

SCIENCE

<http://www.aaas.org>

Publisher: Richard S. Nicholson
Editor-in-Chief: Floyd E. Bloom
Editor: Ellis Rubinstein
Managing Editor: Monica M. Bradford
Deputy Editors: Philip H. Abelson (*Engineering and Applied Sciences*); John I. Brauman (*Physical Sciences*); Thomas R. Cech (*Biological Sciences*)

Editorial Staff

Assistant Managing Editor: Dawn Bennett
Senior Editors: Eleanore Butz, R. Brooks Hanson, Pamela J. Hines, Barbara Jasny, Katrina L. Kelner, Paula A. Kiberstis, Linda J. Miller, L. Bryan Ray, Phillip D. Szuromi, David F. Voss
Associate Editors: Gilbert J. Chin, Suki Parks, Linda R. Rowan
Letters: Christine Gilbert, *Editor*; Steven S. Lapham
Book Reviews: Katherine Livingston, *Editor*; Jeffrey Hearn, *Editorial Assistant*
Editing: Valerie Jablow, *Supervisor*; Cara Tate, *Senior Copy Editor*; Jeffrey E. Cook, Harry Jach, Erik G. Morris, Christine M. Pearce
Copy Desk: Ellen E. Murphy, *Supervisor*; Sherri Byrand, Joi S. Granger, Daniel T. Helgerman, Beverly Shields, Kameaka Williams, *Assistant*
Editorial Support: Sherryf Farmer, *Supervisor*; Brent Gendleman, Carolyn Kyle, Michele Listisard, Diane Long, Patricia M. Moore, Ted Smith
Administrative Support: Sylvia Kihara, Charlene King
Computer Specialist: Roman Frillarte
Telephone: 202-326-6501; **FAX:** 202-289-7562; **TDD:** 202-408-7770

News Staff

News Editor: Colin Norman
Deputy News Editors: Tim Appenzeller, Joshua Fischman, Jean Marx, Jeffrey Mervis
News & Comment/Research News Writers: Linda B. Felaco (copy), Constance Holden, Jocelyn Kaiser, Richard A. Kerr, Andrew Lawler, Eliot Marshall, Kimberly Peterson (intern), Robert F. Service
Bureaus: Marcia Barinaga (Berkeley), Jon Cohen (San Diego), James Glanz (Chicago), Dennis Normile (Tokyo), Wade Roush (Boston)
Contributing Correspondents: Barry A. Cipra, Elizabeth Culotta, Ann Gibbons, Charles C. Mann, Anne Simon Moffat, Virginia Morell, Robert Pool, Gary Taubes
Administrative Support: Scherraine Mack, Fannie Groom
Telephone: 202-326-6500; **FAX:** 202-371-9227; **Internet Address:** science_news@aaas.org

Art & Production Staff

Production: James Landry, *Director*; Wendy K. Shank, *Manager*; Elizabeth A. Harman, *Assistant Manager*; Laura A. Creveling, *Associate*; Leslie Blizard, *Assistant*
Art: Amy Decker Henry, *Director*; C. Faber Smith, *Associate Director*; Katharine Sutliff, *Scientific Illustrator*; Holly Bishop, *Graphics Associate*; Elizabeth Carroll, Preston Morrighan, *Graphics Assistants*

Europe Office

Editorial: Richard B. Gallagher, *Office Head and Senior Editor*; Stella M. Hurtley, Julia Uppenbrink, *Associate Editors*; Belinda Holden, *Editorial Associate*
News: Daniel Clery, *Editor*; Nigel Williams, *Correspondent*; Michael Balter (*Paris*), Patricia Kahn (*Heidelberg*), Richard Stone (*Russia*), *Contributing Correspondents*
Administrative Support: Janet Mumford; Anna Sewell
Address: 14 George IV Street, Cambridge, UK CB2 1HH
Telephone: (44) 1223-302067; **FAX:** (44) 1223-302068
Internet address: science@science-int.co.uk

