Talks by D. F. Peppard (Argonne), J. Kooi (Euratom), V. N. Kosyakov (IAEA), and J. Maly (U.S.S.R.) considered various aspects of the solvent extraction of the transplutonium elements. The trialkylamines are most valuable for giving actinide-lanthanide separations, while the alkylphosphoric acids give the best resolution of the actinides from each other. The paper by Maly described an interesting experiment using only 15 atoms of mendelevium to obtain the distribution coefficient of that element between tributyl phosphate and 13.1*M* HNO_3 by a reverse phase chromatographic approach.

D. C. Stewart acted as general chairman of the meeting, while C. H. Youngquist described the new chemistry research hot laboratory and organized the subsequent tour of the facility.

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Plant Tissue Culture

Thirty years after the initial isolation of tomato roots in vitro by Philip R. White, a group of about 150 tissue culture experts from all over the world met, at White's invitation, under the auspices of the Pennsylvania State University and the NATO Advanced Study Institute at University Park, Pennsylvania (28 May–1 June), to discuss the present problems and future developments of plant tissue culture. Subcultures of the roots originally isolated by White and kept in continuous culture for 30 years were mute testimony to the possibilities of tissue and organ culture.

Although defined synthetic media have been used in plant tissue culture for over a quarter of a century, the nature and the extent of the interactions between the tissue and the medium on which it is grown is still the subject of intensive investigation. The older ideas of the medium playing the role of mechanical support and source of needed growth factors and nutrients has been replaced by the realization that not only does the medium act upon the tissue, but also that the tissue has complex effects upon the medium. Street reported that isolated roots release into the medium as many as 18 amino acids as well as some indolic compounds. Other investigations revealed "exsorption" of iron-chelating agents by callus cultures (Heller); the release of arginase by ginkgo tissues (Tulecke); and the release of peroxidase by sunflower tissues (Lipetz).

The release of some of these substances by roots was reported by Street to be light sensitive. Burstrom reported that the action of light upon the growth of roots of monocotyledons could be divided into two parts, red-light action which stimulates cell division and blue-light action which stimulates cell elongation.

The various enzymes released into the medium not only affect its composition, as shown by Tulecke, but also are released in response to calcium concentrations in the medium (Lipetz). These complex medium-tissue interactions were reported to influence the suitability of certain nitrogen sources (such as ammonium) for growth (Street), the differentiation of tissues (Lipetz), and overall growth (Heller).

Wood also reported on the effects of the medium on tissue growth. High concentrations of certain ions could substitute for growth-factor requirements formerly believed to be specific for the tissues. One of the ions reported necessary in high concentrations was K, which previously could not be entirely replaced by Na.

The observations that single cells and small clumps of cells usually require a medium previously "conditioned" by growing cultures (Muir, Reinert, Jones, and others) can possibly be explained in terms of the above reports. More specifically, Earle has demonstrated that single cells require exogenous kinetin for growth, whereas larger clumps of cells do not. It was also noted that as embryos mature, their requirements for exogenous supplies of certain specific growth substances decrease (Raghaven).

Sussex's report on the growth of various members of cell populations in shake culture also seems to bear out the point that all the cells in a given culture are not identical in size, shape, or growth ability. It is thus possible that the medium may act as a selecting agent.

Tissue culture has become an important tool in the study of morphogenesis. The development of flowers and floral organs on isolated stem fragments, separated from correlative and other influences of the intact organism, were reported by Tepfer, Jacobs, and Vasil. Vasil also described attempts to

obtain meiotic divisions in cultures of isolated anthers. Karstens reported on the formation of phloem in tissue cultures and Rier on attempts to influence the reconstruction of stelar patterns in isolated callus tissue. Ball reported on microcinematographical studies of developing isolated meristems. Stonier discussed his attempts to influence meristem formation by the mixing of various cell types and by creating an interdependence between them, thus influencing their organization. Both Hagen and Gunckel reported on studies of abnormal meristem development; the former dealt with hybrid tumors in *Nicotiana* and the latter with neoplasias induced by radiation.

Murashige explored the effects of various gibberellins on the differentiation of callus cultures. He reported that this hormone acts somewhere between the induction of cellular proliferation and the differentiation of the products of the dividing cells. The problem of hormone action on tissues was further discussed by Kulescha who noted that indole acetic acid and 2,4, dichlorophenoxy acetic acid (2,4,D) both led to the appearance of new, as yet unidentified, growth promoters in Jerusalem artichoke tissues.

