

1 December 1978 • Vol. 202 • No. 4371

\$1.50

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Blue?

By and large, it's a miracle how closely the photographic process can match the real thing for color.

Except for an occasional special case. ►

Why this happens is no great mystery. Certain pigments that occur in flowers reflect quite strongly somewhat beyond the long-wavelength limit of human vision, while most color films have a red-sensing layer that does not drop off quite as rapidly at the long-wavelength end as vision drops off. The consensus of technical opinion in our establishment holds that if we were to switch sensitizers for a shorter red cutoff to please photographers of blue flowers, photographers of other subjects might be a shade less pleased with their results.

Now, in designing a color film fast enough for general use with whatever light exists, we had to make it tolerant to situations where part of the illumination might come from skylight, part from tungsten, part from fluorescents, and perhaps part from a bonfire—even if it is balanced for daylight, blue flash, and electronic flash. That's the real reason the new Kodacolor 400 film has a shorter red cutoff sensitization. When we took the above subject on this film and let the printing and processing machines take over, they turned out a print that looked like this. ►

If you are particularly interested in photographing blue flowers, give it a try and see if it does as well on others as it does on "Heavenly Blue" morning glories. If you would like some true sophistication on the subject of true color in color photography, we can send you an article by David L. MacAdam from the January 1967 issue of *Physics Today*. Just write "Truer Blue" with your name and address on a postcard and mail it to Dept. 55-S, Kodak, Rochester, N.Y. 14650.

P.S. To be fair, we must exclude from this discussion work by which professional photographers earn their fees. Color prints done manually by a professional, an advanced darkroom hobbyist, or a laboratory paid to use custom techniques in making a single print can deliver just about any color wanted for a given subject. This degree of freedom can not be expected from high-production machines.



When photographed on a "long red" film and properly machine-printed and processed, "Heavenly Blue" morning glories used to turn out like this. That was before a change made in the film in 1970.

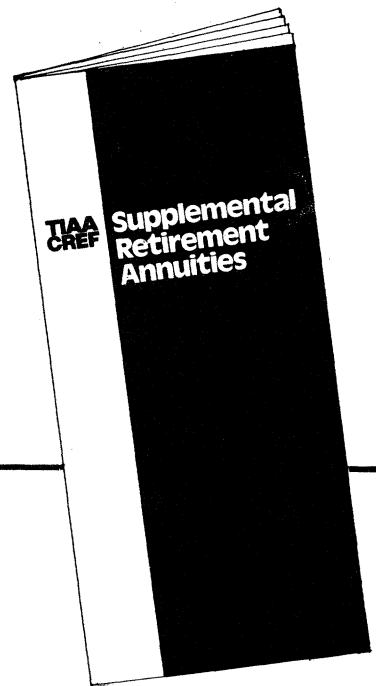


"Heavenly Blue" morning glory photographed again—but this time on our "short red" film.

Truer blue.



TIAA-CREF Supplemental Retirement Annuities



for tax-deferred annuity programs

Supplemental Retirement Annuities (SRA's) are new forms of TIAA and CREF contracts designed expressly for use by persons who want to set aside tax-deferred retirement funds over and above amounts being accumulated under their institution's basic retirement plan. They are available for employees of colleges, universities, private schools and certain other nonprofit educational organizations with tax-deferred annuity (salary-or-annuity option) programs. Through a properly drawn agreement with their institution, staff members may divert part of their compensation before taxes to the purchase of these new contracts.

And SRA's are cashable at any time. This means that if the money accumulated by salary reduction is needed before retirement, the SRA contracts can be surrendered for their cash value. Benefits, whether payable in cash or as income, are taxable as ordinary income when received.

For more information and answers to questions send for your copy of the booklet on Supplemental Retirement Annuities.

Send me a booklet describing
TIAA-CREF Supplemental Retirement Annuities.



