Meetings

Electron Microscopy in the Far East

The resolution of the electron microscope is ultimately limited by spherical aberration of the magnetic lenses and by the DeBroglie wavelength of the electrons. Many of the errors which have prevented the attainment of optimum resolution have been overcome. Over the years, resolution has gradually been improved by correction of astigmatism, stabilization of voltages and currents, mechanical stabilization of the column and stage, and improved electron source image; now further advancement depends on reduction of the spherical aberration of the objective lens.

At the second Regional Conference on Electron Microscopy in the Far East and Oceania, held in Calcutta 2–6 February, E. Ruska (Max Planck Gesellschaft, Berlin), who, with M. Knoll in 1931, built the first electron microscope, described the present state of development of and prospects for the transmission electron microscope. Using Glaser's "optimum electron lens" calculated in 1941, Ruska has constructed an objective which has a point-to-point resolution in the neighborhood of 1 Å. This is a strong magnetic lens, the first half of its field being used as the condenser and the second half as the objective, with the specimen in the position where the axial field strength is maximum. Under these conditions the spherical aberration is about ten times smaller, although the chromatic aberration is larger; there is a net twofold improvement in resolution over more conventional lenses where the specimen is situated in front of the whole field. Because of this low aberration it is possible to achieve good resolution even with low beam voltage and consequently under very favorable contrast conditions.

J. B. Le Poole (Laboratorium voor Technische Natuurkunde, Delft) described a new scanning electron microscope using a quadruple lens which has a theoretical resolution of 1 Å. Le Poole also described a new miniature, long-focal-length lens with small spherical aberration obtained by giving it a wide gap and small bore. The whole lens, including the coil, is only 7 to 9 mm in diameter and is ideal as a condenser, being able to give an illuminated area of 0.3 μ or less and having great stability.

E. Suito (Institute for Chemical Research, Kyoto University, Japan) described several electron microscopes which employ accelerating voltages of 300 to 500 kv. One 300-kv microscope made by Shimadzu is at the Institute for Chemical Research of Kyoto University; a 500-kv instrument has been constructed by Shimadzu-Seisakusho and another one by Hitachi. Suito gave details of their construction and some examples of their uses. They are applied principally to investigations of metals, metallic films, and polymer crystals.

Among the biological reviews presented at the conference were those by C. H. Waddington, (Institute of Animal Genetics, Edinburgh) on ultracellular aspects of cellular differentiation, and by G. Yasuzumi (Nara Medical University, Kashihara City, Nara, Japan) on studies of spermiogenesis in different animal groups. N. Higashi (Institute for Virus Research, Kyoto University), who is now president of the International Federation of Societies for Electron Microscopy, spoke on the mode of multiplication of different animal viruses, and D. H. Moore (Rockefeller Institute, New York) reviewed electron microscopy in tumor-virus research.

R. P. Agarwala (Atomic Energy Establishment, Bombay) reported on the design and use of a new electron diffraction chamber in which metal films can be vacuum-evaporated onto the target area and studied at any orientation or thickness and at temperatures from ambient to 1000°C. A special camera records structural changes continuously while the specimen is being heated. The recorded pictures are the line spectrograms which are sections of Debye-Scherrer rings of different phases. The apparatus can also be used for single-crystal studies.

An extensive study of the fine structural imperfections caused in metals by work hardening was reported by a group from the Institute of Nuclear Medicine and Allied Sciences, Delhi, and the Atomic Energy Establishment, Bombay. Studies of cadmium showed stable polyhedral-shaped contrast effects of the bipyramids of stacking faults in the plane of the foil. The bipyramids arise from condensations of vacancies on the basal plane, which in turn are formed from the intersection of the dislocations resulting from the severe cold working of the foil in the process of rolling. The recovery from cold work in cadmium at room temperature is very rapid.

N. N. Das Gupta and associates (Saha Institute for Nuclear Physics, Calcutta) presented high-resolution micrographs of *Escherichia coli* DNA which had been denatured by various procedures. Exposure to solvents with low ionic strength brings about disintegration to single polynucleotide chains over long regions of the DNA strand with possibility of renaturation later. Heating at 100°C for 10 minutes usually produces diffuse patches along the length of the DNA thread. Under this condition a single DNA molecule is partially denatured in an irreversible manner over part of its length while at the same time it retains its double-stranded form in another part. Changes produced by x-irradiation (12,000 rad) are less dramatic, although the irradiated threads appear to be much more flexible than the nonirradiated control.

From their studies of intercellular connective tissue in laboratory animals after administration of deoxycorticosterone acetate, M. B. Ketkar and S. M. Sirsat (Indian Cancer Research Centre, Bombay) found distinct and characteristic changes in individual collagen fibrils, the most characteristic being lateral swelling.

The conference was highly successful in achieving its aim, which was to give Indian scientists an opportunity to come in close contact with each other and with their foreign colleagues. In the rapidly developing science of electron microscopy, such contacts are not only useful but essential. Lively discussions followed the presentations of all the papers, and it was interesting to note that interpretations in one paper that had been accepted when presented in the United States last year were hotly challenged by Indian colleagues.

