hard to shift resources quickly, it allows established programs to grow rapidly. As proof, he points to spending levels, which have grown from $15 million in 1991 from the two agencies to $35 million this year, not including salaries. Overall, says Matsubara, "the current level of funding and activity [in Japan] is not something to be disappointed about."

Matsubara's view gets some support from Oklahoma's Roe, who says it is a misconception that completing the sequencing of the human genome will mean the end of sequencing. "If we get the whole thing done by some massive effort, what we'll have is the *Encyclopaedia Britannica* with a lot of spelling mistakes," Roe says. Sequencing teams will still be needed to correct those errors, he adds, a task that will stretch "to perpetuity."

Sanger's Sulston agrees that "2 to 3 years is not too late to start" a sequencing effort. In addition to the human genome, researchers would also like to sequence the mouse genome because of its importance to medical and biological research. But Sulston agrees with Shimizu that further delays "would not look good."

The big picture

Appearances are important to Japanese scientists, who still feel the sting of a 1989 charge of scientific freeloading by Nobel laureate James Watson, then head of NIH's genome program. In a letter to Matsubara, Watson indirectly threatened to try to block Japanese access to U.S. genome databases if Japan didn't increase its contributions to the worldwide effort, including the fledgling Human Genome Organization.

Scientists here also worry that a failure to do their share of sequencing will hinder progress on other projects. "I'm very concerned about what [a low level of genome funding] will mean for life sciences and medical research in general," says Sakaki. He sees a large-scale sequencing effort as a necessary first step in analyzing the function of particular genes and, eventually, developing new therapies. Without that initial commitment of resources, he says, the government may not be willing to fund later research and development activities.

Matsubara is optimistic that decisionmakers at Monbusho and STA will find a way to increase support in the future. "They know the importance [of the human genome program]," he says. But Nakamura disagrees, arguing that "the Human Genome Project is seen as a small part of molecular biology or medical research. If the budget stays the same, we have little hope to contribute very significantly to the project."

–Dennis Normile

AGRIBUSINESS

Patents on Native Technology Challenged

The neem tree of India, known as the "blessed tree" and the "curer of all ailments," is at the center of a patent battle that pits advocates of indigenous agriculture against a major U.S. company. Valued in India for its use as a medicine, a spermicide, and as fuel and timber, the neem tree caught the attention of W. R. Grace & Co. of New York because its seeds contain a potent natural pesticide, azadirachtin. Grace patented a method of extracting azadirachtin and stabilizing it. But now the company faces a legal challenge from Jeremy Rifkin, a longtime foe of the patenting of genes and animals. Rifkin claims that Indian farmers have used neem tree seeds as a pesticide for centuries, making this application obvious and unpatentable.

Rifkin's nonprofit group, the Foundation on Economic Trends, has recruited 200 other organizations from 35 countries to join a campaign against the patent, issued in June 1992. Rifkin was scheduled to file a formal petition with the U.S. Patent and Trademark Office (PTO) on 14 September, calling for a revocation of the patent. Rifkin, a consummate coalition-builder (*Science*, 26 May, p. 1126), says the petition is the opening shot in what he hopes will be a widening battle over intellectual ownership of "native technologies." Rifkin argues that "the biological resources that have been discovered by natives ought to be maintained in the open."

AGRICULTURAL RESEARCH SERVICE/USDA

Pesticide factory. Seeds of India's neem tree yield patented product.

While Grace's patent may be under challenge, azadirachtin's effectiveness as a natural pesticide is not. In 1985, U.S. timber importer Robert Larson won approval from the Environmental Protection Agency (EPA) to use the chemical as a nonagricultural biopesticide, and in 1988 he sold the product rights to Grace, which has been marketing it since 1992 as Margosan-O (*Science*, 28 February 1992, p. 1070). In March 1994, the EPA registered Grace's NEEMIX as the first neem product cleared in the United States for use on food crops. Grace entered into a partnership with the Indian company PJ Margo Private Limited in 1993, becoming the minority owner of a factory in Karnataka, India, where seed extract is processed and stabilized for long-term storage. In the past, Indian villagers have not been concerned about storage because they soak the seeds overnight in water or alcohol and place the emulsions on crops the next day.

The Rifkin petition, brought by a coalition of scientific, business, trade, farm, environmental, and cultural organizations, is expected to trigger an automatic re-examination of the patent by the PTO. The agency must respond 1 month after a petition is filed, and petitioners may appeal the decision in federal court.

"We believe we have an airtight case," Rifkin says. The law says an invention may be patented only if it is different from the "prior art" or knowledge a person in the field would have. Grace argues that its patent claim is novel because it applies to "neither the extraction nor the processing of the extract, but to a unique formulation" of azadirachtin developed "to insure its shelf stability." However, according to Rifkin, the petitioners will present "several hundred" journal articles as evidence that Indian scientists had described the extraction method before the patent was issued. And Rifkin says Indian companies were already using the chemical in stable solutions. "The Patent Office was absolutely wrong in granting this patent," he says.

Rifkin also claims the patent will hurt Indian farmers because they may have to stop using their own technology or pay steep royalties. Grace disagrees: "No individual or company is prohibited from the historical or traditional uses of neem extracts," a company statement says. The statement maintains that Grace cannot gain exclusive use of the neem tree extract, because 22 different companies, including three Indian companies, own 40 different patents on neem-related procedures.

Some independent experts in patent law also question the soundness of Rifkin's legal arguments and the significance of the patent for the Indian farmer. John Barton, a Stanford law school professor, says, "It may actually help some Indians by creating an industry for neem seeds." He notes that because the patent covers only one particular method of extraction, it shouldn't directly affect the Indians already using neem seeds.

Rifkin remains confident of his case, however—and of its value as a rallying point for those who oppose patents based on the genetic resources of developing countries.

–Lori Wolfgang