of polytypes (chapter 6). There is also a chapter on dislocations and the spiral growth of crystals. On surveying the subject, one is inclined to agree with the authors' conclusion that a very large number of factors influence the phenomenon of polytypism: the temperature and rate of crystallization, the presence of impurities, the screw and edge dislocations created during growth, the thermal vibrations of the structure, and the electron energy-band gaps. The theories so far advanced are all based on one or another of these factors only, and are therefore unable to provide a satisfactory explanation of all the observed facts. The need for a single consistent theory of polytypism embracing all these factors is clearly a desirable objective.

Verma, who is director of the National Physical Laboratory, New Delhi, India, is well known not only for his many scientific contributions using x-ray diffraction and optical techniques to study the defect structure of crystals, but also for his earlier book *Crystal Growth and Dislocations*, published in 1953. Verma was among the first to photograph molecular growth spirals on crystals by phase contrast microscopy. The heights of the steps of growth spirals are intimately related to the structure of the crystal and thus to the magnitude of the Burgers vector of the dislocation that can form in the structure, and its polytypes (if any). Krishna is a lecturer in physics at the Banaras Hindu University, Varanasi, India, where he obtained his PhD; he worked at the Cavendish Laboratory and has done research on the structure of silicon carbide. In fact, the book, which constitutes the first in a new Wiley series, Monographs in Crystallography, edited by M. J. Buerger, is based on his PhD thesis.

There are in the book many illustrations, both line drawings and photographs, all of good quality. The subject index as well as the name index seems quite complete, although Paterson's name, which appears in three places (pages 267, 293 and 330) is each time spelled incorrectly with two t's—perhaps a rather trivial point, since the authors are to be highly commended for writing a very comprehensive and well documented text on the subject of polytypism. Literature on this subject has been scattered among a number of journals in the diverse fields of crystallography, physics, mineralogy, chemistry, geology, metallurgy, etc., each presenting a different aspect of the problem. The authors' aim to present a single collected account of all the different aspects of the problem may be regarded as particularly successful. Stress is placed more on the underlying physical principles involved than on elaborate mathematical treatments. Each aspect of the problem is described from a sufficiently elementary level for it to be intelligible to one comparatively unacquainted with this field. The volume is intended to be completely self-sufficient, and the various developments are effectively presented so as to maintain continuity of thought rather than chronological order. Indeed, the subject matter of the book is such that we may expect it to be the forerunner of polytypes to come!

* * *

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Coulomb excitation and symmetry

COULOMB EXCITATION. By L. C. Biedenharn and P. J. Brussard. 334 pp. Clarendon Press, Oxford, 1965. Paper $6.40

by E. Guth

Coulomb excitation of nuclei is less than fifteen years old. It contributed greatly, and still contributes importantly, to our knowledge of nuclei. Use of the well known electromagnetic interaction avoids the complications of the nuclear-force problem. Thus, nuclear structure can be studied directly, using protons, heavier ions and electrons. The "modern phase" of Coulomb excitation went hand in hand with the development of the unified rotational and vibrational nuclear model by the Copenhagen group. In particular, the collective enhancement of nuclear quadrupole transitions, predicted by the unified model, accounted for the comparatively easy observation of such transitions. Experimentally, it was aided by the then new (1952–53) sodium iodide crystal detectors.

