DNA to bulk cellular RNA through inhibition of the RNA polymerase. This model accounts for the observation that a cell with a scant supply of amino acid makes fewer ribosomes and less protein. There is regulation of the translation of DNA to specific messenger RNA's (G. Attardi) because in the induction of both prophage and β-galactosidase the amount of specific messenger RNA was notably increased.

Based on experiments with bacterial mating and with prophage, F. Jacob proposed a model to account for the fact that each daughter cell gets only its fair share of DNA upon division. His model assumes coordination between the replication of DNA and the synthesis of cell wall, perhaps through an attachment of the two at one phase. When the DNA is fully replicated (in the form of two joined loops) the intruding cell-wall septum would destroy the joining point and thus deliver one complete loop to each daughter. Another aspect of regulation, given by B. Ames, refers to the ten-enzyme system of the histidine pathway. The ten enzymes are in different molar amounts in the cell, and the genetic evidence is that they are transcribed from one long messenger RNA. The suggestion is that the messenger RNA is read from one end to the other and that it contains occasional triplets for scarce transfer RNA's so that synthesis of enzymes from the far end of the messenger RNA occurs less frequently than at the starting end.

Allosteric interactions occur when a small molecule affects the catalytic activity of an enzyme by binding at a site other than its active one and causing a conformational change. Inhibition by end-products, and protection from this inhibition, can be achieved by allosteric effects. The conformational changes may extend even to varying degrees of aggregation and disaggregation of the enzyme molecule. Along similar lines is D. Koshland's model in which the substrate itself can induce conformational changes at the active site of the enzyme to increase its activity.

Complementation, as observed in enzyme systems, was shown by J. Fincham to exist in GDH formed by mutants of *Neurospora*. Incompetent GDH from mutants can be aggregated in mixtures to produce active enzyme, a result made plausible by the observation that wild-type GDH is an aggregate of several sub-units. D. Perrin and D. Zipser reported similar aggregation and activation phenomena with β-galactosidase; Zipser indicated possible in vivo complementation taking place on ribosomes. Complementation of alkaline phosphatase was shown by A. Garen, while M. Schlesinger found that complementation could be accomplished even when the defective enzymes came from different bacterial species. Evidently complementation of enzymes as observed in genetic crosses can be accounted for by a simple aggregation of two or more sub-units that are defective in different respects.

Two review papers on the RNA-protein coding problem were given by M. Nirenberg and J. Speyer. About 50 of the possible 64 RNA triplets are now assigned, a situation that clearly indicates degeneracy in a triplet code. Whether or not the code is ambiguous (one RNA triplet coding for more than one amino acid) was discussed, and some tentative evidence implied that an unambiguous code is inadequate. G. von Ehrenstein found that three separable leucine-accepting transfer RNA's (probably different in their codon triplets because of differing amino-acid incorporating activity), when tested with synthetic polyribonucleotides, incorporated leucine in the same position in synthesized hemoglobin and also in the coat protein of MS-2 phage. Such results indicate that a single triplet in the messenger RNA may be recognized by several transfer RNA's with differing codons. Difficulty has been encountered in fitting results on the analysis of the A protein of tryptophan synthetase of *E. coli* with the messenger RNA code letters derived from in vitro work (C. Yanofsky). In the A protein from mutants and revertants, seven different amino acids are substituted at the same site in the protein. No scheme of permuted, or changed, nucleotide composition in a messenger RNA triplet coding for this site, based upon the current coding scheme, accounts for the amino acid substitutions. An analogous situation exists in the analysis of the protein formed by nitrous-acid mutants of TMV-RNA, where, although there are no genetic data, H. Wittmann has not found it possible to fit a consistent coding scheme to all the 150 mutants whose proteins he has analyzed.

The field represented by the symposium subject is in feverish activity and it is both stimulating and not surprising that moderately conflicting results were reported.

The symposium, organized by H. E. Umbarger, was sponsored jointly by the Long Island Biological Association and (by invitation of the U.S. National Academy of Sciences) by the Commission on Molecular Biophysics of the International Organization for Pure and Applied Biophysics. Generous funds were supplied by several U.S. granting agencies.

