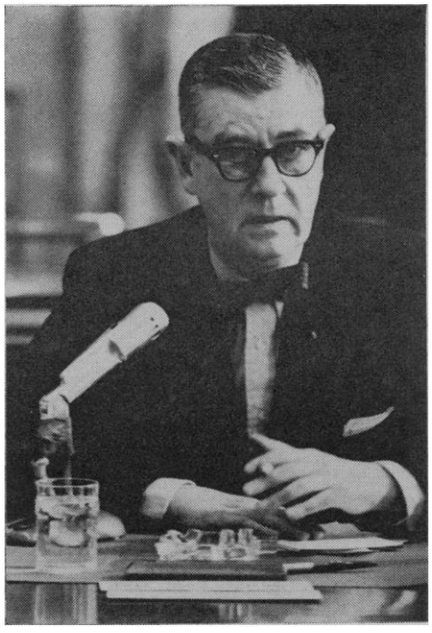

Shannon: how biophysical research increased [Joan Sydlow]

ments of physics had any interest in biology and that there were very few researchers in biophysics. Judging the potential contribution of physics to biology to be large, we set up a study section, with F. O. Schmitt as chairman. With Council approval, a revolving fund of $100,000 a year was granted. They toured the country and put on five seminars in depth that involved the major departments of biology and departments of physics in each of the five areas of the country. The study section was empowered to commit any part of the $100,000 to fellowships, either short-term or long-term grants, training or whatnot, with the agreement that we would blanket this support into our normal program.

"The result was that some extraordinarily effective physically oriented people became broadly preoccupied with some substantial problems in biology. I think it is reasonable to estimate that excellence in biophysical research had increased by a factor of 10 or 15 times within 5 years after we initiated this activity. . . .

"I think the interaction between fundamental and applied research as we see it in our own laboratories is extraordinarily intimate and extraordinarily productive. . . . I think the broad underpinning of basic research has become increasingly important in all fields. I suspect we will not again go through another period of invention like that of Edison's day, when rapid progress was made without understanding of the basic phenomena. . . .

"The educational process would be quite sterile without day-by-day fundamental inquiry." Shannon estimated that a minimum science base in support of medical education would require the equivalent of about two full-time researchers in each preclinical department and the equivalent of about four full-time researchers in the larger, clinically oriented departments. A science base at this level would cost about $2 million a year. He said that about one-third of the medical schools in the U.S. are below this dollar standard and the adequacy of their science base is open to question. It has been estimated that 25 additional medical schools will be built or initiated before 1975. Thus perhaps $100 million annually is needed to provide a more adequate science base for the educational process itself.

Shannon also pointed to the lack of cancer research over the country as a whole (main centers are in Buffalo, New York, Bethesda, and Houston) and to a similar lack of distributed research in the cardiovascular field.

Whatever their differences on specifics, the panel seemed in agreement that scientists will not have the last word on how much support will continue to be given to basic research in a "society that is itself mission-oriented," to use Weinberg's apt phrase. This decision is surrounded by political questions that reflect the most basic values of a society. Few scientists share, for example, the majority opinion supporting heavy commitment of our resources to land a man on the moon, an amount of dollars large enough, Lord Bowden estimated, to feed and clothe half the undeveloped world.

When Weinberg said, "We have decided that sending a man to the moon is worth $5 billion and that achieving better health for our society is worth $1 billion. I think that happens to be a wrong allocation between these two objectives . . ." he was interrupted by sustained applause. All those who attend scientific meetings know how unusual this sort of response is.

"Of all applied scientific activities," Weinberg added, "none strikes me as being anywhere near so important as answering the age-old questions related to the elementary human suffering of premature death and unnecessary disease."

T. L. CAMPBELL

AAAS

Cell, Tissue, and Organ Culture

The relationship between the cultured cell or tissue and its in vivo progenitor was investigated at a 2nd Decennial Review Conference, held in Bedford Spring, Pennsylvania (10–14 September 1966). It was felt that a need existed to define the role of tissue culture as a tool or as a discrete entity worthy of investigation in its own right.

