

**Sex to order**

A BIRTH announcement with a difference is made by D. G. Cran and colleagues in the latest issue of *The Veterinary Record* (132, 40–41; 1993) — the production of three female and three male calves from eggs fertilized by spermatozoa preselected for sex. Behind the news, which in the long run will be good news for beef and dairy farmers, is the refinement of a flow cytometry technique for sorting sperm according to whether they contain X or Y chromosomes. Use of a fluorescent dye and laser detection means that the 4 per cent or so difference in DNA content between X- and Y-bearing sperm can be distinguished with reasonably high efficiency. The birth (after embryo transfer into heifers) of the calves with sexes as predicted was the test that the sperm remain viable after their buffeting, but it will be some time before sexed embryos become available commercially. The necessary large-scale trials have yet to be completed.

**Exclusion principle**

TRACKING the motion of iridium atoms over the surface of an iridium crystal, S. Wang and G. Ehrlich find a curious *cordon sanitaire* just three atoms wide around a surface defect (*Phys. Rev. Lett.* 70, 41–44; 1993). The defect, deliberately introduced, is a small cluster of iridium atoms which mimics the step that forms on a surface as a crystal grows. Alternately freezing the crystal to locate the atoms with field-emission microscopy and then warming it to allow them to wander, the authors find that although the atoms might move anywhere just beyond the exclusion zone, they are never seen inside it. Eventually, the lone atoms can suddenly join the central cluster. What keeps them out of the exclusion zone is not clear — tests seem to rule out the presence of an energetic barrier.

**Myosin multiplicity**

*Acanthamoeba* contains three forms of myosin I, the tailless monomeric myosin that forms no filaments. I. C. Baines *et al.* (*J. Cell Biol.* 119, 1193–1203; 1992) have now determined their distribution in the cell and inferred something of their functions. From its location it seems that myosin IA acts in nipping off the small plasma membrane vesicles and moving them between the membrane and cytoplasm; IB turns up in the fraction of large vacuoles and phagocytic vesicles that derive from the active membrane regions, and thus most probably drives the extension of the membrane; and IC is the only form seen in the contractile vacuole and so is probably involved in its function. It will be especially interesting to discover how these myosins recognize their chosen sites.

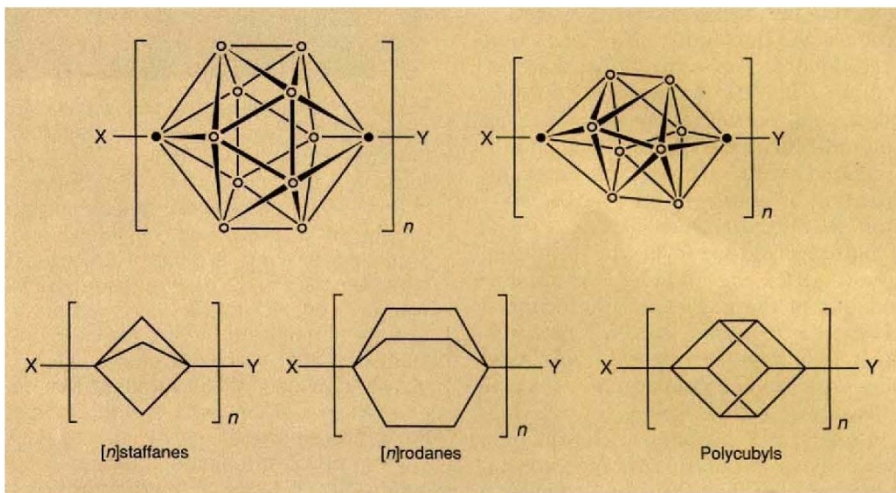
**Carborod molecular scaffolding**

Jeffrey S. Moore

As miniaturization of electronic, photonic and mechanical devices approaches the molecular scale, chemists are recognizing the possibility of building the smallest possible objects from the atom up. This creates the need for the molecular construction kit, which would probably include an assortment of molecular sticks of different lengths, connectors, and a mechanism to bring the pieces together. But even the simplest component of this kit, the non-collapsible rod,

carborane cage means that the carborods uniformly fill space around their longitudinal axis. Thus, of all the so-called 'rigid-rod' molecules, the carborods most closely resemble cylindrical pillars. They are available in lengths that are integral multiples of about 4.5 Å, the average repeat distance of the carborane monomer.

Besides their geometry, carborane monomers have other characteristics that make them ideal constituents



Molecular scaffolding: top, the two kinds of carborod just synthesized; below, three rigid rods previously synthesized. Solid circles, carbon; open circles, boron (B—H).

has proved pretty elusive. To help fill this gap, independent groups in the laboratories of M. Frederick Hawthorne and Josef Michl have developed a new family of stiff molecular scaffolding, named carborods (X. Yang *et al.*, *J. Müller et al. J. Am. chem. Soc.* 114, 9719–9721, 9721–9722; 1992).

These new rods are oligomers of *para*-carborane monomers. Carboranes are inorganic cage molecules with boron and carbon vertices. In the *para* isomers, the carbon atoms occupy the apical positions of high-symmetry polyhedra (see figure). Both laboratories report carborods using a 12-vertex carborane monomer having icosahedral symmetry. Michl's group also described a carborod based on a 10-vertex carborane monomer that has a bicapped square antiprism geometry. The carbon atom sites in both of these polyhedra are ideally situated for linear extension through polymerization.

Carborods are thick compared to known rigid-rod molecules (such as so-called  $[n]$ staffanes,  $[n]$ rodanes and polycubyls, see figure). Their van der Waals diameter is estimated to be more than 7 Å. Moreover, the high symmetry of the

for molecular scaffolding. They are exceedingly robust, having exceptional thermal and chemical stability. They are transparent to ultraviolet and visible radiation, a feature that will be most advantageous in some applications. And perhaps most importantly, carborane chemistry provides a means to prepare rods of discrete length and with specified end-group functionality. This is possible because of the acidity of the terminal CH groups, which offers site-selective reactivity in the growing, multi-vertex carborods.

A practical molecular construction kit will require components with precisely defined structure. Along with uniform length, controlled end-group functionality will be needed to link the rod with connector pieces, through covalent or non-covalent bonding. In making rods of uniform length, one must be able to control the oligomerization reactions. Many of the molecular rods that have been previously described do not allow a means to do this. The methods reported by Hawthorne's and Michl's groups allow carborods to be obtained with modest control. They succeeded in preparing and characterizing end-