LETTERS

Holography and Image Display in X-ray Crystallography

One cannot but agree with Carroll K. Johnson (Letters, 29 Apr., p. 478) concerning the need for crystallographers to continue working on improving solutions to the "phase problem," as required in x-ray crystallography. It is likely, moreover, that holography (*1, 2*) may make a contribution to this problem as well (*2–4*).

Our efforts at this time, however, are directed at another equally important problem in crystallography, namely, that of *displaying* the reconstructed structures, once computed, in three dimensions (*5–7*). Holography (*1, 2*), with its well-known three-dimensional display capabilities in many domains of science from electron microscopy to ultrasonic imaging (*8*), has now been proved through this work (*5–7*) to have a most promising potential also in crystallography and one which is widely considered by many crystallographers to be worthy of further investigation (*7*). A very effective approach, we find, is the use of opto-digital (holographic) computing (*6, 7, 9*), for which we have developed a new type of digital hologram (*7*). Holographic computing combines the most effective steps in digital and optical computing, respectively, through reconstruction of images in sections of the structure. It is now also possible to obtain images of the structure of the entire molecule in three dimensions, with atoms appearing as diffuse sources, through superposition holography (*2*) by a two-dimensional optical Fourier transformation from digitally computed "Fourier-domain projection holograms" (*7, 8*). This technique shows promise of solving the "feature extraction" pattern-recognition problems that have long plagued crystallographers, who heretofore had available only electron-density maps (rather than images) of such sections.

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References and Notes

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Soil Conservation

I read with interest Luther J. Carter's article "Soil erosion: The problem persists despite billions spent on it" (News and Comment, 22 Apr., p. 409). However, he fails to mention an opportunity for correcting the situation at low cost.

Since a decline in a national food supply normally raises prices more than proportionately (barring burdensome surpluses), and since the elimination of water pollution caused by soil erosion would mean at least some shifts from high-yielding, intertilled crops to lower-yielding small grains, grasses, and forests, a truly effective soil conservation program would increase farm receipts while reducing farm expenses. If this fact could be convincingly conveyed to farmers, they might agree that it is not even to their short-term advantage, collectively, to oppose such a program.

To convey this idea would require a significant turnabout by the educational agencies that normally reach farmers. These agencies, to gain the rapid acceptance of new technology that reduces the cost of food, have stressed to farmers the importance of increasing productivity as a means of ensuring individual survival in the competitive struggle. In doing this they have imparted to farmers a knee-jerk opposition to anything that reduces production or that increases costs.

It has been my experience that farmers are at first suspicious but may soon begin to start thinking about the possibility that they might benefit even from an action as extreme as outlawing the manufacture and use of fertilizer. I am confident that a concerted educational effort could gain their acceptance of strong conservation measures if they knew that they were to be applied nationwide and backed up by embargos on foods produced with exploitive techniques elsewhere in the world, and if assurances were given that