derstanding of ocean physics; but progress is being made toward elucidating the processes that affect the formation and long-term movement of rings. For example, data from current meters tethered to the ocean bottom have suggested that part of the Gulf Stream flow returns quickly to the southwest in a tight clockwise circle. It is thought that the southwestward drift of cold-core rings may result from their being caught in this return flow.

Another approach is to program a computer to predict the future movements of ocean waters on the basis of assumptions concerning the driving forces (water temperature differences and the wind), the shape and bottom topography

Speaking of Science

Genetic Engineering: The Origin of the Long-Distance Rumor

Opponents of genetic engineering often cite the possibility that scientists may create a new pathogen of some kind by combining the genes of different species in one organism. The criticism is most often leveled at research on recombinant DNA, which is the most controversial technique for achieving gene transfer, but other procedures, such as cell uptake or fusion, can also be used to introduce new genes into cells.

A recent rumor has it that a cell-uptake experiment performed in New Zealand produced a strain of fungus that kills pine trees. Early this year, the rumor caused quite a furor in New Zealand, where the timber industry is of major importance, and the story is now spreading in this country. For instance, in a public forum on the genetic engineering of nitrogen fixation,* a few speakers alluded to the New Zealand experience, without giving any details, as an example of how a genetic engineering experiment could go awry.

But what actually happened in New Zealand? Was a "killer fungus" unleashed? The answer is no, according to Kenneth Giles, the investigator who did the research in question while he was with the Plant Physiology Division of the Department of Scientific and Industrial Research of New Zealand. Giles, who is now at Iowa State University, says that the New Zealand reports greatly exaggerated and misrepresented the results of his experiments, which were done in 1975. He may have produced a new pathogen—and it is not certain that he did—but the only pine "trees" that died were 10 seedlings, some 2 to 3 inches high, that he studied in the laboratory under conditions very unlike those in nature.

Giles did the experiment because he wanted to introduce the ability to fix nitrogen into a fungus species (*Rhizopogon* sp.) that is a normal symbiotic associate of pine (*Pinus radiata*) seedlings and young trees. The fungus grows in and around the roots and helps the plants absorb phosphate, which they need for growth. He hypothesized that a fungus that reduces atmospheric nitrogen to ammonia, which is also required by plants, might help the seedlings grow even better.

To achieve this goal, he first treated the fungal cells with an enzyme to digest away the cell walls, and then incubated the protoplasts thus formed with the bacteria in an appropriate culture medium. He hoped that after the bacteria became incorporated within the fungal cells they would continue to produce ammonia. Giles found that a very small percentage of the fungal cells did take up the bacteria and, consequently, acquired the ability to fix nitrogen in culture.

The next step was to determine whether the five strains of nitrogen-fixing fungi he isolated were still capable of associating with pine seedling roots and producing ammonia for the seedlings. Giles considered this experiment a success, even though the ten seedlings inoculated with one fungal strain died within a month. The other 40 remained healthy, and there was evidence that the fungi formed associations with most of them and fixed nitrogen.

Giles destroyed by autoclaving all preparations of the strain that appeared to have killed the seedlings because he thought that the containment facilities available to him were not adequate for studying a possible new pathogen. Nevertheless, he says that for several reasons it is very unlikely that any of the fungus could have escaped from the laboratory.

He grew the seedlings in sterile soil in jars with cotton stoppers and screw-top lids. Manipulations of the altered fungal strains were carried out in a laboratory that is always bathed in ultraviolet light when not in use. (Ultraviolet light kills microorganisms and its use in this way is a common precaution to prevent contamination of cell cultures.) Since the laboratory did not have a hood with a filtered exhaust, Giles performed the experiments with the hood fan off to prevent dispersal of the cells. Finally, the fungus used does not form spores in culture and could only spread by vegetative growth. In any event, Giles points out that the altered fungi grow very poorly compared to the wild strains and would not compete well with them under natural conditions.

Giles said that he himself called the material a pathogen when he presented the work at scientific meetings and also in a paper published in *Plant and Soil* in June of this year. He emphasizes, however, that even the wild fungus strain kills about 10 percent of very young pine seedlings in conditions similar to those he used for the experiments with the altered strain. He rather regrets that he destroyed all samples of the altered strain because it is now impossible to determine just how pathogenic it actually was.

Giles was dismayed by the sensational treatment accorded his research in New Zealand and does not want to see it used in a similar manner by opponents of genetic engineering in this country. Nevertheless, it may still become a part of the continuing debate here. One researcher has pointed out that Giles is an experienced and careful worker and no problems ensued; but if a less experienced worker were to inadvertently produce a pathogen and allow it to escape from the laboratory, the consequences might be great.

—J.L.M.

*Public Meeting on Genetic Engineering for Nitrogen Fixation held on 5 and 6 October 1977 at the National Academy of Sciences. The meeting was sponsored by the Research Applied to National Needs Program of the National Science Foundation.