Science Editorial Board

Charles J. Arntzen	F. Clark Howell
David Baltimore	Paul A. Marks
J. Michael Bishop	Yasutomi Nishizuka
William F. Brinkman	Helen M. Ranney
E. Margaret Burbidge	Bengt Samuelsson
Pierre-Gilles de Gennes	Robert M. Solow
Joseph L. Goldstein	Edward C. Stone
Mary L. Good	James D. Watson
Harry B. Gray	Richard N. Zare
John J. Hopfield	

Science's Next Wave

Editor: John Benditt

EDITORIAL

An Enhanced Perspective

Vannevar Bush, the oft-cited architect of the post-World War II federal investment in academic scientific research, had a busy summer 50 years ago. Not only was he then drafting *Science—The Endless Frontier: A Report to the President*, he also managed to anticipate coming technological advances for use in harnessing the scientific literature, one of which *Science On-Line* is today adding to its offerings for our readers.

In the July 1945 *Atlantic Monthly*, in an essay entitled "As We May Think,"* Bush conceived of a hypothetical device called "memex," in which "an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility." Bush's memex was the forerunner of what is known today as hypertext, because it would enable a scholar to follow trails of information in a manner more like that in which the human mind associates facts—in an "associative indexing" arrangement that allows any item of information encountered to be used to select an associated item "immediately and automatically." Items linked in this way and saved digitally for future use could then be linked to other trails of information gathered by scholars with different interests.

With the on-line version of this week's issue, *Science* and HighWire Press of Stanford University (our creative partner for distributing information on the World Wide Web) are offering for our readers' assessment 11 Enhanced Perspectives (expanded versions of 10 Perspectives published between October and December 1995, plus this issue's Perspective by Hilgetag *et al.*). The enhancement is that a series of hypertext notes (HNs) have been added to the reference materials cited by the author in the original printed Perspective. A "click" on any of the HNs establishes live links to the additional bibliography, and these bibliographic notes in turn provide live links to the original sources of information cited, starting with the associated papers in *Science* or other journals. At these linked locations, a scholar may extend the search to related or contrasting items. The reader can even go beyond the text resources cited by the author (for example, to the National Library of Medicine's Medline collection, whose complete citations and abstracts in turn become accessible).

And there's more. Some HNs link to larger databases, ranging from those containing genomic, protein, and crystal structures; to specialized dictionaries and glossaries; to collections of otherwise unavailable abstracts of unpublished information; to notes on the researchers, their laboratory settings, and the funding agencies who supported the work. Other HNs will take a scholar to a new database, such as the National Center for Biotechnology Information's Entrez Browser of molecular information, whose remarkable data and search capacity can take a sample of text from a paper and find new references that have a similar keyword profile.

And there's still more. In addition to providing links to textual resources and databases, other HN links provide animated displays of the phenomena being discussed, which are immediately downloadable and operative. Any or all of these linked information items can be viewed with a scholar's Web browsing software, thus making it possible to reach out to the information stored on the Web and bring it back to the scholar's desk.

All this is pretty heady stuff, even for the Web-savvy editors who have sampled it for the past several weeks. At first glance, the main value added by these latest enhancements is that they allow one to thread together information that is pertinent to what one is currently interested in, rather than simply to discover the existence of an inaccessible reference that will require a trip to the library someday. But that's surely not all this technology will provide. Although the current links have been selected and constructed by human information specialists, if one looks only a short way ahead, one can conceive of intelligent links that know the content profile of the items they start with and of the items they find, and can lead the data hunter to other items of variably definable similarity.

We assume that the Enhanced Perspectives series will soon expand beyond the life sciences to other parts of the scientific frontier. Do readers find such an effort to be useful for their work or intellectual enjoyment? Given the resources required to provide these enhancements, we really want to hear your answer.

Floyd E. Bloom

*"As We May Think" is available on the Web at URL <<http://www.isg.sfu.ca/~duchier/misc/vbush/vbush.txt>>.