AMERICAN
ASSOCIATION FOR THE
ADVANCEMENT OF
SCIENCE

SCIENCE

ISSN 0036-8075
15 APRIL 1988
VOLUME 240
NUMBER 4850

263 This Week in *Science*

Editorial
265 Academic-Industrial Interactions

Perspective
267 The Protein Folding Problem: T. E. CREIGHTON

Letters
268 NIH Drug Tests: J. M. WALSH; C. HOLDEN ■ The Windscale Legacy: D. LOWRY

News & Comment
271 Breakthrough for Education at NSF?
273 Test Ban Test Back on Track
274 Voodoo Science
277 Japanese Views on Science Compare to U.S. Attitudes
278 Editorial Changes for Einstein Papers
279 *Briefing*: Nobel Prizes Go Up ■ More NAE News Members ■ Duesberg Gets His Day in Court ■ Telescope Builder Lured Back to Europe

Research News
280 Superconductivity: The FAX Factor
282 Race for Cystic Fibrosis Gene Nears End
286 Hypercube Breaks a Programming Barrier

Articles
287 Adaptability of the U.S. Industrial Relations System: T. A. KOCHAN
293 The Greenhouse Theory of Climate Change: A Test by an Inadvertent Global Experiment: V. RAMANATHAN
300 Action at a Distance Along a DNA: J. C. WANG AND G. N. GIAEVER

Research Articles
305 Tryptophan-Requiring Mutants of the Plant *Arabidopsis thaliana*: R. L. LAST AND G. R. FINK

Reports
311 Regulation of Interprotein Electron Transfer by Residue 82 of Yeast Cytochrome c: N. LIANG, A. G. MAUK, G. J. PIELAK, J. A. JOHNSON, M. SMITH, B. M. HOFFMAN

■ **SCIENCE is published weekly on Friday, except the last week in December, and with an extra issue in February by the American Association for the Advancement of Science, 1333 H Street, NW, Washington, DC 20005.** Second-class postage (publication No. 484460) paid at Washington, DC, and at an additional entry. Now combined with **The Scientific Monthly®** Domestic individual membership and subscription (51 issues): $65. Domestic institutional subscription (51 issues): $98. Foreign postage extra: Canada $32, other (surface mail) $27, air-surface via Amsterdam $65. First class, airmail, school-year, and student rates on request. Single copies $3.00 ($3.50 by mail); back issues $4.50 ($5.00 by mail); Biotechnology issue, $5.50 ($6 by mail); classroom rates on request; Guide to Biotechnology Products and Instruments $16 ($17 by mail). **Change of address:** allow 6 weeks, giving old and new addresses and seven-digit account number. The identification code for *Science* is 0036-8075/83 $1 + .10. **Postmaster:** Send Form 3579 to *Science*, 1333 H Street, NW, Washington, DC 20005. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

■ The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

COVER Auxotrophic *trp1-1* mutants of *Arabidopsis thaliana*, blocked in anthranilate phosphoribosyl transferase, are fluorescent under ultraviolet light due to accumulation of intermediates in the pathway of tryptophan biosynthesis. The middle column of fluorescent mutant plants is surrounded by larger, nonfluorescent wild-type *A. thaliana* plants. See page 305. [Robert L. Last, Whitehead Institute for Biomedical Research, Cambridge, MA 02142]

314 Three-Dimensional Solution Structure of Plastocyanin from the Green Alga *Scenedesmus obliquus*: J. M. MOORE, D. A. CASE, W. J. CHAZIN, G. P. GIPPERT, T. F. HAVEL, R. POWLS, P. E. WRIGHT

317 Yeast HAP2 and HAP3: Transcriptional Activators in a Heteromeric Complex: S. HAHN AND L. GUARENTE

321 Interleukin-1 Immunoreactive Innervation of the Human Hypothalamus: C. D. BREDER, C. A. DINARELLO, C. B. SAPER

324 Molecular Cloning of Human and Rat Complementary DNA Encoding Androgen Receptors: C. CHANG, J. KOKONTIS, S. LIAO

327 Cloning of Human Androgen Receptor Complementary DNA and Localization to the X Chromosome: D. B. LUBAHN, D. R. JOSEPH, P. M. SULLIVAN, H. F. WILLARD, F. S. FRENCH, E. M. WILSON

330 Functional Expression of a New Pharmacological Subtype of Brain Nicotinic Acetylcholine Receptor: K. WADA, M. BALLIVET, J. BOULTER, J. CONNOLLY, E. WADA, E. S. DENERIS, L. W. SWANSON, S. HEINEMANN, J. PATRICK

