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samples large enough for most physical measurements. By means of Rupprecht's technique, films of arbitrary size and thickness can be formed; adjacent threads agglomerate while drying and form a homogeneous material.

Rupprecht has since refined his method, and samples of oriented DNA have served in a range of studies of potential importance for a better understanding of the genetic material and for verification of quantum chemical theories. Rupprecht's preoccupation has been with the orientation technique; most of the physicochemical studies are being made in cooperation with other specialists.

Conductivity (d-c) measurements on dried oriented DNA have shown semiconductor characteristics of the DNA helix, such as were postulated by A. Szent-Györgyi, and, in agreement with results from unoriented DNA, reported by several other investigators. However, there is no marked anisotropy in the conductivity of the oriented DNA; Rupprecht attributes this negative result to structural changes that occur in the DNA during drying.

Using moist films for studies of hydration of DNA, Rupprecht has found a dependence of the proton magnetic resonance signal on the orientation of the DNA helices in relation to the magnetic field. The result is strikingly similar to that obtained for collagen by H. J. C. Berendsen of Groningen, who explained the effect by postulating chains of water molecules in parallel alignment with the collagen fibers. Rupprecht and Berendsen's group plan to cooperate in further work in the oriented DNA. At the Medicinska Nobelinstitution in Stockholm, A. Ehrenberg has begun studying electron spin resonance in moist oriented DNA samples that have been frozen, and afterward irradiated with gamma rays from a cobalt-60 source. He, too, has found marked dependence of amplitude on the orientation of the DNA helices in the magnetic field. So far, identification of thymine radicals has been reported, and the work is continuing with DNA moistened with heavy water (D₂O), in the expectation that other radicals will be identifiable and that the mechanism of their formation by irradiation may be elucidated.

Measurements of the mechanical properties of the oriented DNA threads and films, and their dependence on spinning conditions, provide Rupprecht with a basis for systematic development of his technique. He has found that the tensile strength of the fibers are markedly dependent on temperature. At present he is engaged in developing thin fibers for high-resolution X-ray diffraction studies, and thin films for use in research on the optical properties of oriented DNA.

A final example of the techniques originating in Hedén's group is E. A. Falch's "one-dimensional" culture for automatic screening of microorganisms. He uses a strip of newly solidified agar containing various nutrients and inoculated along its length with bacteria. The agar is carried into an incubator on a moving surface—a polypropylene belt in the original tests. Zones of growth or inhibition can be detected optically when the agar emerges from the incubator. The uses envisaged range from labor-saving selection of microbial strains that synthesize a particular compound, to automatic identification of microorganisms. The technique was first demonstrated in 1965, but it still awaits full development.

Requests from other laboratories for various items of equipment developed by the Karolinska bioengineering group overtaxed their workshop. In 1966, a company, Biotec, was created to manufacture some of the specialized equipment developed by Hedén and his group. The company has been successful and has established branches in the United States, Britain, and Japan. Biotec, is, incidentally, one of the companies sponsored by Incentive AB, a new Swedish financial enterprise dedicated to encouragement of new industry, with emphasis on science-based activities.

The Project for Applied Microbiology, within the scope indicated at the outset, will be concerned with trouble-shooting and ad hoc research for industrial clients, and also with long-term research on its initiative. As an example of a long-term project, it will take over work, already in progress in the bioengineering group, on culture of methane-fermenting bacteria as a potential source of protein-rich food. Fast-growing strains and appropriate media have been found, but the principal bioengineering problem is one of gas transfer—of oxygen as well as of methane—to the culture. Algal species may have earlier application, if problems of harvesting and food technology can be solved. Hedén is particularly interested in Spirulina, "discovered" by Belgian and French microbiologists as an algal species that Africans in Chad have eaten for centuries. Spirulina is particularly easy to harvest because the helical form of the alga tangles the crop into strong mats. One of the first activities of the project will be to convene a meeting on Spirulina cultivation to help establish a coordinated research program in this area.

