a great deal needs to be known about the significance of genetic alterations before interpretations can be made. What does a chromosome break mean? Are all breaks initiated the same way? Are some mutations due to failure of repair? Are mutations due to direct damage of the nucleic acid or to breakage of protein backbones, or to secondary factors? Are all breaks harmful?

It was agreed that much more basic work on mechanisms and interpretation of genetic alterations is needed, but that this, in itself, is not likely to solve the problem. More trained pharmacologists are needed in the field of genetics in order to extend the basic findings to the practical level of human utilization.

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Notes

1. Participants in the conference included: Bruce Ames, Berkeley, Calif.; John Burns, Nutley, N.J.; Paul Calabresi, New Haven, Conn.; James Crow, Madison, Wis.; Kurt Hirschhorn, New York; Herschel Jick, Boston, Mass.; Robert Krooth, Ann Arbor, Mich.; Leonard Lerman, Nashville, Tenn.; Frederick Philips, New York; William Russell, Oak Ridge, Tenn.; and Margery Shaw, Houston, Texas.

Biological Oceanography: Models

The Committee on Oceanography, National Academy of Sciences–National Research Council, invited an ad hoc group of scientists to meet at the University of Washington at Seattle, 6–7 April 1968, to review the current status of the work on ecological models in biological oceanography and to advise on recent developments in quantitative modeling techniques that might be useful for studying marine ecosystems.

The review and initial discussion included the following points. Many of the ecological models in use today are too vague and ill defined to provide a solid basis for study of the structure and behavior of ecosystems. Food web diagrams, with their array of directional arrows even for a moderately diverse fauna, illustrate the difficulty of using a descriptive approach to determine biological productivity or policies of resource management.

Discussion of ecological models becomes more profitable when restricted to models susceptible to quantitative formulation and testing. The quantitative model provides an essential guide to the design of entire research programs so that submodels can be developed and validated by field observations and fitted into a larger model. Quantification of biological processes is essential if biologists hope to make effective use of chemical and physical information. Quantification and the use of standard mathematical terminology is also essential if biologists hope to communicate effectively with specialists in other disciplines.

The past accomplishment of ecological models in biological oceanography is to have provided insight into the organization and function of marine ecosystems, particularly of the plankton. It is doubtful that some of the present concepts could have been developed in the absence of these models. The models have served as a fertile source of ideas for laboratory experiments and the design of field-sampling programs. They have also helped to assess man's effects on the environment or populations. The models have further served the usual purpose of mathematical models in synthesizing fragmentary studies. Finally, they have been useful in teaching.

The group concurred that there are many opportunities for the application of mathematical models in biological oceanography as well as growing computer capabilities to aid the development of models, and noted that simulation models are not yet widely used in biological oceanography. The following most critical constraints to rapid expansion in the development and use of models were identified. They apply in part to ecology in general, and in part they are specific to the field of biological oceanography.

1) There is insufficient quantitative knowledge about functional relations such as the manner in which the demographic characteristics of a given species change with population density, or how the efficiency of food assimilation depends upon environmental factors.

2) Useful data for building detailed, comprehensive models, and for validating them, are scarce. The obvious way of directing the proper collection of data is through the stimulation and encouragement of model building, which will point to the data most needed.

3) There is no agreement upon the resolution required for a realistic ecosystem model. At one extreme are models of gross energy or mass transfer between trophic levels and, at the other, models that rival the complexity of nature itself by including numbers of individual animals of each species.

4) Biological oceanographers, with only a few notable exceptions, have made little advance in synthesis of the available knowledge. Marine ecosystems are so complex, and available information is so incomplete, that many people may regard prospects for meaningful synthesis to be poor. There is also a lack of examples demonstrating significant achievements with complex ecological models in biological oceanography. One outstanding exception is provided by the field of fishery population dynamics, where models important in resource management have been built for seals, whales, tuna, halibut, and salmon, among others.

5) Development and improvement of simulation models are usually multidisciplinary efforts, but there seem to be few people who can serve as leaders for such efforts.

6) It is doubtful that experience in ecological modeling is sufficient to support development of an ecological computer language, although a general language may be useful in the future. However, computer subroutines to assist biologists in modeling some general ecological processes would probably increase the use of simulation modeling techniques.

The following suggestions were considered to accelerate the development of quantitative modeling in biological oceanography. (i) Encourage specialists knowledgeable about the use of models in other fields to enter biological oceanography. (ii) Use models in teaching introductory courses in biological oceanography to reach students from other disciplines early in their careers. (iii) Publicize the potential of ecological models to those concerned with socially beneficial goals such as the conservation of renewable resources. (iv) Encourage agencies to establish or support interdisciplinary teams for developing computerized models that could be used to plan research and management for studying and eventually regulating total ecosystems. These teams should include theoreticians and experimentalists so that there is an interchange of suggestions derived from the model and from observations in the field or laboratory. (v) In the absence of groups active in quantitative modeling, consider holding a series of workshops to promote appreciation of this approach. These workshops could focus, for example, on acquisition of appropriate ecological and physical data, on methods of analysis such as new multivariate statistical methods not presently used in biological oceanography, or on development of models of specific ecosystems. The group was not able to reach an agreement that any one of these methods would be the most effective means of stimulating the use of modeling techniques in biological oceanography.

