

kilometers a detector of a reasonable size will receive only particles emitted at a very narrow angle to the axis of the beam.

Reeder speaks for a group of physicists from the University of Wisconsin, the University of Michigan and Ohio State University. They are setting up an experiment in a Fermilab beam dump that is designed to have improved statistics and take neutrinos at a much wider angle to the beam axis. To do this they are bringing the detector up close. A detector with a 20-foot-square surface facing the beam is set up 60 meters from the tungsten block where the beam dumps. To get rid of muons, which could be a serious interference, large magnets have been designed to bend them upward and downward away from the detectors. In the CERN experiment, 1.5 kilometers of earth effectively absorbed the muons. Installation is about finished, but observation will not begin until autumn because of a summer shutdown of the accelerator necessitated by budget cuts.

"It's one thing to observe the disappearance of electron neutrinos," says Reeder. "We would like to see positive instead of negative evidence." So three months ago a Wisconsin group proposed to the laboratory management that the laboratory's 15-

foot bubble chamber be used to look specifically for evidence of tau neutrinos produced by oscillations of neutrinos in the beam of neutrinos regularly provided for experiment at Fermilab.

The proposal takes advantage of a limitation on research at Fermilab that the laboratory is momentarily working hard to remove: the upper limit of 400 billion electron-volts on the energy of the accelerated protons on which everything else depends. When these protons strike a target to produce neutrinos for the "neutrino line," they don't have the energy to produce the newly discovered ultraheavy particles, which could be the source of tau neutrinos. Thus tau neutrinos found in the beam line should all or nearly all come from oscillation of electron neutrinos. Tau neutrinos can be identified when they interact with an atomic nucleus in the liquid of the bubble chamber. The interaction products should always include at least one tau particle.

Positive evidence from an experiment of this sort would not only certify that oscillation was taking place, it would rule out another possibility that is being discussed: oscillation of neutrinos to antineutrinos. The introduction of tau neutrinos reopened the question of neutrino oscilla-

tions after evidence had shown that electron neutrinos do not oscillate to muon neutrinos. Discussion has usually assumed that electron neutrinos would oscillate to tau neutrinos and electron antineutrinos to tau antineutrinos.

There is also the possibility that neutrinos may oscillate into antineutrinos. This would be detectable only by the disappearance of neutrinos, because this kind of oscillation produces not ordinary antineutrinos but antineutrinos with their spins in the wrong direction. These "couple" to nothing, that is, they are unable to make their presence known by any kind of interaction. This would be the interpretation of the CERN beam dump result, says Reeder, if the Fermilab bubble chamber experiment is done (it is yet to be approved) but finds no evidence of tau neutrinos and if the Fermilab beam dump detector close to the neutrino source finds equal numbers of electron and muon neutrinos.

If neutrinos oscillate, their shakiness will result in serious problems for particle physics, nuclear physics, astrophysics and cosmology. This business of being an electron neutrino or a tau neutrino is what is called "flavor." In their unending search

Continued on page 383

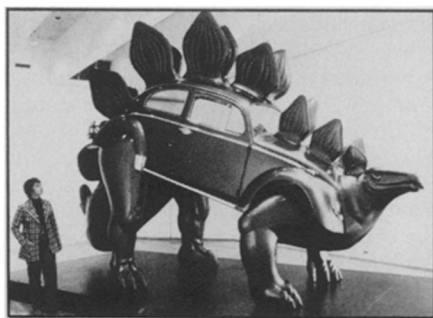
Instead of the usual rings of carbons, the bell-shaped curves and lists of reaction parameters, one speaker at the recent meeting in Houston of the American Chemical Society displayed slides of cars and helicopters transformed into monumental dinosaurs. A symposium on new uses of plastics gave sculptor Patricia A. Renick the chance to convince chemists that working relationships with artists can benefit both groups. She lured them with her adventures as "a woman, small in stature, and in my late forties" who spent five years creating two steel, fiberglass and polyester resin works. Each is 12 feet high, 7 feet wide and 20 or 30 feet long. The themes of Renick's sculptures are as lofty as a Triceracopter's propeller. The hybrid Triceratops-helicopter portrays war as a dying species, and the Volkswagen-Stegosaurus comments on a society unwilling to conserve resources.

"Because the Triceratops had a highly developed defense system, it was one of the last dinosaurs to become extinct. In the Vietnam War, the Cayuse [helicopter] often served as a weapon of attack," Renick says. "In this comparison of biological and technological weaponry, it is my wish to express a hope for the obsolescence of war."

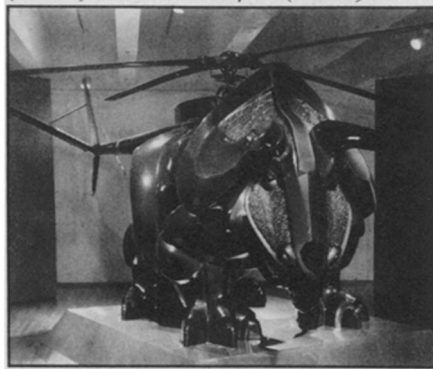
Her motives may be lofty but the problems of construction are down-to-earth. "While industry has the wherewithal, the artist, out of necessity, must make do," Renick explains. Her fabrication processes were a "primitive version" of those used in the automobile styling industry. Tools were made from wire and pipe or adapted

OFF THE BEAT

Better Sculpture through Chemistry



Plastics catalyze art: Vehicle-dinosaur Stegowagenvolkssaurus and sculptor (above) and Triceracopter (below).



from kitchen utensils and hardware store items. For the clay model of Triceracopter, all four and a half tons of clay were heated to working consistency bit by bit in a restaurant-style four-drawer bun warmer. Making the clay model took a full year.

In the final stages of her work, a plastic resin fabrication company came to Renick's aid. She ripped out her studio entrance to bring in the chopper gun and other equipment. A worker from R.L. Industries helped make the final molds, which were transported to the fabrication plant for the final operations.

Renick, who is at the University of Cincinnati, advocates more working relationships between artists and industry. She expects such associations to be mutually beneficial. Artists could gain access to expensive materials, industrial equipment and production facilities. In the work on Triceracopter, besides the aid of the fabrication company, Renick received four and a half tons of used modeler's clay from Ford Motor Co. and 275 gallons of resin from Ashland Chemical Co. in addition, of course, to the salvaged OH-6A Cayuse helicopter from the U.S. Army.

On the other side of the balance, industry could benefit from the creativity and daring of artists. Renick says that an artist's willingness to take risks is the key to future application of plastics in art. "Artists, by the nature of what they do, often develop extraordinary solutions to resolve technical aesthetic problems. Some of these experiments have added to the knowledge of fabrication technology." □

—Julie Ann Miller