Name _____ Date of Birth _____

Address _____
Street

City _____ State _____ Zip _____

Nonprofit
Employer _____

Teachers Insurance and Annuity Association
730 Third Avenue, New York, New York 10017

wi

SCIENCE

LETTERS	Harvard Public Health Dean: <i>P. R. Torrens</i> ; Handicapped Scientists: <i>G. J. Vermeij</i> ; The Nitrite Debate: <i>E. Jakobsson</i> ; Cover Story: <i>D. F. Dinges</i> ; <i>J. C. Stucki</i> ; <i>R. S. Zaris</i>	930
EDITORIAL	The Ph.D. "Glut": <i>H. Shull</i>	931
ARTICLES	Gamma-Ray Astrophysics: A New Look at the Universe: <i>J. Trombka</i> et al	933
	Synchronies in Mental Development: An Epigenetic Perspective: <i>R. S. Wilson</i>	939
	Margaret Mead 1901-1978.	948
NEWS AND COMMENT	EPA Smog Standard Attacked by Industry, Science Advisers	949
	Election Results Worry NSF	950
	Statue on the Mall to Hail Einstein's 100th	951
	Governor Jerry Brown: Reelection of a Politician Committed to Change	952
	Universities "Battered" by Federal Regulators	955
RESEARCH NEWS	NMR Research: Analysis of Living Cells and Organs.	958
	The 1978 Nobel Prize in Physics: <i>R. P. Hudson</i> ; <i>J. R. Pierce</i>	960
AAAS NEWS	1978 Election Results; Amendments to the AAAS Constitution and Bylaws; Board of Directors Makes China Trip; Science Cover Calendar for 1979; A New Magazine of Science?; CSFR Procedures for Individual Complaints; Directory of Puerto Rican Scientists Compiled; Youth Activities at Houston Meeting.	964

BOARD OF DIRECTORS	EMILIO Q. DADDARIO Retiring President, Chairman	EDWARD E. DAVID, JR. President	KENNETH E. BOULDING President-Elect	ELOISE E. CLARK MARTIN M. CUMMINGS	RENÉE C. FOX BERNARD GIFFORD
CHAIRMEN AND SECRETARIES OF AAAS SECTIONS	MATHEMATICS (A) Mark Kac Ronald Graham	PHYSICS (B) D. Allan Bromley Rolf M. Sinclair	CHEMISTRY (C) William E. McEwen William L. Jolly	ASTRONOMY (D) Paul W. Hodge Donat G. Wentzel	
	PSYCHOLOGY (J) Brenda Milner Meredith P. Crawford	SOCIAL AND ECONOMIC SCIENCES (K) Kurt W. Back Gillian Lindt	HISTORY AND PHILOSOPHY OF SCIENCE (L) Robert S. Cohen Diana L. Hall	ENGINEERING (M) Robert B. Beckmann Donald E. Marlowe	
	EDUCATION (Q) Marjorie H. Gardner James T. Robinson	DENTISTRY (R) Sholom Pearlman John Termine	PHARMACEUTICAL SCIENCES (S) John G. Wagner Raymond Jang	INFORMATION, COMPUTING, AND COMMUNICATION (T) Eugene Garfield Madeline M. Henderson	
DIVISIONS	ALASKA DIVISION		PACIFIC DIVISION		SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION
	Donald H. Rosenberg President	Keith B. Mather Executive Secretary	Glenn C. Lewis President	Alan E. Leviton Secretary-Treasurer	James W. O'Leary President Lora M. Shields Executive Officer
<p>SCIENCE is published weekly, except the last week in December, but with an extra issue on the third Tuesday in September, by the American Association for the Advancement of Science, 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Now combined with The Scientific Monthly. Second-class postage paid at Washington, D.C., and additional entry. Copyright © 1978 by the American Association for the Advancement of Science. Member rates on request. Annual subscriptions \$65; foreign postage: Canada \$10; other surface \$13; air-surface via Amsterdam \$30. Single copies \$1.50; \$2 by mail (back issues \$3) except Guide to Scientific Instruments \$6. School year subscriptions: 9 months \$50; 10 months \$55. Provide 6 weeks' notice for change of address, giving new and old addresses and postal codes. Send a recent address label, including your 7-digit account number. Postmaster: Send Form 3579 to Science, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. <i>Science</i> is indexed in the <i>Reader's Guide to Periodical Literature</i> and in several specialized indexes.</p>					

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

- BOOK REVIEWS** Abortion in America, reviewed by R. L. Numbers; Planets and Planetarians, N. S. Hetherington; Scripps Institution of Oceanography, S. Schlee; Mosquitoes, Malaria and Man, B. H. Kean; Cosmic Dust, J. R. Arnold 967