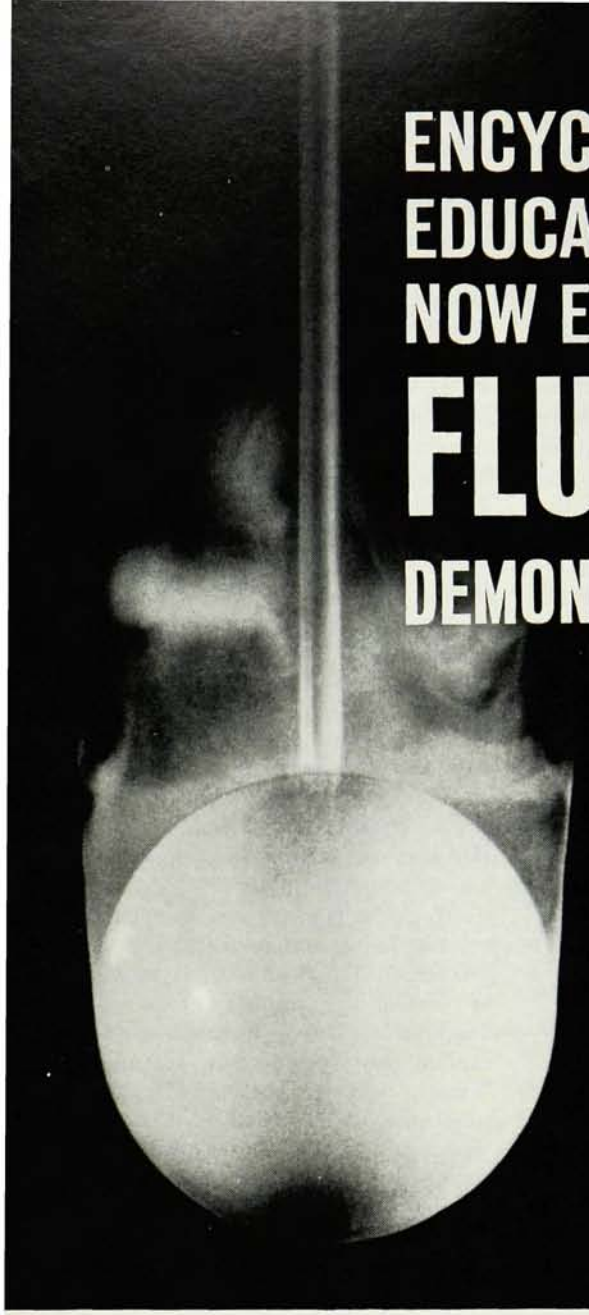
The rapid early development of Coulomb excitation was admirably summarized in the "classic" article in *Rev. Mod. Phys.* by the Copenhagen group. The present very comprehensive book by two experts (L. C. Biedenharn is at Duke University and P. J. Brussard at the University of Utrecht, Holland) is a most worthy successor to that older review and is destined to become a "classic" also. The distinguishing feature of the authors' treatment is the full use of the *symmetry* properties of the Coulomb field. The symmetry groups of the Coulomb problem are the four-dimensional rotation group and the Lorentz group for negative and positive energies, respectively. Such invariance groups are often discussed these days in connection with symmetries of elementary particles.

The book starts with an historical introduction. This is very commendable, as often in physics the historical development is forgotten. Semiclassical and full quantum calculations are presented next. The basis is, wherever possible, the symmetry of the Coulomb field. This symmetry is used to explain the occurrence of the many "exactly soluble" Coulomb-excitation problems. More involved Coulomb processes, like direction-polarization correlation, triple correlations, etc., are thoroughly discussed, followed by multiple Coulomb excitation. The experimental pursuit of the latter was facilitated by the advent of heavy-ion accelerators.

Excitation of high-energy electrons is reviewed next. Finally, there is a short but meaty chapter on nuclear structure in the context of Coulomb excitation. There are many original twists of problems treated before and also many new developments in the book.

The documentation is extensive and authoritative. The reviewer noticed only one small error (on page 312, note 72, the Lorentz group should have been omitted). Although the book is mostly theoretical, comparisons with experiments are made and references to experimental papers are given.

In view of its stress on symmetry, this book should be of great interest



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not only to nuclear physicists, but also it forms excellent supplementary material for a course in quantum mechanics. It will be helpful collateral reading for a course in elementary particles, because of its thorough discussion of Coulomb symmetry.

* * *

E. Guth, who did some of the early theoretical work on Coulomb excitation, is technical advisor to the Director of the Oak Ridge National Laboratory.

