

by the orbit of Mercury than by light bending, although the latter was discovered only after having been predicted from the theory. Second, as subsequent attempts to explain light bending along Newtonian lines failed, scientists came to regard light bending as carrying greater evidential weight. The lesson is that empirical evidence for a new theory counts more heavily when it cannot be handled by, but bears on principles central to, existing theory. The basic point has, of course, been familiar since Kuhn's discussion of anomalies in 1962, but Brush provides an important example which makes clear that merely forecasting a new phenomenon by itself provides only weak support for a new theory.

Thus, Brush shows Popper was wrong in his interpretation of the importance of light bending, but it should be plain that this has nothing to do with the soundness of the falsifiability criterion. A theory so flexible that one can always find a way to explain any phenomenon, whether before or after the fact, is not scientifically interesting or useful. However, this criterion does not demand prediction of novel phenomena in advance. In short, the question of falsifiability concerns the nature of acceptable theory in natural science, whereas the issue of prediction of novel phenomena in advance has to do with the historical process of theory change.

THOMAS P. WILSON
Department of Sociology,
University of California,
Santa Barbara, CA 93106

Brush's use of the word "fact" (for example, "subsequent evaluations of [Einstein's] theory in the technical literature do not seem to give greater weight to the prediction of novel facts than to the persuasive deduction of known facts") undercuts his argument. Since the word "fact" implies immutable truth, use of phrases such as "known facts" undercuts such statements as "observations are not intrinsically more reliable sources of knowledge than theories. . . ." More appropriate words than "fact" would include "observation," "data," and "theory," which imply incompleteness and falsifiability.

This mutability is the basis of the superiority of science as an explanatory-predictive system—scientists' observations and theories can be progressively corrected by scientists' further attempts at explanation and prediction, that is, there is a knowledge feedback loop. The use of "fact" to describe an observation or theory undercuts the system's strength by making a dynamic process into something static.

BERNARD BERGMANN
Departments of Psychiatry and Psychology,
University of Chicago, Chicago, IL 60637

Brush notes that the initial surprise over gravitational light bending—and the initial power of this result in support of Einstein's general relativity theory—soon dissipated when alternative explanations of the phenomenon were tested. This may be an example of what psychologists have studied as "hindsight bias"; uncertain events are rated less surprising after they occur than the same events are rated before they occur (1). It appears that physicists initially reacted to light bending in terms of its prospective surprise value, but moved easily to a reduced surprise in retrospect. If they did not go so far as to say they "knew it all along," many were soon a long way from admitting they "never would have guessed it" (2).

CLARK MCCAULEY
Department of Psychology,
Bryn Mawr College,
Bryn Mawr, PA 19010

REFERENCES

1. B. Fischhoff, *J. Exp. Psychol. Hum. Percep. Perform.* 1, 288 (1975).
2. S. Hoch and G. Lowenstein, *J. Exp. Psychol. Learn. Mem. Cognit.* 15, 605 (1989).

Response: Wilson says that the criterion of falsifiability "does not demand prediction of novel phenomena in advance." Although some philosophers of science agree with him, others do not. My reading of the Popper texts cited in my article is that Popper himself does (most of the time) demand novel prediction [see, for example, (1, p. 117)] and that this was the reason for his original objection to Darwinian theory (1, p. 340). In any case that is the interpretation that has been widespread in the popular scientific literature and has been used to denigrate the scientific legitimacy of evolutionary biology, psychoanalysis, and so forth.

Bergmann dislikes my use of the word "fact" because it implies "immutable truth." I agree that scientists should try to use other words suggesting vulnerability to revision. As a historian I observe that scientists do talk as if light bending and the advance of Mercury's perihelion are "facts."

STEPHEN G. BRUSH
Department of History and
Institute for Physical Science and Technology,
University of Maryland,
College Park, MD 20742-2431

REFERENCES

1. K. Popper, *Conjectures and Refutations* (Basic Books, New York, 1962).

Water Temperatures

In a helpful and informative article about



The Human Genome Organisation Nominations for Membership

HUGO is an international organisation of scientists. Its major objective is the coordination of human genome research, with a view to encouraging collaboration between scientists and avoiding unnecessary duplication of effort. Its other objectives include making the exchange of data and materials as easy as possible. It also plans to encourage debate on the social and ethical impact of human genome projects.

Membership is by election, after nomination either by five HUGO members or by HUGO Council. The Council has decided that it wishes to widen the membership: in particular, it hopes to include people in cognate areas of research such as information technology, scientists working on other genomes, and those involved in assessing the ethical impacts. It also wishes to broaden the geographical base and would particularly like to hear from people outside North America and Western Europe.

The principal criterion for nomination is active involvement in human, or other, genome research as evidenced by academic appointments in a relevant department, or employment in a research institution or company doing relevant work, and by a publication record.

Persons interested in becoming members of HUGO are invited to write to the address below enclosing **two** copies of each of the following:

- a brief up-to-date *curriculum vitae*
- a list of *not more than 6* key publications
- 2 letters of support

Applications must be received by **Friday 18 May 1990**.

ONLY APPLICATIONS CONTAINING ALL THE ABOVE WILL BE CONSIDERED. NO CORRESPONDENCE ABOUT INCOMPLETE APPLICATIONS CAN BE ENTERED INTO.

Applications will be acknowledged only on specific request *and* if a self-addressed label is enclosed.

