toplast cultures in tree improvement programs. Most of the effort and success has been with poplar stock. The surprising delay in emphasizing work with woody species was discussed by several participants.

Now that (i) cell suspension cultures can be manipulated with considerable ease, (ii) haploid cultures can be established for numerous plants, and (iii) totipotency has been demonstrated for many plants, interest has mounted rapidly in obtaining mutants for the study of biochemical pathways and for crop improvement. The biggest deterrent to rapid development of this specific approach is the lack of selection methods. J. M. Widholm (University of Illinois, Urbana) discussed the mutation and selection techniques now used and the results obtained, emphasizing his own work with the biosynthetic pathways for aromatic amino acids.

After a surge of effort in the 1950's on production of secondary products from plant cell and tissue culture, the total efforts subsided for a decade or more. Recently, interest has again mounted in this area. E. J. Staba (University of Minnesota, Minneapolis) discussed the success in the in vitro production of alkaloids (ergot, opium), steroids (diosgenin), triterpenes (ginseng), and proteins (allergens). M. Misawa (Kyowa Hakko Kogyo Co., Tokyo), presented his results with the production of amino acids (glutamine), enzymes (5-phosphodiesterase), antitumor alkaloid (camptothecine), proteinase inhibitors, and inhibitors of plant virus infections.

The ability to obtain haploid plants from pollen and anthers and to derive diploid plants from them opens experimental approaches previously restricted in biochemical and genetical investigations of higher plants. I. K. Vasil (University of Florida, Gainesville) reviewed experimental androgenesis from its initiation to the present, emphasizing the usefulness of haploids for numerous types of investigation. Haploid rice and sweet potato were discussed by S. C. Woo (Academia Sinica) and H. S. Tsay (National Taiwan University), respectively.

Little effort has been made toward utilizing these techniques with agronomically important crops until the last few years (*1*). L. G. Nickell (Hawaiian Sugar Planters' Association, Honolulu) discussed the potentials of cell and tissue culture for crop improvement. This discussion briefly included meristem culture and embryo culture and emphasized manipulation at the cellular level to obtain new plant materials by asexual methods. M. C. Liu discussed the application of these techniques to sugarcane. P. J. Wang reported on the success in elimination of potato viruses and the subsequent increase in seed potato production in Taiwan.

The final session was devoted to discussion of potential cooperative projects between investigators and institutions in the two participating countries and to specific research which should be emphasized in the immediate future for the benefit of agriculture in Taiwan.

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Isozymes: The Third International Conference

It is now well known that enzymes commonly exist in multiple molecular forms even in a single organism. The recognition of this fact has led to a powerful and integrative concept of contemporary biology, chemistry, and medicine—the isozyme concept. The utilization of isozymes in research has had an impact upon virtually every biological discipline. This impact of the isozyme concept and supporting technology was amply demonstrated at the Third International Isozyme Conference held at Yale University, 17 to 20 April 1974. The conference was supported by grants from the National Science Foundation, the National Institutes of Health, and private sources. Over 400 scientists attended, 70 from 22 foreign countries; 224 formal reports were presented in nine simultaneous sessions.

A plenary session for all attendees was held each morning, followed by the simultaneous sessions for the remainder of each day. The first plenary lecture on the biology of isozymes was presented by Clement L. Markert (Yale University), who first formulated the isozyme concept and who has done much to demonstrate the biological and chemical significance of isozymes. The papers presented at the conference demonstrate that virtually all enzymes can exist in multiple isozymic forms. Researchers studying enzymes have become aware of this, and have described many different varieties of isozymes such as allelic isozymes (or allozymes), multilocus isozymes, and conformational isozymes.