334 Exon-Intron Organization in Genes of Earthworm and Vertebrate Globins: S. M. JHIANG, J. R. GAREY, A. F. RIGGS

336 Oral *Salmonella typhimurium* Vaccine Expressing Circumsporozoite Protein Protects Against Malaria: J. C. SADOFF, W. R. BALLOU, L. S. BARON, W. R. MAJARIAN, R. N. BREY, W. T. HOCKMEYER, J. F. YOUNG, S. J. CRYZ, J. OU *et al.*

338 Increased Attention Enhances Both Behavioral and Neuronal Performance: H. SPITZER, R. DESIMONE, J. MORAN

Book Reviews

341 Historical Studies in the Physical Sciences, vol. 8, part 1, *reviewed by* K. HUFBAUER ■ Genetic Constraints on Adaptive Evolution, M. KIRKPATRICK ■ Evolution of the Lewisian and Comparable Precambrian High Grade Terrains, R. ST. J. LAMBERT ■ Experimental Fluvial Geomorphology, R. SLINGERLAND ■ Books Received

Products & Materials

345 Monoclonal Antibody Purifier ■ Planar Liquid Chromatography ■ Stability-Variance Software ■ Densitometer ■ Biocompatible Chromatograph ■ Laboratory Application Language ■ DNA Synthesizer ■ Literature

SCIENCE

15 APRIL 1988
VOLUME 240
NUMBER 4850

Academic-Industrial Interactions

The rationale and mechanisms for public support of research in the physical sciences, mathematics, and engineering are undergoing profound and probably irreversible change. Where once the federal government was essentially the sole source of research funds for universities, the states and industry are becoming significant factors. In an earlier day, the widely held view was that federal sponsorship of basic research would automatically lead to societal benefits, including innovative applications and industrial competitiveness. The belief was more or less valid for the United States at a time when this country was the world's unchallenged leader in technology.

This nation will encounter tough global industrial competition for the foreseeable future. In this circumstance, it is the states rather than the federal government that have been highly innovative. Today, there are 500 state and local high-tech programs in 45 states aimed at improving economic competitiveness.

The recession in 1981 brought hardship and 15% unemployment to the states of the Rust Belt such as Ohio. It was good politics in the Rust Belt to create programs that used state funds to create jobs, to support innovation by small companies, and to facilitate university-industrial collaboration. At least ten different types of programs have been devised, such as research parks, incubators, and provision of venture capital, but the major activities involve university research or industrial extension services. Appropriations are usually leveraged by contributions from industry that match or exceed those from the state. An exuberant report from Pennsylvania tells that in the interval from 1983 to 1987, more than 10,500 jobs were created or retained and that $76.6 million in state funds attracted more than $280 million in private investment. Virtually all the colleges and universities (public and private) of Pennsylvania are members of a partnership that interacts with 2500 firms. More than half are small enterprises that could not afford to maintain research activities on their own.

In Ohio several programs foster start-up companies. However, the major emphasis is on future-oriented major industrial-university interactions. At nine Edison Technology Centers, academic researchers work on industrial problems especially relevant to the state. Each center is built around the problems of a single set of technologies such as advanced manufacturing, polymer innovation, or welding engineering. Each center has a number of companies and academic institutions as members. More than 500 companies and every university in the state participate.

Activities in New Jersey appear to be unusually well conceived. A $90-million state bond issue provided funds for buildings and equipment. Management of the enterprise is vested in a commission on science and technology whose members include bipartisan legislators, university presidents, and highly competent scientists and engineers. Among the various programs being supported, major emphasis is on advanced technology centers, eight of which are in operation. Among the fields covered are advanced scientific computing, industrial ceramics, biotechnology and medicine, computer aids for industrial productivity, and plastics recycling. In the future, centers for photonics and surface modification may be established.

Texas has created what amounts to a science foundation that will support local basic and applied research. Eligible fields for basic research are mainly in the physical sciences and mathematics, but biological, behavioral, and social sciences are included. The biennial appropriation for basic research is $20 million. The corresponding funds for an Advanced Technology Program are $40 million. Among the fields to be supported are aerospace, biotechnology, manufacturing technology, materials science, and micro-electronics. Proposals will be reviewed by out-of-state scientists and engineers, but final authority resides in a 12-member board whose background is predominantly science and engineering.

The states have initiated many programs aimed at improving their ability to use science and technology. Similarities among the programs abound, but all differ in detail, whether in strategy, tactics, or management. It is too early to judge what will prove best, but indications are that initiatives have been largely successful and that the efforts are expanding.

—PHILIP H. ABELSON