such replacement masks the fundamental symmetry of the two equations.) If transmission and reception are phase-coherent and the dolphin has sensory capabilities to detect phase (as I believe humans do not), each center can be located uniquely in position relative to some arbitrary reference (instead of locations by pairs), and the strength of the center can be determined directly.

In a sense, none of this argument is new; in 1802 Young published (*2*) his famous principles of interference, which are taught in a different context of the "double-slit experiment" to all high school students of physics.

Consider a typical sonogram (a plot of frequency and intensity versus time) of two or three people talking at once, which looks fairly hopeless to decipher optically. Then compare the analysis with that done in real time by anyone's ear. While we as humans are busy trying to program big computers to do fast Fourier transforms (*3*) on vast amounts of data on underwater acoustics (to determine the Fourier components of variation of signal strength with space (Eq. 1) or with frequency (Eq. 2), and thus to analyze a complicated object), the dolphin probably does the same job in real time with little conscious effort. The ordinary laws of acoustics show that, with reasonable signal-to-noise ratio, precision of the order of one wavelength (for example, 1 cm at 150,000 hz) should be available to a dolphin acoustically inspecting an object and constructing a three-dimensional image of it.

SEVILLE CHAPMAN
Physics Division, Cornell Aeronautical Laboratory, Buffalo, New York 14221

References

1. R. N. Einhorn, *Electron. Design* **25**, 49 (1967); W. N. Kellogg, *Porpoises and Sonar* (Univ. of Chicago Press, Chicago, 1961); J. C. Lilly and A. M. Miller, *Science* **133**, 1689 (1961); E. F. Uretz, *ASD Tech. Rep. 61-620* (U.S. Air Force, Wright-Patterson Air Force Base, Ohio, Dec. 1961); R. G. Bushel, Ed., *Acoustic Behavior of Animals* (Elsevier, Amsterdam, 1963); W. N. Tavolga, *NAVTRADEVCEN Tech. Rep. 1212-1* (U.S. Navy, Port Washington, N.Y., Feb. 1965); T. G. Lang and H. A. P. Smith, *Science* **150**, 1839 (1965); *Optical Spectra* **1**(4), 58 (1967); L. Gebhart, *Sci. News* **92**, 206 (1967).
2. T. Young, *Phil. Trans. Roy. Soc. London* **92**, 23, 387 (1802). Both reports are reprinted (Nos. 7 and 8) in G. Peacock, Ed., *Miscellaneous Works, Thomas Young* (Murray, London, 1855). The key words are on p. 1 of the second paper: "Wherever two portions of the same light arrive at the eye by different routes, either exactly or very nearly in the same direction, the light becomes most intense when the difference of the routes is any multiple of a certain length, and least intense in the intermediate state of interfering portions; and this length is different for light of different colors." Note that Young indicates that the difference in length of routes may be associated with radial or lateral separation, and that the interference fringes or lobes have different geometry for different colors or frequencies.
3. E. O. Brigham and R. E. Morrow, *IEEE Spectrum* **4**, 63 (1967).

21 February 1968

Computer-Based Journal Distribution for the Individual

The requirements of the user must always be a primary consideration in a system like the one proposed by Brown, Pierce, and Traub for computerized journal publication (*1*). Although stressing human as opposed to hardware implementation, they did not discuss several points.

What a system can provide to the user is mainly a problem of access, that is, how to specify to the computer what output is desired. The system must operate on terms that the subscriber uses and understands in his own work. Generation of indices on the basis of title, abstract, and content wording is technically feasible, and common-usage or nickname terms also might be used. The fact that the "customer is always right" may make the programmer's job more difficult, but an indexing system built on a series of acronyms and codes can rapidly become confusing and lose its utility to the subscriber.

Brown, Pierce, and Traub advocate storing outdated lists of index terms, requiring subscribers to understand the *Zeitgeist* surrounding topics from previous indices. A better solution might be a cumulative index, perhaps for use with older individual lists. A method is needed to amend indices—with new terms, apparatus, and techniques that continually crop up in the literature—and to delete obsolete topics. Since the balance between relevance and coverage is a function of index adequacy, terms used for indexing must be selected with extreme care.

The authors did not discuss the training, indoctrination, or knowledge necessary for a new subscriber to use a journal computer system. Presumably, this much-needed information would be supplied at the time of subscription. The training problem has apparently been overlooked in some other systems (*2*).

A major advantage of computerizing journal publication is that undue publication lags can be eliminated. Although preprints may have filled a need by making information available between completion of an investigation and subsequent publication, they are obviously too informal. A listing of research in progress could keep other workers aware of research not yet published and help avoid duplication of effort. High-speed computers make such listings entirely feasible.

PATRICK A. CABE
Goodyear Aerospace Corporation, Akron, Ohio

References and Notes

1. W. S. Brown, J. R. Pierce, J. F. Traub, *Science* **158**, 1153 (1967).
2. G. V. Barrett, C. L. Thornton, P. A. Cabe, *Human Factors Evaluation of a Computer-Based Information Storage and Retrieval System*, 11th annual meeting of the Human Factors Society, 28 September 1967.

12 February 1968

Cabe's concern with the *Zeitgeist* surrounding previous indices is relevant only when the system is used for retrieval. The issue does not arise for dissemination.

A new subscriber to the system requires neither training nor indoctrination, but only knowledge which may be acquired in a few minutes of reading.

W. S. BROWN, J. R. PIERCE
J. F. TRAUB
Bell Telephone Laboratories, Murray Hill, New Jersey 07974

1 March 1968