Because the greatest hindrance to further development in this direction is the dependence on open-shop operation of large-scale computers, the next stage of development almost surely lies in freeing the music-generating program from its ties to a large-scale computer. Means must be found for using small or medium-scale computers, probably in a hybrid system that will combine the precision of computer sound definition and the economy of analog sound production. The first beginnings in this direction have already been made.

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Thermal Physics

By Charles Kittel
418 pp. Wiley, New York, 1969. $10.95

Nobody would expect Charles Kittel to write a dull book. After the huge success of his *Introduction to Solid State Physics*, any new work of his makes an immediate claim on our attention and expectations. *Thermal Physics* is not a disappointment; it is a highly stimulating and readable book. There are times when one feels that the difficulties are not being fully disclosed; nevertheless, it remains compulsive reading.

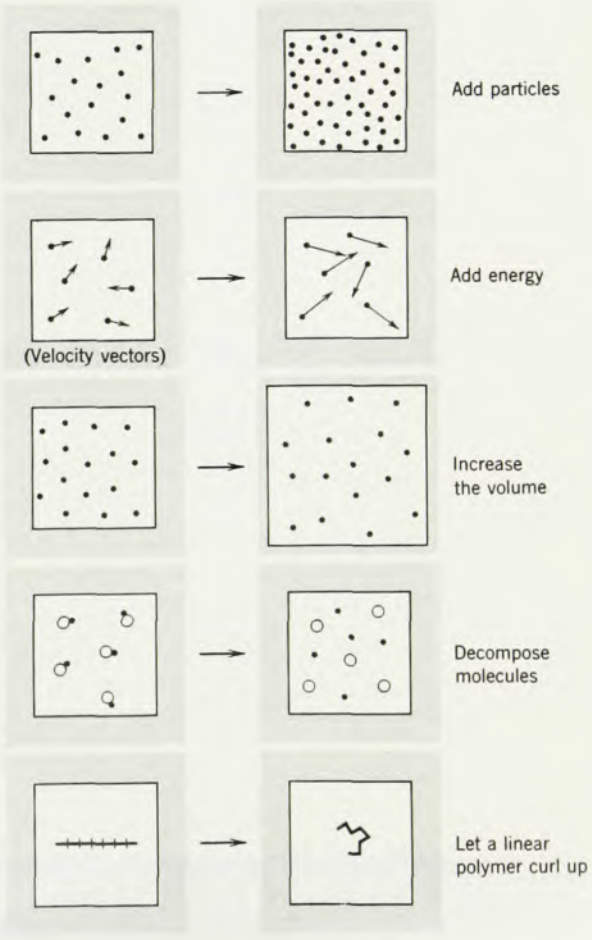
It is essentially a book about statistical mechanics, with classical mechanics reduced to a strictly subordinate role. The statistical treatment is developed for systems with quantized energy states, for, as Kittel says in his preface, "thermal physics is a remarkably easy subject if taught from a consistent quantum viewpoint in which we think of states of an entire system, however large or small."

The development leads swiftly and painlessly through definitions of entropy and temperature in terms of the number of quantum states accessible to the system and to the chemical potential and partition functions, both grand and ordinary. Consideration of special cases then leads to the Fermi–Dirac and Bose–Einstein statistics. There is an excellent discussion of the behavior of quantum systems in the classical limit, and some welcome remarks about the difficulty of trying to construct a truly classical form of statistical mechanics, that is, one where Planck's constant does not appear. An unusually wide range of applications is discussed; it includes biology, chemistry and astronomy as well as the more familiar physical ones. The account of Bose–Einstein condensation is by far the clearest and most useful elementary discussion I have seen. Throughout, a considerable sophistication of physical thought is attempted, but the mathematics is always minimal, so that the subject can be taught at an early stage.

One interesting innovation is the way the student is introduced to the statistical behavior of systems of many particles. Instead of the usual hand-waving arguments, he is given the exact solution of one particular problem, that of a large number N of independent particles, each of which can exist in either of two states corresponding to different orientations of its magnetic moment. The number of states of the system giving the same total magnetic moment is found, and the overwhelmingly high probability of the most probable distribution demonstrated. The same model and the same mathematics are then available for discussions of fluctuation phenomena.

All this is excellent, but there are two major things about the book that I disliked. The first of these is the treatment of classical thermodynamics, which is too condensed and too scattered to give any appreciation of its problems or of its power. It is never quite clear what reliance Kittel is placing on the laws of thermodynamics. In a quotation from Gibbs at a chapter heading we find: "The laws of thermodynamics may easily be obtained from the principles of statistic mechanics, of which they are the incomplete expression." This might lead one to think that he will prove the laws, or at least try to do without them. In fact he appears to use the laws, but without admitting that he does so. In the case of the first law this is very clear; the existence of an energy function for any physical system and the conservation of energy are assumed at an early stage without comment. As for the second law, it never became clear to me whether it had been assumed, proved or rendered redundant. I think the author should have told us.

