that afflicts as many as 20 million people worldwide. Deidre Carter of the University of Sydney notes that the grant is especially welcome "at a time when morale in Australian universities and the research community is very low."

Briones plans to use some of his grant money for travel. "I want to go to high-quality meetings where I can meet people smarter than me," he says. **–RICHARD STONE**

GENOMICS

Wellcome Trust Backs Genome Computation

What began as a one-man crusade now has the weight of the world's largest medical research charity behind it. Last week the U.K.-based Wellcome Trust announced that it would spend $13 million over 5 years to fund hardware and software designed to analyze newly sequenced human DNA. Its support of a project called Ensembl (www.ensembl.org) reflects a growing appreciation of the importance of computers to interpret the human genome.

Tireless crusader. New funds for Ensembl will provide Tim Hubbard with more help.

Ensembl was started in early 1999 by Tim Hubbard, a bioinformaticist at the Sanger Centre near Cambridge, U.K. He began developing computer programs to sort through the vast amounts of data generated by sequencing efforts, which simply determine the order of bases—A, G, T, and C—along each chromosome. However, the sequence has little value or meaning until scientists locate the genes these bases encode and figure out their functions. By midyear, Hubbard had teamed up with Sanger's Michele Clamp, Ewan Birney of the European Bioinformatics Institute (EBI), also in Cambridge, and a few other colleagues to set up automated preliminary analysis of the rapidly emerging rough draft of the human genome.

"The Ensembl budget was cobbled together," Birney recalls. "We were working off bits and bobs of other budgets." By making their rudimentary analysis available to everyone, they also hoped to prevent the genome from being patented by private concerns.

The Wellcome money will put the project on much firmer footing. It allows the 10-person Ensembl staff to triple over 5 years and greatly increases its computing capacity, adding "the equivalent of hundreds, perhaps thousands, of personal computers," notes EBI's Graham Cameron. This investment "will speed up the annotation of the human genome," predicts David Haussler, a bioinformaticist at the University of California, Santa Cruz. "It puts them in a better position to tackle the large bioinformatics problems that are looming."

The new funds will be split between the Sanger Center and EBI, which is an outpost of the European Molecular Biology Laboratory in Heidelberg, Germany. The money arrives at a critical time for EBI, one of the world's three archives of genomics data, whose budget has been hit by changes in the European Union's policies for supporting scientific infrastructure (*Science*, 25 February, p. 1401). It's also "a vote of confidence [in the field] and a commitment by the Wellcome Trust," notes David Lipman, director of the National Center for Biotechnology Information in Bethesda, Maryland.

The award reflects a growing interest in bioinformatics by funding agencies. Haussler, for example, is one of 12 computational biologists who have just been appointed as investigators for the Howard Hughes Medical Institute. The U.S. National Human Genome Research Institute plans to create a network of centers of excellence, several of which will focus on computational biology. The award to Ensembl also kicks off the Wellcome Trust's $150 million initiative in functional genomics, which follows the recent completion of the rough draft of the human genome. "We didn't feel we could wait," says Celia Caulcott, a Wellcome Trust program manager. **–ELIZABETH PENNISI**

EVOLUTION

Parasites Make Scaredy-Rats Foolhardy

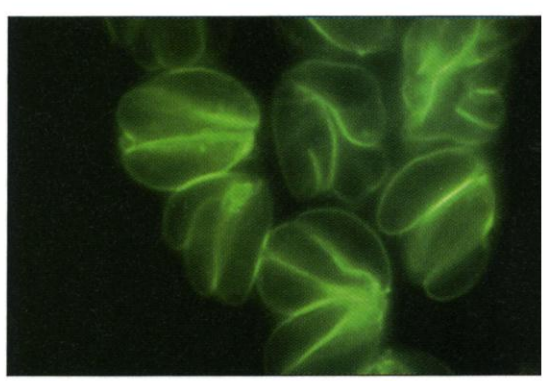
Long before *The X-Files*, Robert Heinlein wrote about parasitic aliens that alter human minds. In his 1955 novel, *The Puppet Masters*, slug-shaped creatures arrive on Earth and clamp themselves to people's spines, forcing their hosts to help spread their kind across the planet. Although the rabidly anticommunist Heinlein may have been less interested in biology than in finding an allegory for the Red Menace, *The Puppet Masters* proved scientifically prophetic: Some parasites, it turns out, alter the behavior of their hosts for their own benefit.