Hedén was the instigator of two conferences on Global Impacts of Applied Microbiology, the first in Stockholm in 1963 and the second in Addis Ababa in 1967. The conferences were convened to draw attention to microbiological needs of the developing countries. The international outlook of the Project for Applied Microbiology is best illustrated by the so-called BIORED scheme (biological resources development teams), which will become its responsibility. This scheme was first proposed by the bioengineering group in 1965 as a contribution to the International Biological Program. A feasibility study, in Ethiopia last year, indicated the form which the first of such operations might take (a base laboratory and a mobile unit in a 2-ton truck) and disclosed a range of local studies of practical importance in Ethiopia. At present the scheme is waiting for the necessary arrangement between the Swedish and Ethiopian governments.—NIGEL CALDER

RECENT DEATHS

Louis G. Austin, 54; professor of biology, Virginia State College, Norfolk; 29 February.

John M. Boutwell, 93; former president of Society of Economic Geologists; 2 March.

George E. Boxer, 53; executive director of the Merck Institute for Therapeutic Research; 14 March.

L. Beverley Chaney, 77; retired clinical professor of neurology, Columbia University College of Physicians and Surgeons; 12 March.

Herbert G. Deignan, 61; ornithologist emeritus and honorary research associate of the vertebrate zoology section, Smithsonian Institution; 15 March.

McKay Donkin, 63; vice president for finance and treasurer of Pennsylvania State University; 17 March.

Rudolph E. Langer, 74; chairman emeritus of the mathematics department, University of Wisconsin, and former director of the U.S. Army Mathematics Research Center; 12 March.
Record or his memory, neither of which is infallible. A single alphabet would appear to be the best remedy for these difficulties.

The book is liberally illustrated with line drawings, a large percentage of which have been excellently reproduced from other publications. Many of them, however, are the original work of Anthony d'Attilleo.

This is the largest phylum that Hyman has attempted to cover in The Invertebrates, and there were those who criticized her for attempting it; indeed, it required ten years to complete more than half the group. Mollusca II and subsequent volumes are to be edited by Joel Hedgpeth. Libbie Hyman is retiring from the field, in her own words, “satisfied that I have accomplished my original purpose—to stimulate the study of invertebrates.”

Joseph Rosewater
Division of Mollusks,
U.S. National Museum,
Washington, D.C.

Chemistry Series


This volume is the first of a contemplated series in which established investigators in high-temperature chemistry are to present topical reviews of emerging areas of knowledge in the field.

Volume 1 consists of nine articles written by 16 contributors and is concerned primarily with the properties and reactions of chemical species existing at high temperature. Fundamental and theoretical aspects of the subject are given about equal space with the experimental and practical. This publication will be of interest to physicists, metallurgists, and ceramists as well as to chemists who are concerned with the atomic and molecular aspects of high-temperature reactions.

The contributors to this volume are R. F. Barlow, Joan B. Berkowitz-Mattuck, Alfred Büchner, K. Douglas Carlson, C. J. Cheetham, Charles R. Claydon, J. B. Ezell, Paul Goldfinger, D. L. Hildenbrand, J. L. Margrave, Thomas B. Reed, J. C. Thompson, R. J. Thorn, P. L. Timms, Edgar F. Westrum, Jr., and G. H. Winslow. The diverse subjects discussed include (in high-temperature context) the spectroscopy, electronic structure, and valence states of molecules, including primarily transition element molecules; alkali metal halide molecules and their bond relationships; some unique possibilities for chemical syntheses; adiabatic calorimetry, and plasmas. An extended definition of high-temperature chemistry is also given.

H. Tracy Hall
Department of Chemistry,
Brigham Young University,
Provo, Utah

Mineral Analysis


This book is a collection of about 250 electron micrographs of clay minerals and associated materials, with short descriptions of the minerals and of the principal features of the micrographs. An introductory section describes briefly the operation of electron microscopes and methods of sample preparation, but is too brief to add to what is readily available elsewhere. A final section gives comprehensive lists of references. A novel feature is the presentation of the text in English and in German in parallel columns; the English text has very few mistakes and these are of no consequence. The book is handsome, large (20- by 30-centimeter pages), heavy with glossy paper, and expensive.

