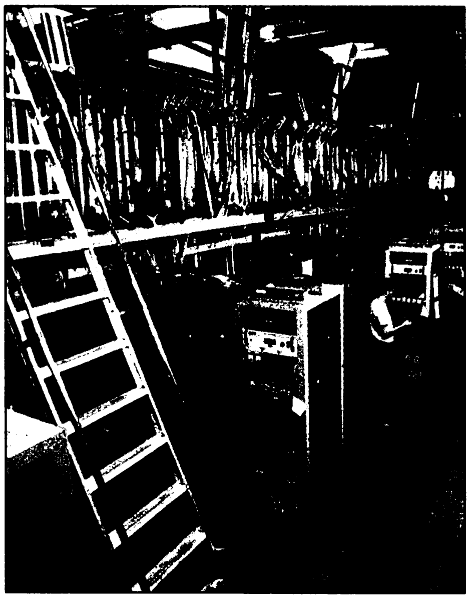

Particle trap. This giant detector at Fermilab gathered puzzling data on neutrinos.

Unlike a similar-sounding quantity called the neutrino mixing angle, which determines the properties of neutrinos (*Science*, 2 November, p. 987), θ_W measures a fundamental force of nature, something that is fully accounted for in the Standard Model.

So when the Fermilab researchers measured θ_W using neutrinos produced by the Tevatron accelerator, they didn't expect to see anything unusual. The Tevatron produced powerful protons, then slammed them into a beryllium-oxide target, producing kaons and pions with various charges. Using magnets, the scientists sifted these particles, picking out varieties that would decay and produce either neutrinos or antineutrinos. They then compared how the resulting neutrinos and antineutrinos interacted with a 700-ton steel detector. The neutrinos and antineutrinos have different spin states and thus are affected differently by the weak force—and θ_W. By comparing the neutrinos' behavior with that of the antineutrinos, the team figured out the size of θ_W.

The result surprised them. The measured value of θ_W disagreed with what the Standard Model predicts by three standard deviations—"three sigma." "A three-sigma result is interesting; it gets people's attention," says Kevin McFarland, a physicist at the University of Rochester in New York state and member of the Fermilab team. In particle physics, such a result is usually considered provocative but not ironclad. But McFarland is sanguine. "I spent the last 8 years of my career making one measurement," he says, and after thorough checking and rechecking, the conflict with the Standard Model remained.

If real, the anomaly might be caused by an undiscovered particle such as a hypothetical new carrier of the weak force called Z′ ("Z-prime"), says Jens Erler, a physicist at the University of Pennsylvania in Philadelphia. "The [Fermilab] experiment is not explained by Z′ , but helped," he says. When combined with another recent intriguing but inconclusive result in atomic physics, says Erler, it is "almost crying out for Z′."

But doubts will remain until new experiments can shed more light on the situation. "Three sigma can easily be a fluke," says Erler. "But we take it seriously enough to have a really close look." **–CHARLES SEIFE**

ANIMAL BEHAVIOR

Single Gene Dictates Ant Society

Genes regulating behavior are very hard to pinpoint; even basic behaviors are thought to be influenced by many genes interacting in mysterious ways. But fire ant researchers at the University of Georgia say they've characterized a gene that may single-handedly determine a complex social behavior: whether a colony will have one or many queens. The gene in question seems to work by controlling how ants perceive pheromones that tell them who's a queen and who isn't.

The research "opens up for the first time the study of genes influencing social behavior across the whole span of the biological hierarchy," says Andrew Bourke of the Zoological Society of London, "from the most basic, molecular level, through the level of individual behavior, right up to the social level." The findings, by biologists Michael Krieger and Kenneth Ross of the University of Georgia in Athens, are published online this week by *Science* (www.sciencexpress.org).

Fire ants have two basic kinds of social organization. A so-called monogyne queen establishes an independent colony after going off on her mating flight, nourishing her eggs with her own fat reserves without worker help until they hatch and become workers themselves. Polygyne queens, in contrast, are not as robust, fat, and "queenly" as monogynes, says Krieger, and they need worker aid to set up new colonies. They spread by "budding" from one primary nest into a high-density network of interacting colonies. Monogyne communities permit only a single queen, and those with a resident royal kill off any intruding would-be queen. Polygyne colonies can contain anywhere from two to 200 queens and accept new queens from nearby nests.

All these differences, the scientists suggest, depend on which version of a gene known as *Gp-9* ants possess. It encodes a pheromone-binding protein that may be crucial for recognizing fellow fire ants. All ants in a monogyne colony have two copies of the *B* allele, but among the polygynes, at least 10% are heterozygous, carrying a mutant allele, *b*. Polygyne communities kill off any potential *BB* queens, but the *Bb* proportion of the colony somehow "persuades" the rest to accept *Bb* queens, says Krieger. They apparently escape attack because the *Bb* workers aren't very good at recognizing *Bb* queens. The *b* allele appears to code for a faulty protein, he says. He theorizes that this prevents the polygyne workers from detecting as many pheromones as the monogyne workers do, and this leads them to allow many young heterozygous queens to survive, whereas the more queenly *BB*s are easy to target.

This is the first time scientists have nailed down the identity of "a single gene of major effect in complex social behavior," the researchers claim in their paper. Until now, about the closest anyone has come to a social behavior gene is one that determines whether nematodes, a kind of parasitic worm, clump together when food is plentiful, says Krieger. But nematodes don't really count because they're not "social animals," like bees or ants or primates, he claims.

Some researchers already suspected that this gene was pivotal in determining the shape of fire ant society, but the notion was "so unexpected as to arouse skepticism," says entomologist Ross Crozier of James Cook University in Townsville, Australia. Crozier says many scientists cling to the view that "genetic details are not important in studying evolutionary changes, because changes are due to many genes of small effect." The fire ant story is "a significant new example" to the contrary.

–CONSTANCE HOLDEN

Full pheromone power. Monogyne workers tending their queen possibly have more sensitive pheromone receptors than do some polygynes.

CREDITS: (TOP TO BOTTOM) FNAL; K. ROSS