tron transport in metal-flavoproteins. The sequence was derived from a very detailed study of the kinetics of appearance and decay of ESR signals attributable to flavin, molybdenum, and iron. A direct interaction between the flavin semiquinone and the metal ions was suggested by saturation experiments. A potential use of NMR in the study of helix-coil transitions of nucleic acids and polynucleotides was discussed by C. C. McDonald, W. D. Phillips (Du Pont), and S. Penman (M.I.T.).

The third category of studies—the biological applications *sensu proprio* of at least ESR (comparable applications of NMR are virtually nonexistent)—was surveyed by B. Commoner (Washington University), who also gave an illustration of ESR as a diagnostic tool for differentiating medical from surgical jaundice. Among the several interesting reports which followed—notably those of E. Weaver (Stanford), R. Ruby (University of California), and A. Ehrenberg (Nobel Institute)—there emerged a disquieting lack of consensus concerning the significance of the observations. Despite the masterful exercise of the art of chairmanship by M. Kamen (U.C.S.D.) and B. Chance (University of Pennsylvania), the discussion often became heated and left one wondering whether the abundance of enthusiasm and technical know-how displayed by the ever-increasing number of pioneers in this area is really sufficient to cope with the very real handicap posed by the lack of uniquely identifying characteristics in most of the signals observed. A ray of hope for dispelling the reigning uncertainty was offered by H. Beinert, whose isotopic substitution experiments with Fe^{57} suggest that the heretofore unidentified signal at $g = 1.94$, frequently reported in biological materials, is indeed due to iron.

As N. Davidson (Caltech) pointed out in closing the last session, one may or may not agree with Thurber's dictum that it is better to ask some of the questions than to know all the answers, but one must acknowledge that some parts of the field have raised many questions with no answers in sight. Somewhat paradoxically, in view of the wave of popularity for biological applications of ESR, as compared with NMR, the latter emerges as contributing the proportionally larger share of generally applicable answers. The former continues to rely heavily on technical tours de force, hope, and promise. The meeting left little doubt that both branches of magnetic resonance spectroscopy are established as powerful tools for the study of molecular structure and molecular interactions even in rather complex, but chemically well characterized, systems. Beyond that, one treads the treacherous ground between the hope of dramatic discovery and the danger of having a vast investment of skill, labor, and funds rewarded by rather inconsequential observations. It is encouraging to observe, however, that the pure joy of a new adventure, which has dominated the field in its first years, is more and more tempered by careful consideration as to whether the questions one is asking are indeed answerable, or, for that matter, worth asking.

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Estuaries

Inshore and estuarine waters are of importance to man for various reasons, including their value as a source of food and recreation. However, with the continuing and extensive development of coastal areas it has become evident that our fundamental knowledge of the estuarine and coastal environments is not keeping pace with the need to resolve the practical problems evolving from their intensive exploitation.

The increasing need for a more comprehensive understanding of estuaries and adjoining waters and the lack of an adequate mechanism to foster an exchange of ideas concerning estuarine research stimulated the development of the Conference on Estuaries—the first one ever held on this subject—which took place on Jekyll Island, Georgia, during the period 31 March–4 April 1964. Its objectives were (i) to provide an opportunity for an interdisciplinary exchange of ideas between individuals and groups active in estuarine research; (ii) to critically summarize the status of knowledge relating to the natural characteristics of estuaries; and (iii) to delineate the direction of current research efforts in the estuarine environment.

The program was organized in a series of plenary sessions interspersed with 15 concurrent symposia; participants were selected to provide coverage of present knowledge of estuarine phenomena, as well as current research activities. There were nearly 90 invited participants and observers, including representatives from Mexico, Germany, the Netherlands, England, France, Australia, Denmark, Nigeria, Canada, Spain, the Republic of South Africa, Norway, Portugal, Italy, and New Zealand. Approximately 500 registrants and about 50 nonregistrants were in attendance at the conference. Six manufacturers displayed a wide variety of their newest equipment designed for estuarine research.

The topics treated by the papers were extremely broad and included the origin of estuaries, circulation, sediment transport and sedimentation, sediment geochemistry, instrumentation, physiology of estuarine animals, fisheries, plankton, benthos, microbiology, nutrients, organic detritus, pollution, and related subjects.

In a symposium on geomorphology and coastal processes arranged by James A. Steers, the transient nature of estuaries was discussed. Examples were taken mainly from Great Britain, because the island has numerous estuaries of various types with records that assist in understanding the changes that have taken place in estuaries during the last 4000 years. Axel Schou presented information on estuarine conditions along the North Sea coast of Denmark. Since 1931, this area has been studied in detail as an integral part of research as a base for reclamation projects. The regional characteristics of Australian estuaries were reviewed by J. N. Jennings in terms of major dynamic factors: river regimes, wave conditions, tidal ranges, vegetation effects, dune formation, and neotectonism. The question of the origin of sediments in estuaries was discussed by Andre Guilcher. Early Dutch investigations suggested that estuarine mud was derived from the sea. However, studies in other areas have demonstrated that estuarine muds may originate from tidal erosion of deposits covering the lower parts of the slope or from inland sources. These differences can be ascribed to contrast in supply of sediments by rivers and in hydrological structure of estuaries.