My second grumble is quite a different one. The experience of many teachers of statistical mechanics is that



ENTROPY. This figure, which shows five factors that increase the entropy of a system, is taken from *Thermal Physics*.

ELECTRON BEAMS, LENSES AND OPTICS

Volume 1

by A. B. EL-KAREH, Department of Electrical Engineering, Syracuse University, and J. C. J. EL-KAREH, Syracuse, N. Y.

Volume 1 treats the ideal case where all lenses are assumed to be free from errors. It presents a thorough mathematical analysis of the electrostatic immersion lens, both symmetrical and asymmetrical, and covers the Einzel lens and the symmetrical magnetic lens in detail.

CONTENTS: Electron Beams and Light Rays. The Paraxial Ray in Symmetrical Electric Fields. Analytical Determination of Electrostatic Fields. General Properties of Electrostatic Lenses. The Electrostatic Immersion Lens. The Electrostatic Unipotential Lens. Optical Image Formation by Rotationally Symmetrical Magnetic Fields. The Symmetrical Magnetic Lens. References. Subject Index.

August 1970, about 407 pp., $22.50

Volume 2

Volume 2 presents a systematic coverage of aberrations. It analyzes the geometrical aberrations and treats the spherical and chromatic aberrations in great detail. The coefficients of spherical and chromatic abberation have been computed for a series of electrostatic and magnetic lenses and are listed in table form. The book also covers space charge and its effect on highly focused electron beams.

CONTENTS: Geometrical Aberrations of Lenses. The Spherical Aberration of Electric and Magnetic Lenses. Measurement of the Spherical Aberration of Various Electric and Magnetic Lenses. The Theory of Diffraction. The Influence of Space Charge in High Density Electron Beams. Chromatic Aberration. References. Subject Index.

September 1970, about 315 pp., in preparation

THEORETICAL MAGNETOFLUIDDYNAMICS

by HENRI CABANNES, Faculté des Sciences, Université de Paris, Paris, France

Translated by MAURICE HOLT, Division of Aeronautical Sciences, University of California, Berkeley, California

This book contains a thorough explanation of the theory of motion of compressible fluids under the influence of external or self-induced magnetic fields. The subject is treated from the macroscopic or continuum point of view and can be regarded as a generalization of the theory of nonconducting compressible fluids when electromagnetic fields are included. The subject is developed from first principles beginning with a complete derivation of equations of motion and shock wave equations. Later chapters deal with small disturbance theory, properties of MHD shocks, one-dimensional flows, and aerodynamic problems treated both from the exact and linearized points of view.

August 1970, about 230 pp., $12.50

MOLECULAR BEAMS AND REACTION KINETICS

edited by CHARLES SCHLIER, Universität Freiburg, Freiburg, West Germany

CONTENTS: CHARLES SCHLIER: Introduction. D. BECK: Collision Mechanics. D. BECK: Elastic Scattering of Nonreactive Atomic Systems. R. J. CROSS, Jr.: Vibrationally and Rotationally Inelastic Scattering. H. Gg. WAGNER: Relaxation Methods. D. R. HERSCHBACH: Reactive Collisions of Thermal Neutral Systems. J. ROSS and E. F. GREENE: Elastic Scattering of Reactive Systems. F. S. ROWLAND: Hot Atom Chemistry. A. HENGLEIN: Kinematics of Ion-Molecule Reactions. G. G. VOLPI: Gas-Phase Proton-Transfer Reactions. R. S. BERRY: Chemiionization. R. S. BERRY: Transfer of Electronic Excitation. J. ROSS: Nonequilibrium Effects in Chemical Kinetics. H. Gg. WAGNER: Rate Constants and Reaction Cross-Sections. F. S. ROWLAND: Experiments on Unimolecular Reactions: Theory. M. KARPLUS: Potential-Energy Surfaces. H. CONROY: Special Results in Potential-Energy Surfaces. D. L. BUNKER: Trajectory Studies. M. KARPLUS: Special Results in Trajectory Studies. J. ROSS: Quantum Theory of Reactive Scattering. M. KARPLUS: Special Results of Theory: Distorted Waves. D. L. BUNKER: Special Results of Theory: Compound-State Approaches.

This is Course 44 of the International School of Physics "Enrico Fermi."