- REPORTS** Gulf Stream Ring Coalescence with the Gulf Stream off Cape Hatteras: D. R. Watts and D. B. Olson 971
- Low Repetitive DNA Content in *Aspergillus nidulans*: W. E. Timberlake 973
- Calcium-Induced Contraction of the Rhizoplast of a Quadriflagellate Green Alga: J. L. Salisbury and G. L. Floyd 975
- Serotonin Shifts the Phase of the Circadian Rhythm from the *Aplysia* Eye: G. Corrent, D. J. McAdoo, A. Eskin 977
- Medical Technology and Cost Containment: Two Applications of Operations Research: R. S. Ledley, T. R. Thiagarajan, T. P. Landau 979
- Homoeologous Chromosome Pairing: Frequency Differences in Inbred and Intraspecific Hybrid Polyploid Ferns: L. G. Hickok 982
- Long Ascending Projections from Substantia Gelatinosa Rolandi and the Subjacent Dorsal Horn in the Rat: G. J. Giesler, Jr., et al. 984
- Spinothalamic Tract Neurons in the Substantia Gelatinosa: W. D. Willis, R. B. Leonard, D. R. Kenshalo, Jr. 986
- β -Endorphin Is Associated with Overeating in Genetically Obese Mice (*ob/ob*) and Rats (*falfa*): D. L. Margules et al. 988
- Conservation of Liquid and Solid Quantity by the Chimpanzee: G. Woodruff, D. Premack, K. Kennel 991
- Child Spacing and Birth Order: Effect on Intellectual Ability in Two-Child Families: L. Belmont, Z. Stein, P. Zybert 995
- Long-Latency "Subthreshold" Collicular Responses to the Constant-Frequency Components Emitted by a Bat: A. D. Grinnell and P. Brown 996
- Conformational Changes in 16S Ribosomal RNA Induced by 30S Ribosomal Subunit Proteins from *Escherichia coli*: A. A. Bogdanov et al. 999
- Technical Comments: Ultradian Cortisol Rhythms in Monkeys: Synchronized or Not Synchronized?: R. E. Kronauer, M. C. Moore-Ede, M. S. Menser; J. W. Holaday and B. H. Natelson 1001

MIKE MC CORMACK FREDERICK MOSTELLER	RUSSELL W. PETERSON CHEN NING YANG	WILLIAM T. GOLDEN Treasurer	WILLIAM D. CAREY Executive Officer
--	---------------------------------------	--------------------------------	---------------------------------------

GEOLOGY AND GEOGRAPHY (E) Gerald M. Friedman Ramon E. Bisque	BIOLOGICAL SCIENCES (G) Ursula K. Abbott Walter Chavin	ANTHROPOLOGY (H) June Helm Priscilla Reining
MEDICAL SCIENCES (N) Leon O. Jacobson Leah M. Lowenstein	AGRICULTURE (O) James B. Kendrick Coyt T. Wilson	INDUSTRIAL SCIENCE (P) David B. Hertz Robert L. Stern
STATISTICS (U) Samuel W. Greenhouse Ezra Glaser	ATMOSPHERIC AND HYDROSPHERIC SCIENCES (W) Kenneth C. Spengler Glenn R. Hilst	GENERAL (X) Allen V. Astin Joseph F. Coates

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

Plant muscle. Sequence showing contraction of rhizoplasts of the green alga *Platymonas*. The contraction is triggered by calcium and is cyclic in the presence of both calcium and adenosine triphosphate. Rhizoplast contraction is thought to be functionally linked to flagellar activity. The upper rhizoplast pair is a composite image. (Actual length of one extended rhizoplast is approximately 2.5 micrometers.) See page 975. [J. L. Salisbury and G. L. Floyd, Ohio State University, Columbus]

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Science serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in *Science*—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

Editorial Board

1978: RICHARD E. BALZHISER, JAMES F. CROW, HANS LANDSBERG, EDWARD NEY, FRANK W. PUTNAM, MAXINE SINGER, PAUL E. WAGGONER, F. KARL WILLENBROCK