In the 7 August issue of the *Proceedings of the Royal Society of London B*, researchers at Oxford University offer a striking demonstration of this ability by the protozoan *Toxoplasma gondii*. Rats, the intermediate hosts of *Toxoplasma*, appear to lose their fear of cats when the parasite infects them. And cats, not coincidentally, are *Toxoplasma*'s final host. By precisely altering rat brains, the parasite potentially increases its chances of completing its life cycle. "They certainly have demonstrated that the parasite is changing behavior in a rather specific way," comments Hilary Hurd, a parasitologist at Keele University in the United Kingdom. "It's fascinating that this happens."

What makes the story all the more fascinating is that *Toxoplasma* is extremely common in humans. Perhaps half of all people on Earth carry its cysts in their brains without visible effects. (It is dangerous only when it invades a host with a weak immune system, such as AIDS patients or fetuses, where it can cause brain damage or even death.) Recent research has hinted that even in this latent form, however, *Toxoplasma* may create subtle changes in personality.

The relatively innocuous *Toxoplasma* is an unlikely candidate for a mind bender. Dwelling in a cat's bowels, it produces egg-like oocysts that leave its host's body along with the feces. The oocysts can survive in soil for decades, waiting for a rat or some other warm-blooded mammal or bird to pick them up. Once inside an intermediate host, the parasite invades cells and replicates. *Toxoplasma* elicits a strong immune response, which prompts the parasite to form tough-coated cysts in which it finds refuge until its host happens to be eaten by a cat. The mildness of *Toxoplasma*'s effects on its intermediate host make good evolutionary sense: It's not in the parasite's interest to be lethal, as cats find dead animals distasteful.

Yet a parasite's gentleness need not mean that it's passive. Since the 1960s, parasitologists have documented various ways in which parasites may alter their intermediate hosts to improve their chances of infecting a final host. The lancet fluke *Dicrocoelium dendriticum*, for example, forces its ant host to clamp itself to the tip of grass blades, where a grazing mammal might eat



Mind bender. *Toxoplasma* causes rats to lose their aversion to cat scent.

CREDITS: (TOP TO BOTTOM) ENSEMBL; D. ROOS/UNIVERSITY OF PENNSYLVANIA

it. Another fluke, *Euhaplorchis californiensis*, causes infected fish to shimmy and jump, greatly increasing the chance that wading birds will grab them. To see if *Toxoplasma* might somehow increase its chances of getting into a cat, the Oxford team, led by zoologist Manuel Berdoy and parasitologist Joanne Webster, set up a maze with a nest box in each corner. On each nest they added a few drops of a particular odor: eau de rat's nest, fresh straw bedding, rabbit urine, or cat urine.

When the researchers set healthy rats loose in the maze at night, the curious animals shied away from the cat odor and were unlikely to return to that part of the enclosure later in the night. The researchers then put *Toxoplasma*-carrying rats in the enclosure. In previous experiments they have shown that infected rats are for the most part indistinguishable from healthy ones: They can compete for mates just as well, keep their rank in the rat hierarchy, and have no trouble feeding themselves. In the latest experiment the researchers found only one difference: The scent of a cat had no effect on them. They would explore the nest treated with cat urine at least as often as anywhere else in the enclosure. In some cases, the rats even had a fatal attraction to the cat scent.

The specificity of *Toxoplasma*'s effects argues against some general pathology. Because both infected and noninfected rats preferred rat reek to rabbit, "that reaction to predator odors is not due to an impairment of the [sense of] smell," says Berdoy. Instead, he speculates, *Toxoplasma* cysts may release a compound that interferes with a rat's own neurotransmitters, short-circuiting neurological pathways that would keep the rat out of danger.

Hurd says Berdoy's work does not close the book on *Toxoplasma,* however. "One of the key elements that they haven't demonstrated is whether it actually works, whether the host really is predated more because of this behavior," she says. "This is interesting, but it's really only the beginning."

If *Toxoplasma* finds its way into a human instead of a rat—people can pick up the parasite by handling litter boxes, eating undercooked meat, or gardening in oocyst-laden soil—it has no hope of completing its journey, because cats don't eat people. But there's some evidence that it may alter its host's behavior.

Parasitologist Jaroslav Flegr of Charles University in Prague administered psychological questionnaires to people infected with *Toxoplasma* and controls. Those infected, he found, show a small, but statistically significant, tendency to be more self-reproaching and insecure. Paradoxically, infected women, on average, tend to be more outgoing and warmhearted than controls, while infected men tend to be more jealous and suspicious. In the current issue of *Biological Psychology*, Flegr reports that these personality differences appear to become greater as people are infected for longer periods. Others are not yet convinced. Robert Simon, a psychologist at the University of Delaware in Newark, calls Flegr's work "courageous" but hardly conclusive. "I don't know for sure what to make of it; we need more people looking at [these correlations]."

