Letters

Of Doomsday and the Lower Mississippi

Stuart A. Umpleby (Letters, 25 Sept., p. 1555) warns us that doomsday is approaching even more rapidly than was predicted by von Foerster *et al.* (*1*) in 1960. Extrapolating a rectangular hyperbola and justifying the assumption that the rate of population growth will continue to accelerate exponentially, von Foerster *et al.* found that infinitely rapid growth would occur on 13 November 2026. This mathematically hermetic reasoning attracted nationwide attention (citations in Umpleby's letter). Uneasy journalists looked in vain for the disclaimer of O. W. Holmes *père*, in the last line of "The Deacon's Masterpiece" (*2*): "logic is logic, that's all I say."

Umpleby's warning is nothing if not timely. It comes only 12 years after the 1975 repetition by Serrin (*3*). Some 13 years elapsed between the 1961–1962 flurry of correspondence in *Science* (*4, 5*) and Serrin's reminder. The frequency of warnings is therefore accelerating, although not so rapidly as the human reproductive rate was thought to be by von Foerster *et al.*

In 1960, when I had some credentials as a paleodemographer (*6*), I read the *jeu d'esprit* of von Foerster *et al.* with deep enjoyment. I noticed with amusement that their world (5.27×10^7 square miles) is considerably smaller than mine (36.1×10^7 square kilometers) and that in their short time perspective (about 2000 years) their selection of data was disingenuous. "The missile has left the pad and is heading out of sight," was the way I put their argument; "who cares whether there were a million or a hundred million people around when Babylon was founded?" Being no mathematician, I hesitated to warn *Science's* readers that population doubling times are unlikely to be shorter than 9 months, however logical the extrapolation. When von Foerster *et al.* called Coale's objections "demographic numerology" (*5*), I was glad I had stayed out of the argument.

I have savored the irony in all the subsequent correspondence, including Umpleby's. Twenty-seven years after the "Engineer's Masterpiece," though, the spoof is beginning to lose its charm. Umpleby and his "small group of scholars" are certainly in on the joke, and so are most other scholars. Unfortunately, modern governments (names on request) are noted neither for scholarship nor for keen appreciation of irony. Intellectual games that reduce serious arguments to absurdities are dangerous; some humorless official may be listening.

Hyperbolic extrapolation was Mark Twain's literary stock in trade. The following passage (*7*) deserves close study by scholars who practice humorous exaggeration. Perhaps because the master ironist had so often felt the edge of his own favorite weapon, Twain leaves no doubt of the distance between his tongue and his cheek.

> In the space of one hundred and seventy-six years the Lower Mississippi has shortened itself two hundred and forty-two miles. That is an average of a trifle over one mile and a third per year. Therefore, any calm person, who is not blind or idiotic, can see that in the Old Oölitic Siluran Period, just a million years ago next November, the Lower Mississippi River was upward of one million three hundred thousand miles long, and stuck out over the Gulf of Mexico like a fishing-rod. And by the same token any person can see that seven hundred and forty-two years from now the Lower Mississippi will be only a mile and three-quarters long, and Cairo and New Orleans will have joined their streets together, and be plodding comfortably along under a single mayor and a mutual board of aldermen. There is something fascinating about science. One gets such wholesome returns of conjecture out of such a trifling investment of fact.

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2. Also known as "The Wonderful One Hoss Shay."
3. J. Serrin, *Science* **189**, 86 (1975).
4. J. S. Robertson, V. P. Bond, E. P. Cronkite; W. E. Hutton; W. E. Howland; M. Shinbrot; H. von Foerster, P. M. Mora, L. W. Amiot, *ibid.* **133**, 936 (1961); H. F. Dorn, *ibid.* **135**, 283 (1962); H. von Foerster, P. M. Mora, L. W. Amiot, *ibid.* **136**, 173 (1962).
5. A. J. Coale; H. von Foerster, P. M. Mora, L. W. Amiot, *ibid.* **133**, 1931 (1961).
6. E. S. Deevey, *Sci. Amer.* **203**, 194 (September 1960).
7. S. L. Clemens, *Life on the Mississippi* (Harper, New York, 1896); cited from Bantam Classic edition (New York, 1981), p. 93.

GenBank Information

On 30 September 1987, the National Institute of General Medical Sciences of the National Institutes of Health awarded a new contract for GenBank, the nucleotide sequence database, to IntelliGenetics, Inc., of Mountain View, California. The Los Alamos National Laboratory (LANL) will remain the site of data collection; IntelliGenetics will be responsible for data distribution. Data collection will continue to be shared with the European Molecular Biology Laboratory Data Library in Heidelberg, West Germany, and a new partner, the DNA Data Bank of Japan. The project is supported by a consortium of government agencies, including the National Institutes of Health (National Institute of General Medical Sciences; National Cancer Institute; National Library of Medicine; National Heart, Lung and Blood Institute; Division of Research Resources; National Institute of Allergy and Infectious Diseases; National Institute of Diabetes and Digestive and Kidney Diseases; National Institute of Dental Research; and National Eye Institute), the Department of Energy, the National Science Foundation, and the U.S. Department of Agriculture.

