suggested in the Perspective "Mirror on the wall: You're omnidirectional after all?" by Jonathan P. Dowling (*Science*'s Compass, 4 Dec., p. 1841). Also, their resulting product design is not unique, although the specific choice of tellurium and polystyrene as coating materials may be.

With the use of thin-film design tools commercially available, it is relatively easy to design such "perfect" optical coatings using a broad range of coating materials. Many companies, including Optical Coating Laboratory, Inc. (OCLI), have for 30 years or more manufactured multilayer dielectric products that have the property of reflecting at all angles over a span of wavelengths, but are not necessarily sold as "omnidirectional mirrors." One such product we sell is an "infrared blocking filter" (*1*).

The optical coating market is supplied by many companies, with OCLI being among the largest. We have found that up to now there has not been a significant demand for lossless omnidirectional reflectors. Mirrors that require high reflectance at high angles of incidence are usually made using high-quality metal reflectors. The benefit of these mirrors may be to awaken interest in this issue and thereby lead to new applications for optical thin-film coatings.

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Notes

1. The OCLI Web site is at www.ocli.com.

Response

In my Perspective, I gave the impression that the idea was new in the photonic band-gap and optics communities. In fact, it was new to me and to several learned experts on one-dimensional, periodic optical structures with whom I discussed the paper at length. In particular, most of us in this field were unaware of this structure, and in fact thought its existence was impossible. Our error was to assume that a proof denying the existence of an omnidirectional photonic band gap in an infinite periodic dielectric implied the nonexistence of an omnidirectional reflector in a finite quasi-periodic structure, for reasons I outlined in my Perspective.

Nevertheless, after the publication of the report by Fink *et al.* (John D. Joannopoulos and his colleagues) and my Perspective, I received several communications from various researchers, including Seeser and Carniglia, to the effect that this idea of an omnidirectional mirror had been discussed before in various contexts. In hindsight, I could now make a case that the discovery of the existence of a one-dimensional, omnidirectional photonic band-gap reflector of sorts has been made more or less independently by (at least) the Massachusetts Institute of Technology (MIT) group of Joannopoulos; the University of Bath group of Philip Russell in the United Kingdom; the University of California, Los Angeles, group of Eli Yablonovitch; the Belarus group of Sergey Gaponenko; and a thin-film computer design program at the OCLI laboratory of Seeser.

To the best of my current state of knowledge, the MIT group were the first to spell out in a compelling photonic band-gap theoretical framework, both conditions —necessary and sufficient—needed for such a structure to occur. In addition, they performed a convincing experiment demonstrating the effect. Finally, they published these results in a refereed journal article, which subsequently found a wide audience. Perhaps the existence of such structures in some form or another was well known to a small minority, but a large majority of the members of the optics community were simply not aware of this interesting and important result, or of the complete set of conditions needed for it to occur. The specifications of these precise theoretical conditions—together with their experimental implementation—are the primary novel scientific contributions of the recent MIT paper, which I dare say most of us in this community have received with great enthusiasm.

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Brown Dwarf Origins

In Alexander Hellemans's article "Binaries answer riddle of brown dwarf origins" (News of the Week, 13 Nov., p. 1240), I am quoted as saying that the G 196-3 binary system consisting of an M-type star and a brown dwarf is "too young...for the dwarf to have formed from an accretion disk, like a planet" and that, "[b]ecause the brown dwarf is so far away from the star, fragmentation of a molecular cloud is the most likely scenario for its formation."

I would like to clarify that what I meant was that the evidence collected by Rafael Rebolo *et al.* (Reports, 13 Nov., p. 1309) on G 196-3 and by E. L. Martin *et al.* on CFHT-Pl-18 (*1*), a binary consisting of two brown dwarfs, indicates that brown dwarf binary companions (to normal stars or brown dwarfs) are more likely to form by fragmentation than in an accretion disk. In particular, the brown dwarf binary companions in CFHT-Pl-18 most certainly formed by fragmentation, simply because a brown dwarf is unlikely to have an ac-

cretion disk sufficiently massive to form an object as massive as another brown dwarf.

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References

1. E. L. Martin *et al.*, *Astrophys. J.*, in press.

Scientific Responsibility in Global Climate Change Research

Over the last few years, several "major findings" in the area of global climate change research have been retracted or shown to be erroneous. The credibility of a few others is still being challenged in the literature. All of them were attempts to extract global climate change signals from satellites that are either so new that we are still learning how to use them or are so old that sensors are continuously degrading, orbits are declining, and the local observation time is drifting from one year to another. So, to try to extract a signal of global warming that, for example, is predicted to be of less than 1°C per decade, with a sea-level rise of 3 to 6 millimeters (mm) per year and an increase in the growing season in the Northern Hemisphere of about 1 day a year is challenging, to say the least.

It's no wonder then that when papers come out saying, for example, that the sea level is rising at the rate of 5.8 mm per year (*1*), it is immediately taken by the media as "proof" of the onset of the much-awaited response of the ocean to greenhouse warming. This result was based on the analysis of data from one of the altimeters on board the U.S.–French satellite Topex-Poseidon. However, in less than a year an error was found in one of the algorithms. A joint paper, this time with the French team, revised the estimate of global sea-level rise over a 3-year period down to zero (*2*). Today, after a more careful analysis of both the altimeters on board the satellite over a longer period (1992–1997), one finds a positive trend of between 1 to 2 mm per year (*3*). The implications of these differences are huge when one is trying to predict when the Maldives or large parts of Bangladesh will go underwater: in 50 years or 200 years?

During most of the last decade, a battle has been raging between those who have said that the 1990s are the warmest years on record and those who have published satellite data showing that the middle at-