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Hurricanes and Tropical Meteorology

The impact of the meteorological satellite, of high-speed digital computers, and of new and more sophisticated facilities for experimentation and analysis was evident in the recent technical conference on hurricanes and tropical meteorology held at Mexico City from 6 to 12 June. Attended by 125 scientists from the United States and from Central and South America, this was the third conference of this type to review research progress since the establishment of the National Hurricane Research Project by the United States in 1956. The meeting was sponsored jointly by the American Meteorological Society, the American Geophysical Union, and the Mexican Geophysical Union.

The 11 scientific sessions were devoted to discussions of large-scale flow patterns in the tropics, convection and air-sea-earth exchanges, precipitation and weather modification, and the development, structure, and prediction of hurricanes.

In reviewing the role of the tropics in the general circulation, Herbert Riehl presented the results of recent computations which indicate that, in the tropics, the meridional circulation is self-supporting and does not depend upon the energy of perturbations for its maintenance.

The development of more powerful computers has led to a more intense search for an effective means of describing numerically the circulations of the tropics. Roy Endlich described a dynamical method for deriving stream functions from layer mean winds by using contour-height data for first approximations in areas where wind data are sparse. Joe Vederman described statistical procedures now being used to augment wind observations in objective multilevel machine analyses of the Pacific area. A means of extending

the use of the quasi-geostrophic equations to circulations which cross the equator was presented by Jules Charney, and Lester Hubert discussed the problems of interpreting circulation patterns from satelite pictures and presented a new method for expressing the field of divergence from these pictures. The principal difficulty is that of determining the height of the photographed clouds.

Meteorological satellite pictures have provided a means of reexamining classical models of cloud distributions associated with the intertropical convergence zone, the easterly wave, and other perturbations. H. M. Johnson presented photographs that confirm what long has been suspected—namely, that the so-called convergence zone in the equatorial trough is in no sense continuously convergent but rather consists of a series of perturbations. Sigmund Fritz showed cloud photographs of other perturbations apparently associated with, or accompanying, hurricane systems, which are attended by separate areas of heavy rain and severe weather.

Still the most perplexing problem of the tropics is the means by which perturbations develop and intensify. Results of theoretical, experimental, and analytical research all point to the singular role of convective scale motions in the initial growth of tropical disturbances. The two areas of major uncertainty are the initial generating source of organized convection and the instability mechanism by which convective scale motions generate synoptic scale disturbances. M. Yanai used case studies and climatology to describe a unique superposition of circulations in the upper troposphere upon those of the lower troposphere. This superposition generates convection and gradually creates a column of warm air, of synoptic scale, suitable for the development of tropical cyclones. M. Alaka discussed the role of anomalous winds and of dynamic instabilities in triggering the development of hurricanes. The source of these winds remains obscure.

In a theoretical study, G. Arnason demonstrated that a disturbance of convective scale, developing in a slightly baroclinic field, would grow to synoptic-scale proportions if account were taken of the β effect. Other important progress has been made in the development of mathematical-physical models of the intensification of disturbances. J. Spar, in surveying previous efforts, pointed out that investigators had had difficulty in modeling the release of latent heat. In recent months this problem has been attacked with greater success by Kasahara, Ooyama, Kuo, Estoque, and Rosenthal. Kasahara considered latent heat as a space variable, constant in time, while Ooyama considered large-scale circulation as a quasi-balanced vortex in two layers, with heating stemming from moisture advected by the lower inflow layer. Kuo's model, which has not yet been tested, starts with the establishment of a water budget, then supplies the necessary flux from the ocean to satisfy this budget. Rosenthal uses large-scale pseudo-adiabatic motion, assuming complete saturation of the volume. All of the models tested have shown good similarity to the hurricane circulation; the main difficulty is the rate of development. Kasahara's model required 10 days to generate winds of hurricane force, while Rosenthal's took only a few hours.

In a survey of recent progress on problems of tropical convection, Joanne Malkus emphasized the role of penetrative convection in the tropics and the need for identifying the physical mechanisms that generate and sustain these tall towers. She also presented the results of preliminary studies of diurnal variations in cloud patterns on the island of Barbados and noted that progress in understanding tropical convection had reached the point where scientific experiments in modifying weather in the tropics are now in the planning stage or in progress.