1979: E. PETER GEIDUSCHEK, WARD GOODENOUGH, N. BRUCE HANNAY, MARTIN J. KLEIN, FRANKLIN A. LONG, NEAL E. MILLER, JEFFREY J. WINE

Publisher

WILLIAM D. CAREY

Editor

PHILIP H. ABELSON

Editorial Staff

Managing Editor
ROBERT V. ORMES
Assistant Managing Editor
JOHN E. RINGLE

Business Manager
HANS NUSSBAUM
Production Editor
ELLEN E. MURPHY

News and Comment: BARBARA J. CULLITON, *Editor*;
WILLIAM J. BROAD (intern), LUTHER J. CARTER, CONSTANCE HOLDEN, ELIOT MARSHALL, DEBORAH SHAPLEY, R. JEFFREY SMITH, NICHOLAS WADE, JOHN WALSH, *Editorial Assistant*, SCHERRAINE MACK

Research News: ALLEN L. HAMMOND, *Editor*; RICHARD A. KERR, GINA BARI KOLATA, JEAN L. MARX, THOMAS H. MAUGH II, WILLIAM D. METZ, ARTHUR L. ROBINSON, *Editorial Assistant*, FANNIE GROOM

Associate Editors: ELEANORE BUTZ, MARY DORFMAN, SYLVIA EBERHART, JUDITH GOTTLIEB

Assistant Editors: CAITILIN GORDON, RUTH KULSTAD, LOIS SCHMITT, DIANE TURKIN

Book Reviews: KATHERINE LIVINGSTON, *Editor*;
LINDA HEISERMAN, JANET KEGG

Letters: CHRISTINE KARLIK

Copy Editor: ISABELLA BOULDIN

Production: NANCY HARTNAGEL, JOHN BAKER; YA LI SWIGART, ELEANOR WARNER; JEAN ROCKWOOD, LEAH RYAN, SHARON RYAN

Covers, Reprints, and Permissions: GRAYCE FINGER, *Editor*; CORRINE HARRIS, MARGARET LLOYD

Guide to Scientific Instruments: RICHARD SOMMER

Assistant to the Editors: RICHARD SEMIKLOSE

Membership Recruitment: GWENDOLYN HUDDLE

Member and Subscription Records: ANN RAGLAND

EDITORIAL CORRESPONDENCE: 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Area code 202. General Editorial Office, 467-4350; Book Reviews, 467-4367; Guide to Scientific Instruments, 467-4480; News and Comment, 467-4430; Reprints and Permissions, 467-4483; Research News, 467-4321; Cable: *Advancesci*, Washington. For "Instructions for Contributors," write the editorial office or see page xi, *Science*, 29 September 1978.

BUSINESS CORRESPONDENCE: Area Code 202. Business Office, 467-4411; Circulation, 467-4417.

Advertising Representatives

Director: EARL J. SCHERAGO

Production Manager: MARGARET STERLING

Advertising Sales Manager: RICHARD L. CHARLES

Marketing Manager: HERBERT L. BURKLUND

Sales: NEW YORK, N.Y. 10036: Steve Hamburger, 1515 Broadway (212-730-1050); SCOTCH PLAINS, N.J. 07076: C. Richard Callis, 12 Unami Lane (201-889-4873); CHICAGO, ILL. 60611: Jack Ryan, Room 2107, 919 N. Michigan Ave. (312-DE-7-4973); BEVERLY HILLS, CALIF. 90211: Winn Nance, 111 N. La Cienega Blvd. (213-657-2772); DORSET, VT. 05251: Fred W. Dieffenbach, Kent Hill Rd. (802-867-5581)

ADVERTISING CORRESPONDENCE: Tenth floor, 1515 Broadway, New York, N.Y. 10036. Phone: 212-730-1050.

The Ph.D. "Glut"

There apparently is little we can do directly to affect the demand for students receiving Ph.D. degrees. Some have hoped to increase demand by encouraging early retirement, altering the nature of the tenure contract, encouraging more part-time employment, and the like. Such actions can be expected to have only relatively minor effects on the demand for new academic employees with Ph.D.'s. The general state of the economy undoubtedly plays the major role in encouraging expansion or contraction of the job market, but we certainly can exert little influence on that.