Getting at the "physics"

EXPERIMENTS IN MODERN PHYSICS. By Adrian C. Melissinos. 559 pp. Academic Press, New York, 1966. $11.75

by Fay Ajzenberg-Selove

This is an excellent and much needed book. It describes the one-year junior-senior level course in experimental atomic and nuclear physics given at the University of Rochester. The Rochester course is one of the most interesting and sophisticated of the laboratory courses given in this country and Melissinos's book will be a boon to teachers attempting to set up similar courses elsewhere. The arrangement of the material is very good; each section discusses the general theory of the phenomenon to be investigated, describes the apparatus, comments on pitfalls and finally shows and analyzes typical data obtained by a student experimenter (who is credited in a footnote). The equipment used is commercial whenever possible; home-built apparatus is described in some detail. The emphasis in the course is to get at the "physics" of the experiments using modern techniques and research-grade equipment. The experiments at Rochester are performed over a three-term period. Many of the experiments can be done in one afternoon. Most take no longer than two or three weeks. This means that over the three-term period a considerable number of different experiments can be performed. The variety of the experimental work is great. It ranges from the standard experiments on the measurement of e, h/e and ionization potentials to very modern experiments on time-coincidence techniques. The experiments include studies of atomic spectra, some solid-state experiments, scattering experiments (Rutherford, Compton, Mössbauer), and magnetic-resonance experiments. In addition to a description of these, the book includes "background" chapters dealing with general experimental techniques (electronic, vacuum, radiation), with detectors of photons and particles and with statistical problems. There are also eight appendices dealing with standard physical data and with relativistic transformations. One of the appendices shows a typical Fortran program for least-squares fitting.

Each instructor would probably have a somewhat different view of the most useful collection of experiments to be performed by his own students. My own tastes would run to replacing some of the experiments by ones dealing with x-ray crystallography, lasers, the analysis of bubble-chamber film (e.g. to determine the mass of the Λ°) or of photographic emulsions (e.g. to determine the π mass from a study of π-μ decays), and most of all I would emphasize computer techniques more in analyzing the data. But Melissinos's selection is entirely reasonable and the range of his book is such that it will be an extremely useful book to most physics professors and to their students also, both undergraduate and graduate.

* * *

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Vital functions

GENERALIZED HYPERGEOMETRIC FUNCTIONS. By Lucy Joan Slater. 273 pp. Cambridge University Press, Cambridge, England, 1966. $13.50

by Werner C. Rheinboldt

The theory of the Gauss hypergeometric series began some time in the 18th century, and by now the great importance of these functions in the applications of mathematics to physics is certainly undisputed—if only for the well known fact that a large number of the functions used in mathematical physics are special cases of the hypergeometric functions or their confluent forms.

Throughout the past 150 years various generalizations of these series have been investigated. These include the so-called generalized Gauss series ${}_AF_B(a_1, \ldots, a_A; b_1, \ldots, b_B; z)$ of which the ordinary Gauss series is the special case $A = 2$, $B = 1$, the bilateral series first investigated by Dougall in which the summation extends from $-\infty$ to $+\infty$, and the double and multiple series named after Appell and Lauricella. A generalization of a somewhat different type was given by Heine who introduced the so-called basic numbers, defined by $a_q = (1-q^a)/(1-q)$ so that in the limit as $q \to 1$, $a_q = a$, and considered series, called basic hypergeometric series, which for $q \to 1$ ($|\, q \,| < 1$), converge to ${}_2F_1(z)$. For each of the mentioned generalizations a corresponding definition of a generalized basic series can be given.

In 1936, Bailey wrote a Cambridge tract entitled *Generalized Hypergeometric Series*, which has by now become a classic and which gave, for the first time in book form, an account of the results then known about these generalizations. Since then the research in this field has continued steadily and considerable advances have been made, with the result that the need for an up-to-date comprehensive work on these generalized functions has become very apparent. Already fifteen years ago, Bailey, with the assistance of the author of this book, planned such a comprehensive book, and after Bailey's death the author continued this plan singlehandedly. This book represents the fruits of these efforts.

Following an introductory chapter 1 on the ordinary Gauss series, the generalized Gauss functions ${}_AF_B(z)$ are introduced in chapter 2, and then the various summation and transformation theorems connected with such names as Gauss, Kummer, Saalschutz, Dixon and Dougall, are presented.

Throughout the book, the theory of the standard and of the basic generalizations are developed in parallel, and each chapter is followed by a corresponding chapter on the basic series. Accordingly, chapter 2 is followed by chapter 3 on the basic hypergeometric (Gauss) series. Here the infinite product $\Pi_{n=0}^{\infty}(1-aq^n)$ the inverse of the Euler partition function, plays a role similar to that of the gamma