Patrick Squires discussed a "double plume" model for penetrative convection, consistent with observations, and Boyd Quate described a model for the generation of convection, the intensity of which depends upon the depth of dry air in the upper troposphere. In other studies of convection, two interesting reports on laboratory fluid models were presented. Douglas Lilly showed pictures of a convectively driven, tornado-like vortex in which vertical circulations were well identified; and Willem Malkus presented a quantitative theory of penetrative convection with constant vertical heat flux; this makes it possible to predict thermal structure and degree of penetration and provides a basis of comparison for the atmospheric problem.

While most aspects of hurricane structure are well described from observations of research aircraft, Noel LaSeur pointed out the uncertainty

which remains about fluxes of heat and momentum in the boundary layer, the role of convective-scale motions, and the role of internal and surface friction in the more intense core of the hurricane.

The role of the satellite in the study of some illusive aspects of structure was considered by Robert Fett, who identified a pronounced ring of apparently subsiding air near the "rim" of outflow cloudiness and discussed a hypothesis concerning the generation of pre-hurricane squall lines, an anticyclonic wind maximum near the outer edge of cirrus cloudiness, and the development of secondary vortexes in the upper troposphere. Cecil Gentry reported on an investigation of the release of kinetic energy in spiral rainbands. In this study he used wind data from aircraft observations and found that the rainbands generate kinetic energy at the rate of 10^{14} kilojoules per day. This result is consistent with computations of other investigators for the entire storm.

A new hypothesis of hurricane-rainband generation was presented by David Atlas. It is proposed that the band is formed initially by the evaporation of precipitation advected downstream from a prominent cumulonimbus. No initial convergence mechanism is required for this generation. Several difficulties with the hypothesis were brought out during the discussion: rainbands seem to propagate upstream as well as downstream; moreover, it is not obvious why the precipitation should be advected from the tops of large cumuli while the cumuli themselves lag behind in a system where tangential wind speeds decrease with height.

Several interesting papers were presented on the air-sea-earth interaction in hurricanes. Banner Miller gave results of computations, based on data from hurricane Donna, which show that the decay which follows the movement inland is due to removal of the oceanic heat source rather than to increase in surface friction. Robert Stevenson showed the remarkable influence exerted by hurricane Carla on the upper waters of the Gulf of Mexico.

James Black discussed the design of a weather-modification experiment in which asphalt coatings would be used to create an artificial "thermal mountain" (as described by J. Malkus) to augment precipitation from tropical clouds. A succession of preliminary experimental and theoretical investigations will be conducted to determine the feasibility of using such coatings and the required scale of the cover.

In discussing weather-modification efforts aimed at reducing the wind hazard from hurricanes, Robert Simpson described the design of an experiment for cloud seeding in hurricanes and the results of the first such seeding in hurricane Esther (1961). The principal result was a change in radar reflectivity downstream from the seeded area. This and other evidence was considered sufficiently interesting to warrant continuance of the project, known as "Stormfury," for several years.

In another discussion of weather modification, Ed Kessler, drawing upon knowledge of microphysical factors in convective systems, suggested that a convective system tends to compensate so rapidly for local changes which are induced artificially that little overall change in precipitation from the system might be expected, and that, therefore, the best means of influencing the effectiveness of a convective system is to alter the timing or distribution of the precipitation.

In surveying progress in hurricane forecasting, Gordon Dunn pointed out that the areas of least progress were those of forecasting the genesis and dissipation of hurricanes. A number of very useful objective methods have been developed for predicting their movement and for estimating storm surge. However, the greatest problem in prediction is that of accurate analysis. Until more information is available routinely for analysis, this problem is not likely to be eliminated.

Charles Jordan suggested that, in tracking hurricanes, better results would come from tracking "the whole storm" than from tracking some singularity which is frequently difficult to locate. He proposed that center tracking be abandoned.

H. Riehl and F. Baer presented a new regression method for predicting cyclogenesis. It is based mainly upon the rate of mass inflow in the lower troposphere; supplemental parameters are associated with circulation patterns in the middle and upper troposphere.

George Morikawa discussed a numerical model for predicting hurricane trajectories, an extension of earlier work on the translation of a geostrophic point vortex.

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