Three impressions concerning the ontogeny of cells in vitro emanated from the Conference. One impression is the extreme lability of most of the cells in an original explant, the plasticity of a minority of the cells, and the question of the homogeneity of such a cell population. Although Patricia Farnes (Rhode Island Hospital) pointed out that the established cells derived from explants of bone marrow seem to be a perivascular fibroblast by histochemical tests, it is not obvious whether the fibroblasts are a homogeneous cell population or whether the enzymatic marker reflects only coincidental identity. It is this overriding problem of adaptability and the limits thereof that would cause one to have reservations about Stanley Gartler's (University of Washington School of Medicine) rather sensational statement that all cell lines examined by him to date are contaminants of the HeLa strain. Could not the genetic variant of glucose-6-phosphate dehydrogenase, peculiar to the Negro, which he found in HeLa and in the other 18 lines tested, be a reflection of either a selective process or an induced change? Intimately associated with the matter of cell plasticity is the influence of environment. Here it was interesting to see how the work of Harold Ames (Harvard Medical School) and Katherine K. Sanford (National Cancer Institute) complemented each other. The former spoke of uncharacterized activator molecules in serum which in his hands served as positive signals to maintain the differentiated biochemical phenotype. Sanford, addressing herself to the question of spontaneous malignant transformations, remarked that cells of most animal species frequently alter in vitro; this alteration can be reproduced within definite time intervals by such factors as different sera in which carcinogenic agents cannot as yet be identified.

Quite obvious to all was the debt that biology owes to the in vitro system. Without this system much of what is now accepted as facts of tissue and cell interaction would still be unknown.

A case in point is the work of Clifford Grobstein (Stanford University) in which the in vitro system gave rise to his logical and stimulating new hypothesis regarding cell and tissue interaction in organogenesis. It must be remembered, however, that direct extrapolation of in vitro results may be partially or wholly fallacious. On the other hand, one must also appreciate the potential application of tissue culture techniques to a variety of puzzling elementary problems. Michael Abercrombie (University College, London) emphasized research on cell adhesiveness itself. His incidental finding that minute quantities of sera, added to his cultures, reduced cell adhesiveness may be an in vitro demonstration of that enigmatic problem of immunological enhancement which, while apparently of fundamental importance in tumor physiology, has proven refractory to detailed in vivo evaluation.

The Conference was held under the auspices of the Tissue Culture Association. The proceedings will be published in monograph form by the National Cancer Institute.

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Electron Microscopy

"The analysis of matter including living bodies may be called the greatest undertaking to be discharged in the latter half of the 20th century." With these words, Prince Takamatsu, brother of the Emperor of Japan, opened the Sixth International Congress on Electron Microscopy in Kyoto, Japan (26 August–4 September 1966). Approximately 1320 persons from 37 foreign countries attended the meeting which was held in the new Kyoto Kokusai Kaikon (International Hall).

In the opening sessions, general lecturers on electron microscopy summarized developments that had taken place since the previous congress in 1962. N. Higashi (Kyoto University) reviewed developments in Japan and included statistics relating to the scope of activity in electron microscopy in Japan. For example, the Japanese Society of Electron Microscopy has 1800 members, almost the same number as its American counterpart. In 1965, 473 electron microscopes were produced in Japan; of these, 65 percent were exported. At present, 35 percent of the electron microscopes in use throughout the world were produced in Japan.

Means of improving the relatively low contrast of amorphous materials, especially unstained biological substances, were discussed by Gaston Dupouy (Electron Optics Laboratory, Toulouse). In particular, he illustrated the increase achieved by the use of a small metallic disk located on the optic axis in the aperture of the objective lens. This disk intercepts the large fraction of electrons (in the beam) not scattered by the specimen, and results in a large increase in contrast, even at 1,000,000 electron volts. Seishi Kikuchi (member, Japan Academy) reviewed the status of theoretical and experimental studies of Kikuchi lines and bands and emphasized the need for considering multiple reflections in any complete analysis of the effect to explain all the features observed in these patterns.