HUGO
President's Office
Imperial Cancer Research Fund
P O Box 123, Lincoln's Inn Fields
London WC2A 3PX
UK

AIDS TARGETED INFORMATION/ATIN

TARGETS YOUR LITERATURE SEARCH

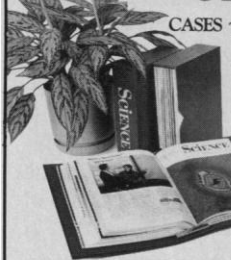
Expand your base of knowledge about AIDS/HIV with *AIDS Targeted Information/ATIN*. Every month, *ATIN* not only provides abstracts but also in-depth evaluations of the current published scientific literature on AIDS. Written by clinicians and researchers for clinicians and researchers, *ATIN* provides an authoritative command of the world's literature on AIDS. Published by Williams & Wilkins. Indexed. 12 issues per year. \$125.

To order call
1-800-638-6423

Sponsored by the American Foundation
for AIDS Research (AmFAR).

Circle No. 244 on Readers' Service Card

SAVE YOUR COPIES OF SCIENCE



CASES These custom-made, imprinted cases and binders are ideal for protecting your valuable Science copies from damage. Each binder or case holds one volume of Science, or 13 weekly issues — order four binders or cases to hold a complete year of issues. Constructed from reinforced board and covered with durable, leather-like red material and stamped in gold, the cases are V-notched for easy access; binders have a special spring mechanism to hold individual rods which easily snap in.

BINDER

Cases	1 — \$7.95	2 — \$14.95	4 — \$27.95
Binders	1 — \$9.95	2 — \$18.95	4 — \$35.95

SCIENCE

Jesse Jones Industries, Dept. SCE
499 East Erie Ave., Philadelphia, PA 19134

Enclosed is \$_____ for _____ Cases;
Binders. Add \$1 per case/binder for postage & handling. Outside USA \$2.50 per case/binder (US funds only). PA residents add 6% sales tax.

Print Name _____

Address _____

No P.O. Box Numbers Please

City _____

State/Zip _____

CHARGE ORDERS (Minimum \$15): Am Ex, Visa, MC, DC accepted. Send card name, #, Exp. date.

CALL TOLL FREE 7 days, 24 hours 1-800-972-5858

— SATISFACTION GUARANTEED —

Pure & Simple

They say that variety is the spice of life. But the variety of life insurance products in the marketplace today poses a bewildering prospect—even for the most educated customer. Which is why it's refreshing to know that there's still a kind of life insurance whose appeal lays in its simplicity.

Not only is AAAS Term Life the purest kind of life insurance available, it is also the least expensive. And now that Group Rates have been cut another 15% effective 4/1/88 (they were also cut 10% last October), AAAS Term Life is an even better bargain.

If you're interested in applying for coverage from \$15,000 up to \$240,000, and wish to request generous protection for your family, too, the next step is simple.

Contact the Administrator, AAAS Group Insurance Program, 1255 23rd Street, N.W., Suite 300, Washington, D.C. 20037, or call toll-free (800) 424-9883 (in Washington, D.C. call 296-8030). They will be pleased to answer any questions you may have about this valuable member benefit.

the new ITS-90 temperature scale (Research News, 23 Mar., p. 1411), Robert Pool correctly lists the triple point of water as 273.16 K, but incorrectly as 0°C. The triple point is defined by the mutual thermodynamic equilibrium between pure water vapor, liquid water, and ice. The ice point of water, saturated with air at one standard atmosphere and in equilibrium with ice, is a thermodynamically distinct point and defined 0°C on the Celsius scale of temperature; but this is no longer used as a fixed point. The triple point defines 0.01°C (and part of the Celsius scale of temperature) and is consistent with the older, obsolete definition based on the ice point.

Pool's statement about what "any cook knows" is reminiscent of Aristotle's "knowledge" that women had fewer teeth than men, although he never looked inside the mouth of a healthy woman. Many authors' wives or husbands will readily share the knowledge that water boils at a lower temperature when air pressure is lower—95°C (203°F) will start the pot bubbling in Denver, but not in Honolulu. I invite the reader to consider at what temperature water would boil when exposed to the near-perfect vacuum (zero pressure) of outer space; its boiling point is not very high.

DAVID R. SMITH

National Institute of Standards and Technology,
325 Broadway,
Boulder, CO 80303-3328

Response: My thanks to the many readers who have written or called to let me know that my foray into the kitchen left me with egg on my face. I've tried to use this blooper to convince my editor that I need a research trip to the mountains, preferably during ski season, but so far he's not biting.

—ROBERT POOL

Erratum: In Marcia Barinaga's article "Loma Prieta: Saved by a short, sharp shock" (15 Dec., p. 1390), the legend for the figure at the bottom of page 1390 should have indicated that the map was adapted from the work of S. E. Hough *et al.* at Columbia University's Lamont-Doherty Geological Observatory. In that map, the top part of the line representing the Nimitz Freeway from point A to point B should not have been drawn to the right of the boundary between the mud and the alluvium.

Erratum: In the Research News article by Robert Pool, "Heart like a wheel" (16 Mar., p. 1294), the Purkinje fibers were incorrectly identified as a system of nerves. They are instead modified heart muscle cells that are specialized for high-speed conduction.

Erratum: In the Table of Contents for 30 March 1990 (p. 1524), the letter by H. L. Robinson and M. Somasundaran, "Correction: Copy numbers of HIV-1 RNA," was inadvertently omitted.

Erratum: In the Author Index to volume 247, January-March 1990, the entry for "Spencer, Roy W. and Christy, John R." was incorrect. It should have read, "Precise monitoring of global temperature trends from satellites. p1558 30 Mar 1990."