letters

Icosahedral boron molecules form rhombohedral crystals. The newly found quasicrystals don't seem to consist of packed icosahedra, but they do have icosahedral symmetry.

There is nothing surprising about isolated molecules having icosahedral symmetry. That occurs not only in boron compounds, but also in organic carbon chemistry.[1] In fact, isolated molecules can belong to any one of the infinite number of three-dimensional point groups.

Periodic crystals, on the other hand, can belong only to one of the 32 point groups that are consistent with translational symmetry. The icosahedral and pentagonal point groups are not among these 32.

Sites within a crystal have a point-group symmetry that is a subgroup of that of the crystal. When a molecule is incorporated in a crystal structure, its symmetry is either reduced or remains the same. It becomes that of the site. The point-symmetry group of the crystal can be a higher symmetry than that of the molecules in the crystal, but it must be one of the 32.

All these points are easily visualized. Diatomic molecules have an infinite rotation axis, a very high symmetry. No crystalline packing of such molecules will place molecules in an environment with such a symmetry. Low-symmetry units can be packed in symmetric arrays to give rise to higher-symmetry crystal rotation axes, but except for glide planes or screw axes, such axes do not go through the individual units, which retain their low symmetry.

Indeed there are boron crystals with periodically arranged molecules that are approximately icosahedral. But Berezin correctly calls these crystals rhombohedral. That crystallographic symmetry is definitely not icosahedral! The molecules are not in an icosahedral environment. Careful measurement reveals that they have been distorted by that environment and are no longer packing units with strict five-fold axes in their geometries. Having so many different nonequivalent atoms is the result of having lost symmetry, not the other way around.

It is not necessary that the recently discovered icosahedral metallic solids have icosahedral packing units. In one such alloy Mössbauer evidence indicates[2] the iron atoms are not at centers of icosahedra. In this regard these solids are like Penrose tiles, which individually have low symmetry but pack in an aperiodic pattern with a noncrystallographic ten-fold symmetry.

The observation that a solid has icosahedral symmetry implies that it can't be periodic. The observation of a crystal of periodically packed boron molecules definitely implies that no five-fold rotation axes have survived.

References

1. R. J. Ternansky, D. W. Balogh, L. A. Paquette, J. Am. Chem. Soc. **104**, 4503 (1982).
2. L. J. Swartzendruber, D. Shechtman, L. Bendersky, J. W. Cahn, Phys. Rev. B **32**, 1383 (1985).

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Warning to vacuum users

Recently we became aware of a phenomenon that is of danger to the users of vacuum systems. Any improperly grounded metal portion of the vacuum chamber, in the presence of millitorr local pressures (0.1 Pascal and higher), may expose personnel to lethal voltages during ionization-gauge operation—especially during degassing of the gauge. Sufficient plasma can be generated by the gauge at these pressures that the floating metal parts of the chamber can become electrically coupled to the gauge anode and can thus be lifted to within 20–40 volts of the anode potential. In the measurement mode, the chamber may be lifted to about 160 volts above ground. When the gauge is being degassed by electron bombardment, the chamber has been measured at as high as 900 V above ground, with some controllers, under these conditions.

All ionization-gauge tubes and controllers that I have tested to date have shown this effect. Please check the grounds on your vacuum chambers—they play an important role in your safety.

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Apartheid

The racial laws of apartheid in South Africa deprive all nonwhites of the most elementary rights of a citizen. It is therefore with dismay that we see PHYSICS TODAY (March 1985, page 177), the official voice of the American Institute of Physics, accept advertisements from the University of Stellenbosch and the University of South Africa, Pretoria. The violations of fundamental human rights in South Africa are not on par with those of other African states or the Soviet Union. What we are talking about is the unambiguously codified legislation of repressive practices blatantly proclaimed and enforced by South African courts. It is totally irrelevant whether these uni-