Problems in resolving individual atoms were outlined by R. D. Heidenreich (Bell Telephone Laboratories). In addition to instrumental factors, such as stability, specimen drift, and contamination, he described the effect of illuminating and focusing conditions on the images of single or small groups of atoms. A unique interpretation of single images is not possible; it may be necessary to link a computer to the microscope for processing the information in a series of images to produce the correct representation of the specimen.

Approximately 750 papers were delivered at the conference, divided almost equally between biology and nonbiology. About 50 papers were devoted to instrumentation, including high-voltage and high-resolution electron microscopes, electron guns, lens aberrations, superconducting lens properties, ultrahigh vacuum techniques, and specimen devices and accessories. Significant advances have been made in the 4 years since the preceding conference, leading to the day when a resolution of 3 or 4 Å will be routine, at least on suitable specimens.

Various aspects of electron interactions with the specimen, including extensive treatments of the dynamical theory of diffraction and its relation to image contrast and the resolution of individual atoms, were discussed. Much of the current interest in this subject is concerned with inelastic scattering effects, and a number of papers dealt in detail with anomalous absorption and related measurement and interpretation of the energy losses of electrons during transmission through thin crystals. The principal nonbiological applications discussed were point defects in quenched or irradiated materials, phase transformation and precipitation, crystal growth and surface reactions, and the dislocation structure of deformed materials. With two or three exceptions, all of the papers were assembled in two volumes, as preprints, edited by R. Uyeda of Nagoya University.

The next international meeting will be held in 1970 in Grenoble, France. The organizing committee for this meeting will be headed by Professor Gaston Dupouy, newly elected (at the Kyoto conference) president of the International Federation of Societies for Electron Microscopy.

Our Japanese hosts may rest assured that "Kyoto 66" will not soon be forgotten by their many new friends from abroad.

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Calendar of Events

Forthcoming Meetings—May

11–12. Canadian **Operational Research** Soc., 9th annual conf., Ottowa, Ont., Canada. (Chairman, The Society, Box 120, R.R. No. 1, Ottawa, Ont.)

12–13. Association of University **Radiologists**, annual mtg., Philadelphia, Pa. (S. Rogoff, Dept. of Radiology, Univ. of Rochester Medical School, Rochester, N.Y. 14620)

12–13. **North Carolina Acad.** of **Science**, Duke Univ., Durham. (J. A. Yarbrough, Meredith College, Raleigh, N.C.)

12–13. Northern and Southern societies for **Electron Microscopy**, joint mtg., Anaheim, Calif. (R. F. Bils, Hancock Foundation, Univ. of Southern California, Los Angeles 90007)

14–19. Institute of **Food Technologists**, 27th annual, Minneapolis, Minn. (The Institute, 221 N. LaSalle St., Chicago, Ill. 60601)

14–19. Society of **Photographic Scientists and Engineers**, annual conf., Chicago, Ill. (W. S. Dempsey, Itek Corp., 1735 Eye St., NW, Washington, D.C. 20006)

15. **Biomacromolecules**, symp., New York Soc. of Electron Microscopists and New York Univ. School of Medicine, New York, N.Y. (S. S. Breese, Jr., Plum Island Animal Disease Lab., Box 848, Greenport, Long Island, N.Y. 11944)

15–17. **Aerospace Electronics** Conf., 19th annual conf., Dayton, Ohio. (Inst. of Electrical and Electronics Engineers, Dayton Office, 1414 E. 3 St., Dayton 3)

15–17. **Diagnosis** and **Treatment** of **Deposited Radionuclides**, intern. symp., Richland, Wash. (T. Bauman, The Symposium, P.O. Box 999, Richland 99352)