Electron microscopy in India is hampered by its relative isolation from communities of high activity, such as Europe and Japan. Securing and maintaining instruments is a major problem. In all of India there are only about 30 electron microscopes and these are scattered over thousands of miles all the way from Madras to Chandigarh and from Bombay to Calcutta, so that the frequent service normally provided by manufacturers is impossible. However, when the previous regional conference was held in 1956, India had only four or five instruments, and there are indications that the rapid rate of acquisition will be continued. At present there is a relatively large number of workers for each microscope, many of them having been trained in Europe, America, or Japan.

The conference was arranged by N. N. Das Gupta, president of the Electron Microscope Society of India, at the request of the International Federation of Societies for Electron Microscopy. The proceedings of the conference, as well as other information about the Electron Microscope Society of India, can be obtained on request from the Secretary, Electron Microscope Society of India, Saha Institute of Nuclear Physics, 92 Acharya Prafulla Chandra Road, Calcutta-9, India.

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Solar Energy

Within the past century, increasing amounts of limited natural resources have been used to produce power and energy. Because such resources are not uniformly distributed around the world, scientific research has been directed toward discovering ways of utilizing the sun's radiation as an alternate source of energy.

A broad spectrum of scientific and engineering activities in the field of solar energy—solar stills, low-temperature solar collectors, low-temperature processes, solar measurements and instrumentation, energy conversion devices, and solar furnace designs—was presented at the annual meeting of the Solar Energy Society in Phoenix, Arizona (15–17 March 1965). Contributions were received from Australia, Canada, England, France, Israel, Japan, Senegal, and the U.S.S.R.

Several authors discussed the operation of solar stills in terms of theoretical determinations of water production, materials, construction, and test results. Farrington Daniels (University of Wisconsin) reported on small, family-sized solar stills on Rangaroa, Guam, and Galapagos. The stills, which are 12 feet long by 3 feet wide (3.6 by 0.9 m) and have water-collecting plastic covers, have been developed with emphasis on simplicity of construction and low cost of materials. The performance of these stills and their suitability were tested under local conditions; the stills produced over 2 gallons of water a day on bright days. Efficiencies ranged from 25 to 40 percent depending upon whether the floor insulation was concrete or butyl rubber. The impact of such stills on an island economy was illustrated in terms of the needs of one family which has to obtain its water from coconut milk. Since coconuts provide about 1 gallon of liquid at a cost of 8 cents, water produced from a solar still at a cost of 1 cent per gallon would make solar stills economically attractive and allow the island's produce to be used for other purposes.

D. W. Tliemat and E. D. Howe (University of California) reported on the effectiveness of solar stills for nocturnal production of water.

C. N. Hodges and co-workers (University of Arizona) noted results achieved with the Puerto Penasco Solar Desalination Plant, Sonora, Mexico. This plant, operated in cooperation with the University of Sonora, relies on multiple-effect operation by separating processes of energy collection, evaporation, and condensation. It produces 0.5 gallon (2 liters) per day of distilled water for every square foot of solar collector area. The solar collectors are inflated plastic units 5 to 10 feet wide and 300 feet long. The evaporator is a packed tower filled with carbon-filled polyethylene pall rings; the condenser is an extended surface heat exchanger. Two large storage reservoirs allow operation of the evaporator-condenser 24 hours per day even though the solar collectors operate only during the 8 hours of maximum solar radiation. On the basis of the operations of the plant since the summer of 1964, a production cost of between \$1 and \$.50 per thousand gallons is projected for a 1-million-gallon-per-day plant.

H. Tabor (National Physical Laboratory, Israel) described continuing work with solar-heated ponds. Two experimental ponds, about 25 by 25 m, are now in operation near Atlit, Israel. The operation of the solar pond depends on obtaining a concentration gradient of salt in water ranging from a density of about 1 at the top to a density of about 1.3 at the bottom of the pond. The bottom of the pond is covered with black butyl rubber or some other absorbing medium so that the salt layer at the bottom heats up to about 96°C. Through careful control of the concentration gradient, mixing within the pond is prevented, and convection currents are reduced to a minimum. The water with the lower salt content acts as an insulating layer and contributes to the heating of the bottom layer of the pond. Tabor discussed the test results obtained with the pond and the results of hydrodynamic experiments in which portions of the pond water were replaced at desired depths to control the concentration gradients. Studies on the physics of the pond and research on ways of obtaining distilled water, salt, and electric power from the pond are receiving considerable attention. Projections of the capabilities of solar ponds indicate that electric power in the range from 500 to 5000 kw could be produced at less than 2 cents per kw-hr and that salt could be obtained at a cost of \$5 to \$6 per ton, depending upon the concentration of salt in the water supplied to the pond. The water distilled from the pond can be recycled and portions of it used for drinking purposes.

W. A. Beckman and co-workers (University of Wisconsin) reported on a photovoltaic power system which uses concentrated solar energy to obtain radiation intensities of 25 watts/cm^2. By means of an auxiliary-cell cooling system, the power system could provide an output of 1.5 watts/cm^2. To permit operation at the high flux levels, a new circuit, including a distributed diode, a distributed series-resistance, a single–shunted-series di-