Bright Wilson, Jr, the serious-minded and fairly weighty treatise of E. C. Kemble, and the classic of P.A.M. Dirac. Those whose German was superior to the minimum needed to squeeze through the usual language requirement were fortunate in having access to several nontrivial additions to this reading list, including V. Pauli's demanding *Handbuch* article and Arnold Sommerfeld's elegant *Wellenmechanik*. (There was then current the story of the professor, basing his lectures in large measure on Pascual Jordan's *Anschauliche Quantenmechanik*, who was reticent to mention his source out of concern for the physical well-being of the single library copy.) Admirable as these books are in many respects, none of them was ideally suited for a modern course aimed at first-year graduate students of physics.

The publication in 1949 of the first edition of Leonard Schiff's *Quantum Mechanics* must then be viewed as an event of some consequence in the pedagogical history of quantum mechanics. This volume, supplemented

by some reading in Dirac's book, gave the student for whom it was intended exactly the right mix of what quantum mechanics was and (even more) how one solved a variety of problems with it. Of the soluble examples for the motion of a single particle in a potential, there are few problems worth consideration at this level that were not included. (Among the latter I could mention the double potential—illustrative of tunneling and the periodic potential. Naturally enough, these can be found in one or more of the excellent texts of more recent vintage.)

The new edition is Schiff's response to the most important developments and changing emphasis of the last two decades. Thus, it is difficult to argue against too early an introduction of the student to the role of symmetry and its relation to group theory, to the notion of the scattering matrix and of its analytic properties, and to the use of the density matrix for the description of systems about which we have less than maximal information. All of these major topics have been added to the third edition. The presentations are in the straightforward manner characteristic of the older material, satisfying simultaneously the requirements of economy and completeness. The author has, moreover, taken advantage of the occasion to make other additions of obvious merit: a much more complete account of the matrix formulation, including transformation theory in the notation of Dirac, and an extended discussion of approximation methods for bound states and for collision problems. Again very little of consequence appropriate to the framework has been totally bypassed.

There is a well known theorem of Eugene Wigner that everyone has at least two faults, which should moreover be mentioned in a letter of recommendation. I shall assume a corresponding theorem for books and reviews of them. One may, for instance, cavil at the pedagogical soundness of some of the new material. A most glaring specific example is the concept of weight function in group space for a continuous group, first mentioned on page 196 and several times subsequently, but *never defined*. The second criticism belongs to the category of *chacun à son gout*. To one reader at least, this book, though of course well written, does not contain much beauty, charm, or elegance. Perhaps these possible outcomes were precluded by the deliberately chosen

eclecticism in approach, in effect by the aim of the book. The success of this augmented edition of what is now a standard text appears nonetheless to be assured, and for very solid reasons. As one of my colleagues put it, if one were exiled to Corsica for a year in order to learn quantum mechanics, and could take but a single volume, a very good case could be made for the choice of this book.

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Special Functions: A Group Theoretic Approach

By James D. Talman

(Based on lectures by Eugene P. Wigner) 260 pp. Benjamin, New York 1968. Cloth \$10.00, paper \$5.95

This delightful volume does for most of one's favorite special functions what arithmetic does for the exponential: It displays them not as solutions to differential equations but as matrix elements of representations of elementary Lie groups.

If you feel deeply that there is nothing more to say after pointing out the e^x is the solution of $f' = f$ (with $f(0)=1$) and do not care that it is also 2.71828... multiplied by itself x times, then you also might feel inclined to ignore this book. This would be a pity, because almost half is devoted to the kind of general exposition of Lie groups, Lie algebras and their representations that few mathematicians are capable of treating us to. It is an exposition that prefers words to symbols, is intuitive and does not require us to scale a mountain when we only want to peek over the garden hedge. Knowing only a little linear algebra, one can read this much with joy and enlightenment without compromising one's devotion to differential equations.

If, however, you have always suspected that there was more to Bessel functions, Gegenbauer polynomials, associated Laguerre polynomials, and Hermite polynomials than Morse and Feshbach or Watson were letting on, then you can indulge in the feast as well as the cocktails. And there, in the algebraic paté, you will come upon those higher transcendental truffles you long ago snuffled in the garden of analysis. Only a hard man could fail to be moved by this trans-

formation, and you can see what it has done to a soft-hearted esthete like your reviewer.

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Statistical Mechanics Of Chain Molecules

By Paul J. Flory

432 pp. Interscience, New York 1969. \$17.50

In polymer science it is important to know the shape of an isolated polymer molecule and quantities that characterize this shape, such as the radius of gyration and distribution of end-to-end length. Almost always the chemical structure of the repeating unit (residue) is such that rotation is allowed about at least one chemical bond in each residue.

This means that a polymer molecule that is typically composed of thousands of residues has an enormous number of available shapes and that the calculations of measures of shape and size must rely on the methods of statistical mechanics. In this book, Paul J. Flory deals with this problem; he is eminently qualified to write such a book because he has worked extensively in this field.

By far the largest amount of effort is devoted to the formalism and calculations of the rotational isomeric-state model with short-range interaction. In this model, one allows rotation about certain chemical bonds to minimize the rotational-potential function. The energy of each molecular shape is calculated by accounting for interaction between atoms that are close to one another along the chain backbone. Interaction between atoms that are physically near to each other because they close a loop is ignored if the length of the loop is greater than a certain (small) size.

Flory's development is well done. The difficulty of the text is proportionate to the subject matter; there are no extraneous difficulties introduced by the author. By use of matrix methods, pertinent quantities are derived that describe the configuration of the macromolecule. Topics discussed in the theoretical part of the book include: a description of previous more approximate models, the

more accurate statistics of polymers with interdependent rotational potentials and a useful comparison of various solutions (both exact and approximate) of various polymer-chain models. The treatment of copolymers, which, however, takes up only four pages of the book, is in error. Use of the mole-fraction-weighted arithmetic mean on page 118 gives correct results only in certain limiting cases. A correct treatment of the copolymer problem has been obtained recently by G. W. Lehman and J. P. McTague (*J. Chem. Phys.* **49**, 3170, 1968).

Flory assumes, as a working hypothesis, that one can choose a solvent for a polymer that exactly cancels the effect of excluded volume (interaction of residues separated by relatively large distances along the chain backbone). This assumption, on which the validity of the application to real systems rests, is not discussed adequately. One is therefore not convinced that the parameters of the model have a meaning outside the model.

About a third of the book is devoted to application to real systems. Symmetric chains, asymmetric chains and biological macromolecules each comprise a chapter. It is shown that the parameters of the isomeric rotational-state model can be chosen so that its various predictions are in reasonable accord with available experiments for a sizable number of polymers. In addition (where comparisons are available), the required energy parameters are about what one would expect from independent estimates based on molecular structure.

Application is made to light scattering and to strain and electric birefringence in the last chapter. This book is a worthwhile addition to the library of anyone interested in the conformational statistics of polymer molecules.

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Theoretical Elasticity

By A. E. Green, W. Zerna

(2nd edition) 457 pp. Oxford U. P., London, 1968. \$16.80

Although not intended to be a treatise on the theory of elasticity, the first edition of this book in 1954 was a comprehensive presentation of the general theory of finite elastic deformations,