the appearance and course of the disease.

From the discussions which followed the various papers it was evident that there is a need to confine viruses which cause serious diseases to their respective continents of origin; Egtved virus should be prevented from being introduced into American trout and, conversely, IPN virus should not be introduced into European trout. Because of the present lack of regulation of import and export of fish and fish eggs, it is likely that such viruses will be introduced, and researchers must shoulder some responsibility for effecting changes to prevent this.

Several papers on fish cell and tissue culture reflect the need for, and growing employment of, these techniques in fish virology. At the same time it was evident from both the sessions on amphibians and those on fish that the embryonate egg could be used to good advantage in poikilothermic vertebrate virology, as the avian egg is in homoiothermic animal virology. Similarly, there is a need for experimental animals free at least of specific infectious diseases, if not of all infectious diseases.

Cultivations of cells from poikilothermic animals have been used to propagate a variety of viruses from warm-blooded animals. Tubiash (U.S. Bureau of Commercial Fisheries) renewed a plea that such cells be considered for use in the production of vaccines for human use, since they would not be likely to introduce into the vaccine agents which are oncogenic or pathogenic to man.

The final session concerned immune reactions in cold-blooded vertebrates. Rather surprisingly, Sigel (University of Miami) found evidence that anamnesis in these animals may be defective, or at least different from that in higher vertebrates.

The conference was sponsored jointly by the New York Academy of Sciences and the Eastern Fish Disease Laboratory of the U.S. Fish and Wildlife Service. The principal chairman and organizer was S. F. Snieszko, director of the Eastern Fish Disease Laboratory.

It is of historical interest that this was the first such conference of international scope; participants included representatives of Canada, Denmark, France, Germany, Israel, Italy, Yugoslavia, Switzerland, and the United States. In addition, the titles of papers contributed from East European countries were read, their authors' attendance being prevented because of complex international relations which obstruct scientific communication and progress.

The collected papers from this conference will be a prime reference for many years in vertebrate microbiology, pathology, and immunology.

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Thin Films: Nucleation, Growth, and Structure

The first symposium of the newly formed Thin Film Division of the American Vacuum Society was held in Chicago on 29 September 1964. The theme chosen for the symposium was "Nucleation, Growth, and Structure of Thin Films." The emphasis was on new results in this field.

In his opening remarks, the division chairman K. H. Behrndt (Bell Telephone Laboratories) emphasized the importance of a better understanding of film structure for those who fabricate and use thin film devices. Such devices make use of the unique properties of thin films, as well as of their thinness; these properties more often than not are dictated or at least greatly influenced by the structure of the films, which includes crystalline orientation, grain size, strain, defect structure, surface roughness, and concentration of impurities. The structure in turn is determined by the phenomena which control the nucleation and growth of the film. This is true regardless of the method of film preparation.

The application of the electron microscope to the study of thin film growth, making possible direct observation of the film as it is deposited, has had a large impact on our understanding of the initial stages of film growth. H. R. Poppa (General Dynamics/Astronautics) reported on some new results he has obtained with this technique. So far most of this work has been of qualitative nature. At this meeting, he described quantitative investigations of the nucleation and growth process as it occurs for silver on carbon substrates at incident beam fluxes of the order of 10^{13} atoms per square centimeter per second. It was possible to infer the surface diffusion energy of silver on carbon substrates as about 20 kcal/mole.

Electrodeposited films have traditionally been neglected in previous meetings of this type. The paper by K. R. Lawless (University of Virginia) was therefore received with special interest. Using electron diffraction and electron microscopic techniques, Lawless studied the growth and structure of nickel, gold, and copper films electrodeposited on single crystal metal substrates. He concluded that continuous films of these metals develop at thicknesses of less than 50 Å, except for gold films, which may be discontinuous longer on specific substrate crystal faces. Deposits of copper and nickel showed a very nearly perfect orientation relationship to the substrate for all thicknesses up to 1000 Å, but gold films had a tendency to develop polycrystalline areas above 500 Å. The structure of the electrodeposited films in this study was found to be a very critical function of substrate surface conditions and the plating current, but these films seemed to be generally more nearly perfect than vacuum-deposited films.

Nucleation and the coalescence of nuclei were discussed by R. F. Adamsky (P. R. Mallory and Co.) in a paper on the growth of epitaxial films of gold and silver films. Nuclei as small as 5 Å have been found. Coalescence to form larger islands depends on the mobility of atoms and clusters on the substrate. This mobility was found to be highest on deposited single crystal substrates. The density of the nuclei was counted as a function of evaporation time and was found to vary sharply with deposition time and substrate temperature. Nucleation rates were measured as a function of substrate temperature.

The influence of gases on the growth and structure of thin films was the subject of a paper by E. Bauer and G. Turner (Michelson Laboratory, China Lake, California). This paper was concerned with the theory of the accommodation and condensation coefficient of gases on crystals, and their effect on the crystal growth proper, that is, after the nucleation step. Comparisons with experimental data were made, but this paper brought out clearly that there is much still to be learned about the influence of gases on thin films.