Even if the changes are real, people who carry the parasite are hardly likely to throw themselves at lions. But if Flegr's findings hold up, they are a very personal reminder of the ways in which parasites try to control their destiny. **–CARL ZIMMER**

Carl Zimmer is the author of *Parasite Rex*, to be published in September.

PARTICLE PHYSICS

Elusive Particle Leaves Telltale Trace

Nearly massless and incredibly rare, the tau neutrino scorns its surroundings, seldom interacting with more common matter. These properties make it difficult to detect. Now, an international team of physicists has laid claim to the first "direct" detection of the tau neutrino. Scientists had already confirmed indirectly that the particle exists, but "it was an experimental major success," says Gordon Kane, a physicist at the University of Michigan, Ann Arbor.

Neutrinos were discovered after scientists failed to balance their subatomic books. In the 1930s, Wolfgang Pauli proposed that a very lightweight, weakly interacting particle was carrying away the energy that was missing from radioactive decays. The existence of the neutrino was confirmed a few decades later. Physicists believe there are three types of neutrinos, each named for the fundamental particle it interacts with: The electron neutrino interacts with electrons, the muon neutrino with muons, and the tau neutrino with taus. (Some theories posit other varieties of neutrinos, such as the so-called "sterile" neutrinos, but nobody knows whether they exist.) When physicists have fired beams of electron neutrinos at a target, they produce electrons. Likewise, muon neutrinos shot at a target generate muons. But no one had observed this for tau neutrinos.

At the Direct Observation of the Nu Tau (DONUT) experiment based at the Fermi National Accelerator Laboratory near Chicago, scientists tried their hand with an 800–giga-electron-volt proton beam. When the beam smashed into a target, it created all manner of subatomic particles, including, presumably, tau neutrinos. The neutrinos then passed through meter-long steel targets. One out of every trillion tau neutrinos interacted with an iron nucleus and created a tau particle, which, in turn, left a telltale track on layers of emulsions that acted like photographic plates. The yield: four taus that the DONUT team is quite confident came from tau neutrinos.

"It was a hard experiment, an expensive experiment, and a somewhat unfashionable experiment," says Stanford University physicist Martin Perl. Physicists already knew that tau neutrinos existed, from missing-energy analysis of tau particles, so some scientists saw no need to perform it at all. Perl disagrees. "It was very, very important to find out," he says. "Not only does it confirm [the tau neutrino's] existence, it shows that it interacts in a more or less normal fashion." DONUT team member Regina Rameika agrees. "It's just a relief, really," she says. "It's kind of one of those things you had to do." **–CHARLES SEIFE**

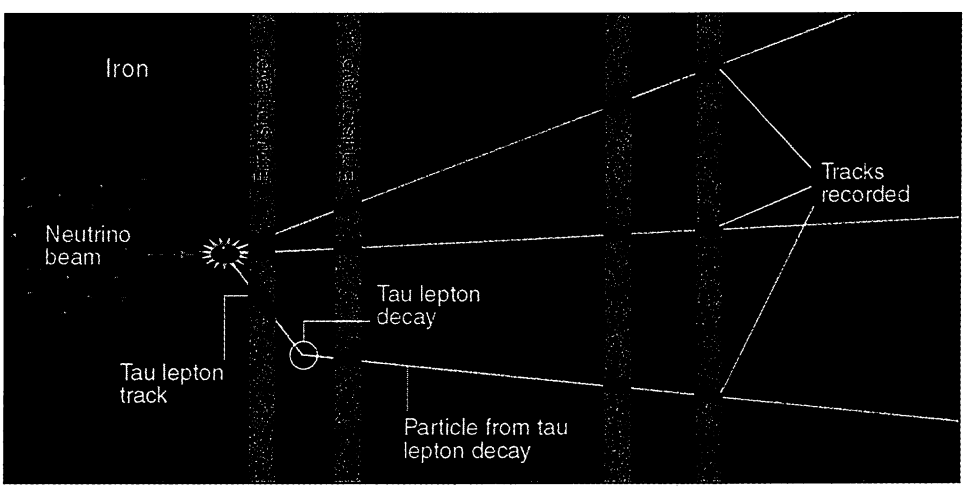


ILLUSTRATION: C. CAIN

Making tracks. About one tau neutrino in a trillion reacted with an iron nucleus, creating a tau particle that left its signature in emulsion plates.