Letters

Global Change Program

Wallace Broecker is quoted by Richard A. Kerr (News & Comment, 23 Aug., p. 845) as proclaiming that the World Ocean Circulation Experiment is an "egregious" example of "trendy, grant-enticing packaging" linked to the "global change bandwagon." Those people who have worked hard to design an effective global change program were not even given the courtesy of being asked for a response.

The substance of the issue is that the World Ocean Circulation Experiment (WOCE) is directed at achieving a zero-order understanding of how the ocean transports momentum, heat, fresh water, and biochemically active substances; how, where, and why these quantities are exchanged with the atmosphere; and how they change through time. For example, the ocean carries about half the global meridional flux of heat from equator to pole and is a major factor in determining today's climate state. We do not know whether this flux is stable from month to month or from year to year, nor do we know what mechanisms control its value. WOCE attempts to bring about an understanding of these processes, among a myriad of other related goals. Assertions that such problems are not connected with understanding global change are foolish. Those who insist that their own specific interests define the boundaries of useful and interesting work appear to be practicing a form of religious fundamentalism that should not be confused with science.

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Kerr misses one important point regarding Broecker's public attack on the Joint Global Ocean Flux Study (JGOFS). From its inception in the mid-1980s, the U.S. global change research effort and its international counterparts, the International Geosphere-Biosphere Programme and the World Climate Research Programme, have been presented to the scientific community, science funding bodies, and government decision-makers in a consistent manner that is fundamentally different from Broecker's present personal view as to what constitutes a study of global change. The case presented by the research community is that scientists are ill-prepared to assess, let alone predict, major changes in the earth's climate system (including interacting components of biogeochemical cycles) or to state with certainty whether major changes are of natural or anthropogenic origin. Thus, identifying and resolving key uncertainties in our current understanding of the climate system constitutes a considerable portion of the national and international global change research programs.

A good example of such uncertainty is the ocean carbon cycle, which up until a few years ago many eminent geochemists (including Broecker) argued was absorbing about half of the carbon dioxide released to the atmosphere via fossil fuel combustion. In 1990, however, a single scientific paper (*1*) called this consensus into serious question and postulated that perhaps no more than 20% of the fossil fuel carbon dioxide released to the atmosphere is being absorbed by the ocean. The fact is that the existing global ocean data are inadequate to rigorously test this hypothesis. A quantitative understanding of the global carbon cycle is of fundamental importance in a study of global change. JGOFS seeks to address this problem, and after thorough national and international vetting, it has become a constituent of several national global change programs.

Broecker's attack is, by his own admission, not based on a judgment that JGOFS and other global change research projects such as the World Ocean Circulation Experiment are other than good science. Rather, he implies that such studies of ocean biogeochemistry and physics should not be part of a national endeavor to study global change because they do not specifically focus on observed or anticipated anthropogenic effects. In this regard Broecker's view is clearly inconsistent with the national and international documentation that has been used to advance the case for a concerted study of global change.

Interestingly, Broecker was a member of the National Research Council committee responsible for a seminal document in the development of the U.S. and international global change efforts (*2*). As a member of that committee, I remember well Broecker's significant involvement and influence in shaping that blueprint for a study of global change. Anyone who examines this report today will note the following:

1) It fully embraces study of the natural workings of the earth system in key areas where our knowledge is presently insufficient to assess whether change detected in the future is or is not anthropogenically driven:

2) The current projects embraced by the United States and international global change research efforts such as JGOFS are faithful to this statement of focus; and

3) Broecker's personal view on what does and does not qualify for inclusion in a global change research program apparently has itself undergone considerable change.

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REFERENCES

1. P. P. Tans, I. Y. Fung, T. Takabashi, *Science* **247**, 1431 (1990).
2. *Global Change in the Geosphere-Biosphere, Initial Priorities for an IGBP* (National Academy Press, Washington, DC, 1986).

Matter-Wave Interferometer

Faye Flam, in her interesting article "Making waves with interfering atoms (Research News, 17 May, p. 921), seems to imply that whole-atom interferometers are a new concept. While it may be correct that recent advances in technology have facilitated the actual construction of such instruments, the basic concept, design, and applications of such interferometers were developed and patented in 1973 by physicists Saul Altshuler and Lee Frantz (U.S. patent 3,761,721). Their patent discusses the use of the matter-wave interferometer in nearly all the applications mentioned in Flam's article, namely, ultrasensitive measurements of gravity, acceleration, rotation, and magnetic fields—as well as matter-wave holography.

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Elvis Impersonator?

Have I spotted yet another Elvis impersonator? The motif Glu-Lys-Val-Ile-Ser to which James B. Kaper and Harry L. T. Mobley (Letters, 30 Aug., p. 951) refer is EKVIS. The real ELVIS is Glu-Leu-Val-Ile-Ser.

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