The increasing use of "fragmented tissue" cultures, single-cell cultures, and the development of cloning techniques has led to new information on cytology, cytogenetics, radiation biology, pathology, biochemistry, physiology, and morphogenesis. Observations on the events leading up to and following cell division in isolated single cells were reported, with the aid of time-lapse cinematography, by Jones, Muir, and Mota. These observations on living material present a new approach to the problems of cell division, wall formation, the role of the phragmoplast, cell senescence, and cell death. Correlations were made of certain aspects of cellular morphology and their future ability or inability to divide. The report of Earle on the reconstruction of entire plants from single cells is further evidence for the multi- or toti-potency of somatic plant cells.

Single-cell and shake cultures were also used to advantage by Dougall who discussed two methods of using these in metabolic studies, and by Eriksson who studied the effects of ultraviolet radiation on these cells.

The kariology of plant tissues was reviewed (D'Amato), and the point that polyploidy is the consequence rather than the cause of differentiation

was emphasized (Partanen). Torrey presented evidence for the chemical selection of polyploid cells in culture and said that in the presence of certain concentrations of kinetin, the total number of cell divisions increases and the total number of diploid cells decreases. These and other observations make it clear that one cannot consider a callus culture as a mass of essentially identical, relatively undifferentiated cells.

Tissue culture as a tool in the study of phylogeny and comparative embryology was discussed by Maekawa, who compared the development of embryos and the differentiation of single-cell and cell-fragment cultures into intact entire plants.

Tissue culture has also been a valuable tool in phytopathology. Riker reviewed developments in these allied fields, and Nakamura discussed attempts to grow obligate parasites and their host in monoxenic culture. Manigault reported on his use of isolated tissue as test material for the virulence of various mutants of the crown gall organism *Agrobacterium tumefaciens*.

Quak and Hirth reported on studies of the growth and infectivity of tobacco mosaic virus in tissue cultures. The former stated that by using C^{14}-labeled virus, she was unable to show a change in cell susceptibility with age. Hirth demonstrated that the classic anti-infection factors in plants, such as polyphenol oxidase and scopoletin, were present in lower concentrations in moderately susceptible tissue cultures than in highly susceptible plants, thus questioning the physiological role of these substances. Other techniques have enabled the rearing of axenic insect vectors for the infection of axenic plants with viruses known to proliferate in both hosts, and bearing a remarkable resemblance to the REO group (Maramorosch).

The synthesis of natural plant products by tissue cultures was explored. Kinetin appears to favor lignin production by shifting metabolism from the Embden-Meyerhoff pathway to the hexose monophosphate shunt and thus increasing the size of the pool of presumptive lignin precursors (Bergmann). A report was made on the chemical analysis of lignins produced by various tissue cultures and their comparison with the lignin produced by the parent organism (Barnoud). Tissue cultures, unlike intact plants, can synthesize tannins in the dark, and various precursors can, depending upon their con-

centration, enhance or inhibit tannin production (Constabel). Also discussed were the isolation and properties of tissues from various medicinal and other commercially valuable plants (Staba).

The roles of light and temperature on the metabolism and growth of plant tissues were discussed by Duranton and by Petru. Duranton found that light has varying effects, depending upon the season, on the arginine metabolism of Jerusalem artichoke. Petru reported on the "sudden death" of tomato roots after temperature shocks, and their seasonal variations of growth rate.

An international committee was formed to plan the next meeting of plant tissue culturists. Elected to the committee were: Ball (U.S.), Constabel (Germany), Hildebrandt (U.S.), Karstens (Netherlands), Maekawa (Japan), Morel (France), Petru (Czechoslovakia), Street (United Kingdom), Vasil (India), and White (U.S.). Ball was elected secretary of this committee. The conference also decided to accept the offer of Lipetz, Stonier, and Tulecke to edit a newsletter "Explants" which would publish a list of tissues presently in culture and compile current bibliographies on plant tissue culture.

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Radiation Chemistry: Aqueous Media

Basic concepts pertaining to the chemistry of irradiated water and aqueous media were discussed at a conference on radiation chemistry at Gatlinburg, Tennessee (8–10 May). Topics discussed by the 42 invited chemists and biologists covered chemistry of pure water, of dilute solutions, and of complex molecules.

A new impetus was given to radiation chemistry with the general availability of inexpensive and reliable radioactive cobalt-60 gamma-ray sources. On an unprecedented scale, research in this field expanded from national laboratories and a few atomic energy research centers to universities and other chemical, medical, and industrial laboratories throughout the world. As a result, research on a greatly expanded front is now being carried out. No longer is it possible to cover the entire field in any