1970, 437 pp., $20.00

ACADEMIC PRESS NEW YORK AND LONDON
111 FIFTH AVENUE, NEW YORK, N.Y. 10003

what students find hard is not the derivation of any particular form of statistics, but the understanding of when to use what. Why, say, do we use Fermi–Dirac or Bose–Einstein statistics for the translational energy distribution, but Boltzmann statistics for the rotational or vibrational energy? Why do helium atoms in liquid helium "condense" into their ground state but paramagnetic atoms in a magnetic field do not? These are just the sorts of topics that Kittel could explain so persuasively; it is most disappointing that no discussion is given. Without it, statistical mechanics tends to look like magic.

Greatly as I enjoyed the book, I am not at all sure that I would recommend it for the average student with no previous exposure to the subject, as is suggested. But I would certainly want able students with some experience to read it, and I regard it as essential reading for every teacher of the subject.

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University of Oxford

The Mathematical Papers Of Isaac Newton, Vol. III: 1670–1673

D. T. Whiteside, *ed.*
576 pp. Cambridge U. P., New York, 1969. $32.50

Here we have the third of eight projected volumes that will contain a complete scholarly edition of Isaac Newton's mathematical papers. This third volume fully maintains the high standards of scholarship and erudition that marked its two predecessors and that gained for its editor worldwide critical acclaim.

Derek T. Whiteside brings to his project a rare combination of mathematical acumen, editorial sensitivity and encyclopedic knowledge of the history of mathematics in the 17th and early-18th centuries. His edition (assisted by Arnold Prag and Michael Hoskin) of Newton's autograph manuscripts offers the historian not only the words and thoughts Newton meant finally to preserve, but also those that he struck out.

The facing English translations—the papers in the present volume are all in Latin—are at once faithful and eminently readable. Judiciously employing at times a more modern terminology, the translations enhance the value of the edition by making its contents available to readers lacking familiarity with 17th-century mathematical Latin. The richly detailed footnotes elucidate the mathematics and set forth, in outline at least, the historical context of Newton's thoughts, both in terms of his own development and in relation to the work of his contemporaries. They also guide the reader through the often bewildering complexities of Newton's mathematical world.

The 569 pages devoted to the short period of three years in Newton's early career testify more to the profundity than to the prolixity of his achievements during that time. Indeed, the bulk of the volume is taken up by one treatise (1671), "On methods of series and fluxions," in which Newton sought to unite, polish and extend his earlier papers on fluxions (1666) and "On analysis by equations with an infinite number of terms" (1669).

A
TREATISE
OF THE
METHOD of FLUXIONS
AND
INFINITE SERIES,
With its Application to the Geometry of CURVE LINES.
By Sir ISAAC NEWTON, Kt.
Tranſlated from the *Latin* Original not yet publiſhed.
Deſigned by the AUTHOR for the Uſe of LEARNERS.
Hac via inſiſtendum eſt.
LONDON:
Printed for T. WOODMAN at *Camden's Head* in *New Round Court* in the *Strand*; and J. MILLAN next to *Will's Coffie Houſe* at the Entrance into *Scotland-Yard*.
MDCCXXXVII.

A mere glance at the editor's extremely helpful and analytical table of contents of the treatise reveals the brilliance of Newtons' achievement. It reads as an inventory of the research problems of 17th-century mathematics, united in solution by one systematic approach. Though it later circulated privately, the treatise remained unpublished in Newton's lifetime.

In an enlightening introductory commentary, Whiteside discusses Newton's original plans to publish the work. He provides evidence that, in addition to booksellers' reluctance to print mathematical works that at the time were largely unsaleable, Newton's plan fell victim to the rancorous dispute engendered by the 1672 publication of some of Newton's optical researches. Into the resulting self-imposed exile, broken only in 1687 with the publication of the *Principia*, Newton took with him his mathematical masterpiece.

Newton's appointment in the fall of 1669 to the Lucasian Professorship led him increasingly to focus attention on optics. Following a short collection of miscellaneous mathematical memoirs from 1670–73 (including a paper on harmonic motion in a cycloidal arc), Whiteside publishes, in the third main section, mathematical excerpts from Newton's lectures and research papers in geometrical optics. The volume concludes with a summary by Whiteside of the mathematical content of Newton's correspondence during the three years. No texts are presented here, since Whiteside can and does base his report on the modern edition of Newton's correspondence by Herbert W. Turnbull, to whose memory this volume is dedicated.

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Relativity

***By* Ray Skinner**
340 pp. Blaisdell, Waltham, Mass., 1969. $12.50

There has been a deluge of books on relativity in the last few years, and as is well known these have varied greatly in quality and usefulness. A few have been highly worthwhile, but a number appear to have been written in the hope of finding a place in the many revised curricula now in vogue for general physics courses.

Ray Skinner's book is superior to most of these recent volumes. It is part of a projected five-volume set for a standard two-year general physics sequence of courses. The first volume of the set is *Mechanics*, the book under review is the second volume