cluster. Such a remarkable alignment on such a large scale is hard to interpret as mere coincidence, the researchers say.

"The issue is not whether these structures are lined up," says astronomer David Burstein of Arizona State University in Tempe. "They clearly are." What's more difficult to determine is whether the universe contains similar structures elsewhere. Burstein was a member of the international team of astronomers who first identified the large-scale galactic flow toward the Great Attractor (SN: 3/22/86, p.182).

"No definite conclusions can be drawn without a more complete picture of our surroundings," the Italian researchers say. Even the Great Attractor and the Perseus-Pisces region on opposite sides of the Milky Way are difficult to study, because dust surrounding and permeating our galaxy obscures the view in their directions. Nonetheless, the observation of such large features conflicts with theories suggesting the universe ought to be homogeneous on large scales.

Another question concerns whether the cluster containing our galaxy is actually moving toward the more distant aggregation. "It may be pulling us, but we don't see any evidence of that," says Burstein. Just as the moon, being closer though considerably less massive than the sun, exerts a greater tidal influence on the Earth, the Great Attractor's effect probably swamps any contribution from the more distant supercluster. There's also no evidence that objects in the Great Attractor region are themselves moving toward the supercluster.

Interpreting the observed motion of the galaxy clusters is complicated by the possibility that gravity may not be the only influence. On large scales, the structure of the universe itself comes into play. "To the degree that we can digest it, we have information here about conditions in the very early universe," says R. Brent Tully of the University of Hawaii in Honolulu. That leaves lots of room for theorists to try out their favorite cosmological models. — *I. Peterson*

Semiconductor studies get a rise from yeast

For years scientists have worked on making semiconducting crystals so tiny they begin to take on the properties of individual atoms or molecules — but now a simple yeast has produced some of the best specimens yet. Physicists plan to use the new "crystallites" to investigate the unusual properties of very small semiconductor particles.

The finding sprang from two seemingly disparate research efforts. Physicists at AT&T Bell Laboratories in Murray Hill, N.J., had been seeking the size limits below which various materials lose their semiconductor properties and investigating what happens below those limits. At the same time, biochemists at the University of Utah Medical Center in Salt Lake City noted some curious properties in the minuscule (200- to 1,000-molecule) cadmium sulfide crystals that yeast organisms make when subjected to cadmium metal. It was not until the Utah biochemists contacted the AT&T physicists that the two groups realized the yeast had created the first known biologically produced specimens of just the sort of particles the physicists were investigating. The physicists, headed by Louis E. Brus, and the biochemists, led by Dennis R. Winge, describe their discovery in the April 13 NATURE.

An individual molecule, or even several molecules, of semiconducting material will behave differently from an ordinary "bulk" semiconductor, explains Brus. In a normal semiconductor, electrons need an energy boost to free them from atoms, allowing them to flow and thereby to conduct electricity. The free electrons may have any amount of energy within a given range. In a solitary molecule or atom, quantum mechanical rules restrict electrons to specific energy states. Somewhere in between lies the "quantum" crystallite. Like the bulk semiconductor, it contains electrons that can be freed, and like the atom, it is constrained to specific energy states.

The energy boost that frees electrons to conduct must be delivered in the form of photons with more than a certain minimum energy. When the particle is extremely small, Brus says, this threshold energy suddenly increases and becomes dependent on the particle size. Winge noticed that in his yeast-produced particles, the threshold energy was both size-dependent and greater than that of a bigger chunk of the material.

Another quality helping the groups characterize the crystallites was the way they absorb and emit light. Winge sent a spectrum of the specific absorbed energies to Brus, who found it corresponded to the spectrum he would expect from quantum semiconducting crystals.

Winge's yeast-created crystallites were more uniform in size than their synthetic counterparts — a property critical for physicists trying to study the size-dependent behavior, says Brus. Winge explains that a special protein in the yeast curbs particle growth between about 17 and 23 angstroms. He says he has now extracted this protein and used it alone to halt growth at this size.

The yeast organisms convert cadmium to cadmium sulfide in order to detoxify the poisonous metal, Winge says. He suspects they may also utilize the semiconductor properties of a material, possibly for transferring energy or electrons. — *F. Flam*

Dying aphids obey wasp's commands

Pity the poor, parasitized aphid. A tiny wasp, *Aphidius nigripes*, has injected a batch of eggs into the hapless bug's body. For days the eggs develop: first into larvae that consume their host's innards and eventually kill it, then into dormant pupae that incubate in the aphid mummy before hatching as adult wasps.

Playing the perfect, edible host for some wasp's larvae seemingly would drive any insect mad. In fact, aphids often jump to their death soon after becoming parasitized — a "host suicide behavior" entomologists attribute not to psychosis but to an aphid's instinctive sense that by dying immediately, it will kill the wasp eggs too, reducing the chances of other aphids becoming infected. Now researchers have documented an even more complex set of behavioral changes in parasitized aphids, but in this case working to the wasp's advantage. The findings, described in the April 14 SCIENCE, highlight the subtleties of host-parasite interactions among even the tiniest insects.

Jacques Brodeur and Jeremy N. McNeil of the Université Laval in Sainte-Foy, Quebec, examined the behavior of *A. nigripes*-parasitized potato aphids living on greenhouse plants. Adult *A. nigripes* usually emerge from aphid mummies after a two-week incubation. But if the days are short enough, indicating autumn, they remain in the mummies for months and emerge in the spring. Brodeur and McNeil manipulated "day lengths" with artificial lighting to get overwintering and non-overwintering varieties of wasps. They found that aphids infected with the overwintering variety of wasp generally wandered from their plants to die in protected places ideal for the wasp pupae's long hibernation. Aphids infected with non-overwintering wasps remained on plant leaves to die. The researchers suggest the parasites somehow induce host behavioral changes beneficial to pupal survival.

Researchers know of several chemical and hormonal changes induced by insect parasites, and some may trigger specific behaviors in bugs, says Bradleigh Vinson, an entomologist at Texas A&M University in College Station. "The evidence here suggests that the parasitoids are in control in some ways."

Art Shapiro, a zoologist at the University of California, Davis, notes that in an evolutionary sense, host-parasite relationships are in a constant, competitive flux resembling an arms race. He says the new finding complements observations of host suicide behaviors in other aphids and represents a moment in evolutionary time where the parasite seems to have the upper hand. — *R. Weiss*