In his opening presentation Markert pointed out some of the significant biological roles that isozymes play, and the means by which isozymes can be used to probe many kinds of processes of biological organization. In addition to emphasizing the role of isozymes in enhancing the biochemical precision of cells, he also pointed out the insights that isozymes have provided into the structure, function, and evolution of genomes. The use of allelic isozymes has permitted the rapid growth of evolutionary genetics in the last 10 years, particularly in investigations of gene flow between populations and in elucidation of the mechanisms of speciation. The multiple locus isozyme systems have provided insights into the mechanisms of gene duplication as well as into the evolution of different catalytic specificities. Furthermore, the multiple locus systems permit the study of the evolution of gene regulation and the control of specificity in gene function. Markert predicted that some of the most promising lines of isozyme research will involve investigations of evolutionary relatedness of genes (allelic and nonallelic), the specific physiological roles played by isozymes, and the role of isozymes in cellular and subcellular architecture. The use of isozymes as gene markers to analyze the genetic and molecular basis of cellular regulatory systems will also continue to increase, he predicted.

The second day's plenary session was presented by Bernard L. Horecker (Roche Institute of Molecular Biology) on the biochemistry of isozymes. He described his rigorous analysis of the multiple locus aldolase isozyme system to illustrate the chemical differences between isozymes, as well as the contemporary technologies used for purification and characterization of isozymes. He, as well as others at the conference, emphasized the increasing utility of affinity chromatography. He also demonstrated that certain isozymes could be generated epigenetically by a secondary modification of an enzyme after initial synthesis. He emphasized that a clear understanding of the molecular basis of isozymes should be obtained before inferences are drawn about biological roles and significance. He also helped focus attention on the fact that, although many studies of isozymes dealt with synthesis, only a few have so far dealt with degradation, which may be as important as synthesis in regulating cellular metabolism.

The plenary session speaker for the third day was Elliot S. Vesell (Pennsyl-

vania State University), one of the first researchers to appreciate the use of isozymes as diagnostic tools and whose presentation was on the medical use of isozymes. He illustrated the utility of monitoring the isozyme patterns of serums from diseased individuals to facilitate diagnosis, since changes in the isozyme patterns of serums tend to reflect the contributions of tissues suffering cellular damage. The tissue-specific patterns of various isozymes, their possible significance, and the ways in which different patterns can be produced through a combination of synthesis and degradation was presented. An iconoclastic approach was taken in pointing out persuasively that the kinetic properties and physiological roles of a number of isozymes has been inferred from kinetic analyses performed under very nonphysiological conditions and that many of these proposed roles should be reevaluated. The physiological roles of isozymes remain a central area of investigation.

The three plenary session speakers did much to set the tone for the symposium and encouraged a critical approach in evaluating the old concepts, as well as providing encouragement to those with critical new insights. The listing of the following session headings indicates the breadth of the symposium: (i) molecular structure of isozymes, (ii) characterization of isozymes, (iii) isozymes and biochemical regulation, (iv) the physiological role of isozymes, (v) isozymes in developmental biology, (vi) isozymes in evolution, (vii) isozymes in population biology, (viii) genetic analysis of isozymes, (ix) isozymes in somatic cell genetics, (x) isozymes in disease, (xi) isozymes in cancer, (xii) isozymes and gene evolution, and (xiii) isozymes and multiple forms of polymerases. The scope of the sessions often exceeded the specific headings listed above.

The tremendous diversity of isozymology was illustrated by this meeting in which many different kinds of enzymes were discussed. Furthermore, the isozyme analyses were directed at every level of biological organization, and the taxa studied ranged from bacteria to higher plants and animals. In some sessions the researchers focused on the intrinsic properties of the isozymes themselves, such as genetic and epigenetic origin. Other sessions were devoted to discussions of isozymes as probes to study the regulation of cellular metabolism, the expression of gene function during embryogenesis, and adaptation to different environments.

Geneticists found isozymes, particularly the allelic isozymes, to be useful gene markers for investigating genetic linkage, gene expression in somatic cell hybrids, and gene flow between populations. A number of sessions were devoted to isozymes encoded in multiple loci for the purpose of studying the evolution of the genome.

Several new biological observations were presented during these meetings. For example, it appears that many isozymes have characteristic subcellular locales which contribute to overall regulation of enzymatic activity and physiological function. In a very similar vein, evidence was brought forth indicating that some isozymes are bound preferentially in the cell and that the release from binding is mediated by a change in coenzyme ratios. The binding specificities of these isozymes are undoubtedly important in subcellular localization, and there are substantial differences in kinetic properties between the bound and unbound forms, suggesting an important regulatory role for these isozymes.