We need to be better informed, however, about the nature of and trends in demand. We have been remiss in not following more closely how our degree students fit into the general employment market. This is the type of information we need to properly advise new applicants for graduate study. The availability of such information will almost certainly affect supply, and it may give us new insights in how we can affect demand in the future.

There are two less direct ways in which we can affect demand for Ph.D.'s. First, we can make more widely understood the utility of doctoral education, thereby creating demand where none now exists. Second, we can hope to make the expectations of students more realistic, thereby broadening the scope of acceptable employment goals. Each of these has promise for narrowing the gap between supply and demand, and each is something we can hope to affect by our own actions.

We provide added value to the individuals who go through our programs. But there is widespread misunderstanding of even what constitutes the value that is added. There is a general misconception that the main value added is knowledge of a highly specialized nature represented by the title of the dissertation. This knowledge base is by no means the major part, or even a major part, of the real value the Ph.D. received from study.

We are engaged, I believe, in ensuring that each individual possesses a background and a set of tools that enable him or her to define, to attack, and to solve new problems. We use the case-study approach in a single, narrow area as the means of teaching problem-solving. Education is a ladder used to gather fruit from the tree of knowledge, not the fruit itself.

That this principle is true is strongly indicated by what happens to individuals who receive a doctorate. Few of them continue to work in the narrow area represented by the dissertation title even for a time as short as several years, although most continue to work in the same general field. The methodology learned in pursuing one case study is usually transferred to other such studies within the basic discipline.

The fact that we educate problem-solvers is not widely appreciated. Society needs problem-solvers more than ever before, but there is often no recognition that our output of Ph.D.'s is a source of prospective candidates for positions that require this attribute. Our product is adaptable to many end uses. We are remiss in not letting others, especially the students themselves, know how adaptable they really are.

It is obviously important for the student to understand the fundamental nature of the education received. Failure to do so contributes to false expectations. The Ph.D. "glut" was a problem in part because many of those who received their degrees in the critical years failed to obtain the kind of employment they felt was befitting for an individual who had worked hard for that degree over many years. Few companies or institutions looking for employees really understood the attractiveness of bright young problem-solvers for use in a wide variety of employment areas. Were students and prospective employers to make a more realistic appraisal of the values added by graduate education, the problem of the Ph.D. "glut" would be substantially diminished.—HARRISON SHULL, *Professor of Chemistry, Indiana University, Bloomington 47401*.

Extracted from an address presented to the Conference of the Association of Graduate Schools, Austin, Texas, 2 October 1978.

SOLAR ENERGY IN AMERICA

William D. Metz and Allen L. Hammond

An authoritative
book that documents
where solar energy has
been and where it is going.

Based on in-depth reporting for SCIENCE magazine, **Solar Energy in America** is a thorough assessment of our progress in tapping the ultimate energy source — the sun. While no single energy source may meet all future demands, solar energy seems to have the greatest potential. It is technically feasible, environmentally attractive, and rapidly becoming commercially sound. **Solar Energy in America** details the diverse technologies that depend upon the sun as their energy source, evaluates the potential and the problems of each, and alerts the reader to both the short-term and long-range prospects. The authors find that the field of solar energy is undergoing an unparalleled technical revival, and that there is no reason why many solar technologies cannot begin to be used at once. **Solar Energy in America** — the latest edition of the expanding SCIENCE Report series* — will be a useful publication for solar energy enthusiasts as well as skeptics, for college students as well as policy analysts. It is a AAAS book for everyone who wants a broad and thorough perspective on solar energy today.

Solar Energy in America; by William D. Metz and Allen L. Hammond. 1978, xvi + 218 pages, index.
Retail price: \$18.50 (casebound), \$8.50 (paperbound).

*The first title in the series is Combating the #1 Killer: The SCIENCE Report on Heart Research, by Jean L. Marx and Gina Bari Kolata. xi + 205 pages. \$17.00 (casebound), \$7.50 (paperbound). AAAS members deduct 10% from retail price.

To order your copy of **Solar Energy in America**, please send your name and address to AAAS, Department ES-1, 1515 Massachusetts Avenue, NW, Washington, DC 20005. Remittance must accompany all orders under \$10.00. AAAS members deduct 10% from retail price. Please allow 6-8 weeks for delivery.



American
Association
for the
Advancement
of Science