The greater part of the book is devoted to micrographs and descriptions. Taken by itself, it is not much more than an elaborate picture book, but the preface indicates that three parallel volumes will appear in which the same materials will be examined by x-ray diffraction, infrared, and differential thermal methods of analysis. This ambitious project cannot be assessed until it is seen how the total information is integrated, but the reviewer has considerable misgivings as to whether it is a good policy to subdivide the information on the basis of experimental techniques. A subdivision on the basis of mineral groups, with all physical methods of analysis brought together and the results contrasted, would have enabled the authors to discuss many subtleties of structure and composition and how they are revealed by this or that method. It seems now that the investigator will have to surround himself with four massive volumes and make such comparisons for himself. The quality of the electron micrographs is generally good but not exceptionally so. The reviewer regrets that the authors did not include at least some of the outstanding micrographs obtained by other workers in their more specialized studies; the reader could then go to the literature and obtain additional information. Admittedly, this additional information is promised in the future volumes, but one wonders just how much can be achieved by the two authors and their assistants, however industrious they may be. In the present volume, there often seems to be a tiresome repetition of similar micrographs, but this may be justified later by the other data to be given. The reviewer greatly deplores the complete omission of electron diffraction data from this book, since electron diffraction and microscopy go together experimentally and together form a powerful method of investigating both form and structure. Will this be covered by a fifth volume? Taken by itself the present volume does not add greatly to what is already available. One hopes that the authors will eventually give a comprehensive integration of the whole subject matter and that the publishers will find it possible to produce the subsequent volumes less expensively.

G. W. Brindley
Materials Research Laboratory,
Pennsylvania State University,
University Park

Books Received


(Continued on page 104)
the single-cell level; it was clear from
the later sessions that the choice of
theories for assessing quantitatively
the changes caused by radiation in a
single cell is still very limited. The
search must continue for new assay
procedures and further efforts must be
made to improve the stoichiometry of
some of the methods already available.

H. Glubrecht proposed a vote of
thanks to the sponsors and Professor
Serpugi Crescenzi replied on behalf of
NATO.

The general consensus of opinion was
that a meeting of 40 to 50 persons cer-
tainly provides an opportunity for the
maximum interchange of information
and ideas in a way which is not possible
at a larger meeting.

A more detailed account of the meet-
ing is being prepared. Requests for
copies should be addressed to P. P.
Dendy, Department of Radiotherapeu-
tics, University of Cambridge. Tennis
Court Road, Cambridge, England.

P. P. DENDY
University of Cambridge,
Cambridge, England

Calendar of Events

Courses

Epidemiology, University of Minnesota.
16 June–6 July (funded by a USPHS
grant). Courses include fundamentals of
epidemiology and biostatics, epidemiology
of cancer and cardiovascular diseases, and
topics in infectious disease epidemiology.
Although primarily intended for teachers
of preventive medicine and epidemiology
in medical schools, registration is open to
postdoctoral fellows, graduate students,
and residents in departments of preventive
medicine in medical schools. Fee: $120.
(Dr. Leonard M. Schuman, Director,
Graduate Summer Session in Epidemi-
ology, University of Minnesota School of
Public Health, 1158 Mayo Building, Min-
nepolis 55455)

Fundamentals of Optics, University of
Rochester, a 2-week summer course. It is
an intensive course on optical engineering
and the underlying optical science; de-
signed for physicists and engineers in indus-
try and government laboratories. Par-
ticipants must have the equivalent of a
bachelor's degree in physics or engineer-
ing. Tuition: $400. (Fundamentals of Op-
tics, Institute of Optics, Bausch & Lomb
Building, University of Rochester, Roch-
est, N.Y. 14627)

Elements of Simulation, State University
of New York at Buffalo, 3–7 June. A
background in the use of digital computers
is desirable. Enrollment is limited to 40.
Fee: $175. (Office for Continuing Edu-
cation, Millard Filmore College, Hayes
A, State University of New York at Buf-
falo, Buffalo 14214)