Those researchers employing allelic isozymes in population, ecological, and evolutionary studies indicated the importance of examining allelic isozymes at many enzyme loci, loci encoding for enzymes in many different metabolic pathways, in order to gain a coherent picture of responses to different selective forces.

A consideration of gene expression during cellular differentiation and the analysis of isozyme patterns in neoplastic cells may permit the elucidation of some of the genetic and molecular bases of cancer. Furthermore, the presence of embryo-specific and cell-specific isozymes opens new avenues of investigation into the specificity of gene function and in addition raises the rather broad question of whether constellations of enzymes exist in unique isozymic forms within certain specialized cells and tissues.

The success of the meeting was in part reflected by the enthusiastic and vigorous discussions during the sessions and by the large number of younger scientists who use isozymes to test hypotheses that had only been formulated within the last few years. The symposium proceedings are expected to be published, in four volumes, by Academic Press.

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AAAS NEWS

(Continued from page 424)

Other AAAS seminars held since May 1973 have dealt with regional energy resources and transportation problems. During 1974 seminars were held in Tucson, San Diego, Albuquerque, and Portland, Maine. The Association plans to strengthen and broaden the program during the coming year.

—WILLIAM A. BLANPIED

A Request to Readers

"AAAS News" was inaugurated with the 15 November 1974 issue of *Science* as a means of communication between the AAAS Membership and Program offices. Since all five of those offices have presented brief outlines of their programs, it is time to ask AAAS members what they would like to see reported in "AAAS News" and, more generally, how they believe the program offices can better serve their needs and interests.

Letters can be addressed to the Communications Department or directly to the appropriate program offices.

Notes from the Offices

Science and Society Programs. The deadline for completed applications for the 1975–76 Congressional Science Fellows Program is 31 March.

A "Directory of Public Service Internships" is available free of charge from the National Center for Public Service Internship Programs, 1735 I Street, NW, Washington, D.C. 20036.

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Opportunities in Science. Minority and women scientists who are interested in arranging symposia for the AAAS Annual Meeting in Boston in February 1976 should contact the office promptly.

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International Science. The office would appreciate receiving notes, reports, and other information on the problems encountered with the introduction of small-scale technologies, particularly small-scale energy devices and those related to food production and processing. The differentiated introduction to and the use by women is of special concern.

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Communications. A series of seminars on the science of food is being planned. These will be organized in cooperation with local science museums starting in late spring. Suggestions for specific themes, speakers, and locations are invited.

Members interested in participating in other education programs at their local science museums should also identify themselves.

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Science Education. The office will continue its NSF-supported Leadership Specialist Project in 1975–76, assisting ten schools with large minority populations to develop effective in-service programs for teachers who are preparing to use *Science—A Process Approach.*

NOVA Program Schedule

9 February. *The Lysenko Affair.* A dramatic reconstruction of the battle that raged for 20 years in the Soviet Union between the Lysenkoists and the classical geneticists and ended abruptly in 1948 when Stalin announced his support of Lysenko (a BBC/WGBH production).

16 February. *The Tuaregs.* The way of life of Sidi Mohammed and his family, who live high in the Hoggar Mountains of the Sahara Desert, is crumbling. Yet they have still not admitted that perhaps they too must change (a Granada production).

23 February. *Bird Brain—The Mystery of Bird Navigation* (repeat). The use of radar has shown that many migrating birds travel at night and can be excellent meteorologists. Homing pigeons behave as if they have a map to tell them where home lies and a compass to tell them how to get there (a BBC production).

2 March. *The Search for Life* (repeat). The Viking lander will set down on Mars in July 1976 to try to find out if life exists outside the earth. The NOVA team explores the origins of life on Earth and examines the Viking lander being built in its germfree, ultraspecial room before starting on its long journey (a WGBH production).

9 March. *The Plutonium Connection.* An investigation is made on the ease with which a nuclear bomb could be designed using unclassified information, on how effectively the plutonium required for that purpose is guarded, and on whether it will ever be possible to keep track of the increasing quantities of plutonium being produced in reactors around the world (a WGBH production).