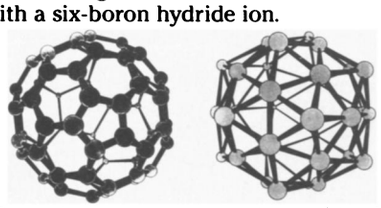
Boron molecules that look like fullerenes

It didn't take Harvard chemist William N. Lipscomb long to pick up on the link between boron molecules and the hollow, 60-carbon molecule called the buckyball. In 1976, he had predicted that a molecule with 32 boron atoms and 32 hydrogen atoms would exhibit an icosahedral structure not unlike the buckyball's soccerball shape, though that molecule had yet to be detected. Lipscomb also knew of smaller boron compounds that resembled other carbon molecules: For example, the eight-carbon cubane matches with a six-boron hydride ion.



Massa and Lipscomb

C_{60} and its corresponding $B_{32}H_{32}$ (right).

Now Lipscomb and Lou Massa, a materials scientist at Hunter College in New York City, have taken a systematic look at the possible correspondence between boron molecules and fullerenes, the new class of all-carbon molecules that includes the buckyball. In the June 10 INORGANIC CHEMISTRY, they describe how a one-to-one match between the faces of one type and the vertices of the other leads to similar shapes and symmetries in these molecules. They use a classical law in geometry to predict matches.

In the boron hydrides, the boron atoms bond to each other to form a particular shape and are the atoms considered in the researchers' comparisons with carbon molecules. The hydrogen atoms radiate from these boron cages.

Superimposing the two molecules, the buckyball's 60 atoms would match up with the boron compound's 60 faces, while each of the 32 boron atoms would fall smack in the middle of the faces formed by the buckyball's carbon atoms, says Lipscomb.

The Descartes-Euler formula describes the fit between the two types of molecules. It sums the number of faces and the number of atoms — which represent the vertices — and subtracts two to get the number of contacts. In closed geometrical structures, contacts represent the connecting lines between vertices; in molecules, they represent the shortest distances between neighboring atoms.

Like fullerenes, hollow boron molecules should have useful new properties, Lipscomb and Massa say. They recommend that chemists try to make closed boron hydrides using lasers to vaporize a calcium boron compound in the presence of hydrogen. *— E. Pennisi*

Sidestepping Galileo's jammed antenna

After several failed attempts to free Galileo's stuck main antenna, scientists last week revealed their plan for continuing the spacecraft's mission to Jupiter without it.

The main antenna, which resembles a large umbrella, failed to open in April 1991 after two of its ribs jammed. Since then, scientists have used Galileo's two smaller, low-gain antennas to transmit data to Earth. While these antennas have performed well so far, scientists worried that when Galileo begins orbiting Jupiter in 1995, the craft's experiments would flood the antennas with more data than they could handle.

Now NASA officials say that a few high-tech tricks could soup up Galileo's communication system to handle much of the data. "The good news we have today is that we have found a way to accomplish the majority of the orbiter's objectives," Galileo project manager William J. O'Neil of NASA said at a press conference last week. In fact, Galileo could still complete up to 70 percent of its experiments without the main antenna, mission scientists say.

Researchers plan to boost the performance of the smaller antennas in two ways. First, Galileo's on-board computer would be reprogrammed to squeeze data into fewer computer bits, enabling scientists to send back more images and sensor information. Second, researchers plan to make the network of ground antennas that receive Galileo's signals more sensitive. Galileo's low-gain antennas could then step up data transmission from 10 bits per second to 100 bits per second. Together, these modifications should improve Galileo's present capabilities a hundredfold.

Loss of the main antenna would still hurt some experiments, especially those that rely on numerous high-resolution pictures, says Galileo project scientist Torrence V. Johnson. Galileo could complete about 80 percent of its atmospheric research, 60 percent of its magnetosphere experiments and 70 percent of its studies of Jupiter's moons, he adds.

Scientists haven't abandoned the idea of unfurling the main antenna. They will make another attempt in December, when the spacecraft whips around Earth for its final gravitational assist on the way to Jupiter.

But even if future efforts to free the antenna fail, scientists remain confident of Galileo's success. "We can still do a very good job," O'Neil says. *— M. Stroh*

Anxiety before surgery may prove healthful

A new study suggests that physicians and nurses should offer this seemingly paradoxical advice to patients awaiting surgery: Don't relax, be worried.

Relaxation training helps people feel less tense before and after surgery for non-life-threatening conditions, but it also seems to spark a potentially harmful surge of two key "stress hormones" during and after surgery, concludes a study reported in the May/June PSYCHOSOMATIC MEDICINE. In contrast, surgical patients who receive no relaxation training experience considerable anxiety, but their stress-hormone levels remain stable or decline slightly after surgery.

Medical evidence now suggests that high levels of stress hormones on the days following surgery may contribute to weight loss, fatigue and impaired immune function, say British psychologist Anne Manyande of University College in London and her colleagues. However, researchers have yet to establish a clear link between stress-hormone levels and medical complications after surgery.

"Our data indicate that simple, innocuous forms of reassurance before surgery can have real biological effects and may need to be used as carefully as medication," contends psychologist Peter Salmon, also of University College, who took part in the investigation. "Preoperative anxiety may protect against the stressfulness of surgery."

The findings support a theory — proposed in 1958 by psychologist Irving L. Janis — that worrying represents mental preparation for surgery and ultimately reduces its stressfulness.

Manyande's team studied adults undergoing minor operations, such as an ulcer repair or the removal of hemorrhoids. The day before surgery, 21 patients listened to a 15-minute tape recording that described mental strategies to reduce tension in different muscle groups. A control group of 19 patients listened to a 15-minute recording that gave background information about the hospital and its staff.

Before and after listening to the tapes, all patients filled out questionnaires assessing the extent to which they felt anxious in general and in response to the upcoming surgery. Patients listened to their assigned tapes at least twice more before surgery and as often after surgery as they wished. On the two days following surgery, each participant again completed questionnaires, as well as a survey of coping strategies regarding surgery, such as worry ("considered several ways of handling the situation"), action ("watched others going through the same