General information about GenBank releases may be obtained from IntelliGenetics at 415-962-7364 or by electronic mail at genbank@bionet-20.arpa. Authors of DNA sequence data interested in submitting their data should continue to contact LANL at 505-665-2177 or genbank@lanl.gov for further information regarding submission of their sequences. Because of the increase in the number of DNA sequences being determined, it is essential for authors to take an active role in the submission of their data. Several journals, including *Science*, are providing data entry forms to their authors; and NIH is actively encouraging its grantees to submit their sequences directly to the database. GenBank will be developing software to facilitate this process.

All of us involved in the GenBank project look forward to a challenging and productive period. We encourage the scientific community to help us build GenBank into the tool needed to meet the research challenges of the future.

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Interpretation of the ABM Treaty

As reported by Colin Norman (News & Comment, 9 Oct., p. 147), supporters of the traditional interpretation of the Antiballistic Missile (ABM) Treaty (that would prohibit Strategic Defense Initiative testing in space) maintain "that ABM systems and components were carefully defined in Article II of the treaty to include those based on future technologies. . . ." The treaty text, however, contradicts this interpretation. The box accompanying Norman's article (p. 148) omits the crucial operational paragraph of Article II, which defines ABM systems and components "for the purpose of this treaty." According to that paragraph, the systems "include those which are (a) operational; (b) under construction; (c) undergoing testing; (d) undergoing overhaul, repair, or conversion; or (e) mothballed." No other catego-

ries are given or suggested.

This listing can be recognized as exhaustive and complete; it clearly refers to 1972 technology, covering all its possible states. Had the drafters meant to cite the five categories merely as examples, they would—or should—have added "but not limited to" after the word "include".

The Soviet version of the treaty does not translate "include" by the most direct term, but uses instead the unambiguous *otnosyatsya*, which means "refers to." In the absence of a qualifier, such as "among others," there is no question that the Soviet version covers only 1972 technologies.

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Monitoring of Atmospheric Ozone

Richard Kerr (Research News, 10 July, p. 131) states that the Dobson spectrometer was not designed for trend monitoring and that there are problems with its maintenance and calibration. We agree (*1*) and believe that cross-referencing data from the Solar Backscatter Ultraviolet instrument with Dobson data must be inconclusive because both systems are subject to drifts of similar magnitude.

Dobson instruments are calibrated against a particular Dobson spectrometer chosen as a reference. The procedure is vulnerable because the reference instrument is also subject to drift and because changes occur during transportation. The precision of Dobson measurements is not readily calculable from instrument characteristics; rather it is established empirically and with difficulty. Checks on performance are intricate, time consuming, and demand dedicated, trained personnel. In practice, the checks are often not adequate and major malfunctions can go undetected, sometimes for years. The Dobson data include a high proportion of empirical zenith sky readings that are unsuitable for long-term trend studies.

The Automated Brewer spectrometer (*2*), unmentioned in Kerr's article, was designed in the early 1980s specifically for monitoring and has numerous fundamental and operational advantages over the Dobson instrument. The sun-tracking feature enables the Brewer to record a large number of direct sun observations and thus to avoid the zenith sky problem. Experimental evaluations of the measurement uncertainty, which are from two to three times smaller than those of the Dobson, confirm the values calculated from the instrument design. Brewer ozone measurements are not affected by sulfur dioxide and do not show dependence on the solar elevation. Instrument checks and self-characterizing procedures are programmed into routine operation of the Brewer, and the results are analyzed automatically. Consequently, malfunctions can be detected and rectified promptly.

The Brewer reference triad, to which the network Brewers are normalized, comprises three reference Brewer spectrometers operating continuously at Toronto. Each of these is independently and absolutely calibrated and can be replaced at any time without significant impact on the reference system. The transfer of calibration to the network spectrometers is usually effected by means of another Brewer that acts as a traveling standard.

In order to obtain better ozone data and to save a significant amount of manpower, Canada has put Brewer spectrometers into operation at six monitoring stations; Dobson instruments in the Canadian system are scheduled for decommission after 3-year periods of parallel measurement. Brewer spectrometers are now located in 11 countries. We believe the Dobson system should be replaced by the Brewer system throughout the global network and in the NASA net-