The processes and nature of estuarine sedimentation were the subject of

two symposia sessions. A paper presented by Hans-Erich Reineck was particularly well received, as it was the first opportunity for many people in this country to hear this well-known German marine geologist. Reineck discussed the processes of formation, as well as the nature, of sedimentary structures in shallow-water sediments. The sedimentation in a particular environment is influenced by the type of deliverable sediment, physical processes and their intensity, rate of sedimentation, and biogenetic factors. The role of organisms in forming certain structures and destroying others was emphasized. K. O. Emery chaired a lively panel discussion which followed the formal papers.

The symposium on the role of detritus in estuaries, organized by Rezneat Darnell, was of particular interest to many biologists because of the recognition of dissolved and particulate organics as an important component in some aquatic food chains. Organic detritus was broadly defined as any material of biological origin which is in the process of microbial decomposition and which represents a potential energy source for consumers. Criteria were established for demonstrating nutritive significance of organic detritus, and the nutritive roles of various types of detritus were discussed. Investigations of particulate detritus in Georgia estuaries was reported by Eugene Odum and Armando de la Cruz. They indicated that the detritus derived from the *Spartina alterniflora* marshes is the chief link between primary and secondary productivity, because only a small portion of the net production of the marsh grass is grazed while in the living state. Results of the study demonstrated that the bacteria-rich detritus is nutritionally a better food source than the *Spartiana* tissue that forms the original base for the particulate detritus. Grover Stephens reviewed his work on dissolved organic material as a nutritional source for marine and estuarine invertebrates. The maldanid worm, *Clymenella torquata*, was provided with labeled glucose and amino acids. Measurements indicated that the free amino acids in the environment can make a very substantial contribution to the total requirements for reduced carbon in these worms. Studies of the relation between salinity and the accumulation of glycine in nereid polychaetes demonstrated that the process of uptake virtually stops at lower salinities. Such studies suggest that the accumulation of small organic molecules may represent an important source of reduced carbon for invertebrates in marine and estuarine environments.

The conference on estuaries reached a large, interdisciplinary audience and attracted outstanding talent to share knowledge, experience, and opinions with fellow workers and others in allied fields. Papers from the meeting will be published in the AAAS Symposium Series.

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Bacterial Structure and Replication

The fine structure and replication of bacteria and their parts was the main theme of a bipartite symposium during the 64th annual meeting of the American Society for Microbiology held in Washington, D.C., 6 May 1964. The purposes of the symposium were consideration of current knowledge, inclusion of new information of general interest, and speculation for exploration of new areas. Microbiologists from several European countries and Canada participated. Each of five invited speakers dealt with an aspect of bacterial anatomy or replication; and each was followed by an invited discussant who supplemented, complemented, or sometimes dissented from, the information given.

In discussing the cell surface, and particularly the arrangement of cell wall components, R. G. E. Murray (University of Western Ontario) contrasted the great variety of regular substructure seen in walls of gram-negative bacteria with the paucity of such organization in gram-positive organisms. He presented examples of elegant substructure in walls of *Spirillum, Rhodospirillum, Halobacterium, Lampropedia*, and *Nitrocystis*, and in the gram-positive exception, *Micrococcus radiodurans*. From two to five different layers of wall may often be distinguished; the correlation between the electron microscopic appearance and chemical information on different layers appear to be good. Photographs of true septal ingrowth in *Escherichia coli* during growth at elevated temperatures were shown, together with that of a mesosome. This was compared with the usual concept of "constrictive division" in gram-negative bacteria (as exemplified by *Nitrosomonas*) and of the idea of the lack of typical mesosomes in gram-negative organisms.

The lack of regular structure in the wall of gram-positive organisms was emphasized by P. Gerhardt (University of Michigan), who reviewed electron micrographic and permeability data. He indicated that a random meshwork of molecular strands and subsequent "heteroporosity" existed in the walls of bacilli. However, special techniques demonstrated that the exosporium consists of four close-packed layers, each with a hexagonally punctate lattice. Hair-like protrusions arise from the outer surface. Orderly structure would thus seem not to be limited to organisms of a particular staining reaction, even though such structure may not be usually nor readily apparent and may not necessarily occur in walls of vegetative cells.

G. W. Fuhs (University of Koln) reviewed the evidence suggesting that the bacterial nucleoid contains not more than one DNA unit of extended length, 1100 to 1400 μ, in the form of a closed circle and consisting of not more than two polynucleotide strands. He emphasized the continuous replication of DNA and its simultaneity with nucleoid separation. He demonstrated by serial sections the effects of different fixations on preservation of the architecture and detail of the nucleoid. Evidence from serial sections suggests that the DNA molecule (or "bacterial chromosome") may not be folded and refolded to form a true multistranded ring, but instead may be a series of fibrils linked together by proteins as in Kellenberger's model. Despite the intimate contact of nucleoid and cytoplasmic membrane—usually through the mesosome—the failure to see any special structure or arrangement at the point of contact led Fuhs to suggest that the mesosome does not play an active role in nucleoid division.

P. C. Fitz-James (University of