Recent work on the structure and annealing behavior of thin copper and gold films deposited at temperatures near 80°K on glass and then annealed to temperatures up to 300°C was reported by R. W. Vook and F. Witt

(Franklin Institute). The stacking and twin fault densities, strain, grain size, and orientation were followed in the annealing process. Films as deposited at temperatures near 80°K have a mild (111) structure. A shift to (100) and (311) texture occurs on warming to room temperature or higher. Grain size increases from about 0.05 to 0.1 mm. A strain argument was used to explain the change in orientation on annealing: When the film is warmed from the deposition temperature, the elastic strain energy in the grains increases; however, this increase depends on orientation, because of the different Young's moduli in the different crystalline directions. The increase in strain energy is least for grains oriented with their (100) and (311) planes parallel to the substrate, and most for those oriented (111). To minimize this strain energy there is preferential growth of the (100) and (311) oriented grains at the expense of the (111) and other orientations.

A new degree of complexity is introduced into thin film technology when two or more component systems are involved. Formation of alloy films by the simultaneous deposition from the vapor phase allows mixing of the constituents on an atomic scale. If the substrate temperature is kept low, diffusion can be reduced so that homogeneous solid solutions can be prepared, even if there is no miscibility in the annealed bulk state. S. Mader (I.B.M.) reported on thin films of face-centered cubic solid solutions and amorphous phases of the systems Co-Cu, Cu-Ag, Cu-Mg, and Au-Mg prepared by codeposition. If the difference in the atomic diameter of the constituents exceeds 10 percent, an amorphous phase is found, provided there is not complete miscibility at that concentration.

A paper by F. Arntz and F. Chernow (M.I.T.) was concerned with the optical and structural properties of oxidized titanium films previously deposited in ultrahigh vacuum onto single-crystal or amorphous substrates. On single-crystal substrates, highly oriented titanium films can be deposited. The oxides of these films were not oriented, with the exception of those on CaF_2 substrates, where the oxide was identified as rutile with the (100) plane parallel to the surface of the substrate. The *c*-axes of the rutile were in the plane of the substrate parallel to the three <110> directions. Oxides of nonoriented titanium films were nonoriented or even amorphous.

It has again become clear in this symposium that the variation in structure which can be obtained by thin film deposition is extraordinary. The range from single-crystal to liquid-like amorphous phases was covered. The extreme sensitivity of the thin film structure to preparation conditions was strikingly illustrated.

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Learning, Remembering, and Forgetting

The New York Academy of Sciences sponsored the second conference on learning, remembering, and forgetting, which was held 27–30 September in Princeton, New Jersey. Karl H. Pribram of Stanford University chaired the conference, and Frank Fremont-Smith, director of the New York Academy of Sciences Interdisciplinary Communications Program, served as sponsor and host.

These conferences are designed to provide an opportunity for interdisciplinary "discussion in depth" on the general topics of learning, remembering, and forgetting. Arthur Melton (University of Michigan) led the first discussion session, which was focused on the organization of short-term memory. Melton covered the subject from the standpoint of human paired-associate learning. The discussion which was evoked was continued during the next session led by Donald Broadbent (Applied Psychology Research Unit, Cambridge, England). Broadbent approached the problem by means of experiments using different simultaneous inputs to the two ears. The discussion at this session dealt with the relative importance of "interference" and "filtering" with respect to what is and what is not remembered. Gordon Bower (Stanford University) discussed a mathematical and structural model of human memory. Edward Walker (University of Michigan) emphasized the importance of the occurrence of some perturbation (as shown by the galvanic skin response) to consolidation of a memory trace. Much of the evidence discussed on this day had to do with the coding processes that are engaged before an experience becomes fixed in memory.

Discussions on the final day of the conference were focused on the organization of memory in the central nervous system. Lawrence Weiskrantz (Cambridge University) discussed behavioral impairments seen in monkeys with frontal or temporal lobe lesions. He presented evidence that subjects with lesions in the frontal lobes had difficulty in controlling irrelevant sensory input, especially when attempting to perform complex tasks, while monkeys with lesions in the temporal lobe had difficulty remembering what they had learned the day previously.

The concluding session was led by E. Roy John (New York Medical College). John presented electrophysiological data recorded from chronically implanted cats working in a variety of training situations. On the basis of his data three categories of central processes important to memory were proposed and various neural structures tentatively placed in each category.

The conference was supported by funds from the National Institute of Child Health and Human Development and the Office of Naval Research. The proceedings will be published under the editorship of Daniel Kimble.

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Radio Astronomy

Radiointerferometers and some recent results on brightness distributions of discrete surfaces, as well as astronomical spectrum analyzers and observations of interstellar gas, were described at a symposium on radio astronomy held as a part of the Northeast Electronics Research and Engineering Meeting (NEREM) in Boston on 5 November.

N. Keen of the National Radio Astronomy Observatory described the recently completed 11-centimeter interferometer. The closest spacing of the two 85-foot (25.9-meter) antennas of this instrument is at present about 1200 meters, and larger spacings up to 2700 meters are provided for. However, smaller projected baselines are obtained by tracking a source over a substantial fraction of a day.

The azimuth of the baseline is 62 degrees east of north. Keen pointed out that the choice of a baseline orientation other than east-west or north-south leads to a particularly accurate determination of the exact orientation. The measurement is made by observ-