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Fluctuations in Superconductors

Many of the unique properties of superconductors, such as zero resistance, quantized flux, and Josephson tunneling, may be applied with extraordinary sensitivity to the measurement of voltages, magnetic fields, and infrared radiation. Superconducting tunneling devices may even provide the world's voltage standard. Are the sensitivity limitations of superconducting devices limited by intrinsic or extrinsic noise? Can a study of these noise processes help us to understand more about the physics of superconductors?

The Conference on Fluctuations in Superconductors was held at the Asilomar Conference Grounds, near Monterey, California, 13 to 15 March 1968, in order to consider problems of noise in superconductors. The conference was sponsored by the Office of Naval Research and the National Aeronautics and Space Administration.

Richard Ferrell (University of Maryland) discussed the fluctuation dissipation theorem, illustrating the way in which fluctuations can occur and the manner in which they are driven by external sources (a film illustrated the collapse of the Tacoma Narrows Bridge as a result of wind-driven fluctuations). As other examples of fluctuations he also discussed how gravitational waves could drive the quadrupole mode of the earth and the effect of light-scattering on an antiferromagnet.

In his talk on thermodynamic fluctuations, Ronald Burgess (University of British Columbia) emphasized that thermodynamic fluctuations do occur in superconductors (one might naively expect that superconductors should exhibit no thermal noise). All sources of energy must be included in an attempt to relate fluctuation power to the thermodynamic power per mode ($1/2kT\Delta\nu$). Using the two-fluid model, Burgess showed that in a superconducting ring the energy is the sum of contributions from the magnetic field, supercurrents, and normal currents. Burgess developed a Langevin equation to calculate the fluctuations of the wave function Ψ, the complex order parameter of the Ginzburg-Landau theory. There was much discussion on how the stochastic forces should be introduced into a Langevin equation. Burgess stated that the independent forces were those for the real and imaginary parts of Ψ; others felt that the amplitude and phase of Ψ might possibly be better choices.

The use of weak links and Josephson junctions as a quantum phase detector was discussed by James Mercereau (Ford Scientific Laboratories, Newport Beach, Calif.), James Zimmerman (Philco Aeronutronics, Newport Beach, Calif.), Lorin Vant-Hull (Ford Scientific Laboratories, Newport Beach, Calif.), and Bruce Ulrich (Ford Scientific Laboratories, Newport Beach, Calif.). Figure 1 shows noise data obtained with a superconducting interferometer. The properties of wide junctions were discussed by Douglas Scalapino (University of Pennsylvania), Allen Goldman (University of Minnesota), Michael Stephen (Rutgers University), and John Clarke (University of California, Berkeley). Wide junctions exhibit a pattern of critical current as a function of magnetic field which is quite different from that of the diffraction pattern shown by narrow junctions. Some of the special properties of the a-c Josephson effect, such as line width and plasma oscillations, were discussed by William Parker (University of California, Irvine) and Arnold Dahm (University of Pennsylvania).

Collective modes, particularly those of vortices in Josephson junctions, were discussed by Douglas Scalapino, Alexander Fetter (Stanford University), and Michael Stephen. The noise spectra of a Josephson junction can be represented as sums over the strengths of contributions of the various quasiparticles. Therefore, from a knowledge of what types of modes are possible, one can tell where to expect peaks and other dramatic behavior in noise spectra.

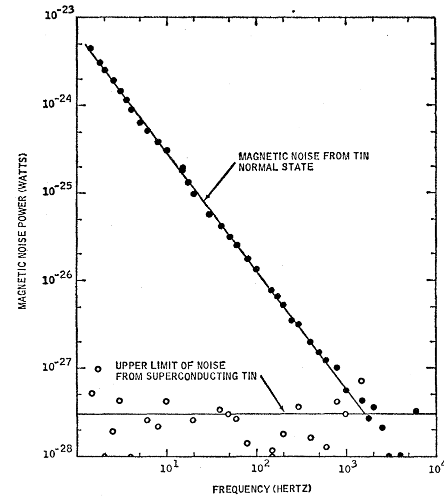

Fig. 1. Direct measurement of the change in the frequency spectrum of electronic thermal noise at the superconducting transition (L. L. Vant-Hull). Open circles represent measurements on superconducting tin, and solid circles represent measurements on normal tin. Experiments utilized a superconducting interferometer to determine the magnetic field produced by these thermal noise currents. The total noise power under the curve corresponds to 60 percent of the thermal energy at the sample temperature of 3.8°K; the remainder occurs below 1.5 hz. The observed power spectrum for normal tin is the result of the frequency-dependent skin depth.

Flux flow noise was the subject of talks by Frank Chilton and Gerard van Gurp (Phillips Research Laboratories, Einhoven, Netherlands). Flux flow occurs in many different kinds of instruments which contain superconductors. Flux flow noise is much larger than Johnson noise in metals in the normal state. The question of why the noise is so large and variable in one experimental geometry as opposed to another was considered. Some of the noise may be related to temperature fluctuations, as van Gurp has shown by the observed reduction in temperatures below the lambda-point of helium where the temperature stability is improved.

Interpretation of the observed noise spectra seems possible but puzzling. Van Gurp achieved reasonable agreement with his data by assuming a model of random and independent voltage pulses from each fluxoid (flux vortex). Chilton pointed out, however, that the pulses should not be considered independent but rather as part of a lattice which, if sufficiently extensive, could reduce the noise spectra.