Biology

Julie Ann Miller reports from San Francisco at the Annual Congress for Recombinant DNA Research

Gene splicing for herbicide resistance

For the first time a commercially useful gene has been transplanted and shown to be active in an important crop plant, reports William Hiatt of Calgene, Inc., a plant biotechnology company in Davis, Calif. After a bacterial gene was introduced into tobacco plants, the plants showed an increased tolerance to the widely used herbicide glyphosate. A problem currently limiting the usefulness of herbicides is that they must distinguish between the crop and the pest — plants that often have biochemical similarities. Thus researchers have looked for more and more specific herbicides to kill the pest but spare the crop. But genetic engineering has made more practical another approach — the tailoring of the crop plant to make it less susceptible to a particular herbicide.

The gene that Calgene scientists have transplanted into tobacco originally arose in mutagenized bacteria. A form of the gene *aroA*, it encodes an enzyme in which one amino acid is different from its natural counterpart. The mutant enzyme has a lower affinity for the herbicide glyphosate than either the plant or normal bacterial enzyme. In the leaves of tobacco plants containing the transplanted gene, the mutant gene provides 25 percent of the total activity of the enzyme that normally is inhibited by glyphosate.

Calgene now plans to extend this work to other crop plants. According to science team leader Luca Comai, the scientists have already introduced the mutant *aroA* gene into soybean, tomato and oilseed rape cells in laboratory culture and are currently working on corn cells. Calgene also plans to develop and market glyphosate-tolerant varieties of corn, in collaboration with Phytogen of Pasadena, Calif., and forest trees, in collaboration with the U.S. Forest Service.

New targets for DNA probes

Genes in the cell nucleus are an obvious target for new diagnostic techniques that identify a microorganism by the presence of characteristic DNA segments (SN: 8/18/84, p. 104). But in their search for ways to distinguish similar organisms or to detect a quite divergent set, researchers are now looking beyond the nucleus.

The parasitic disease called leishmaniasis is caused by about a dozen species of protozoa, each triggering characteristic symptoms that range from self-healing skin lesions to fatal infection of internal organs. Determining exactly what species are responsible is important for selecting the appropriate treatment. Scientists at Codon, a biotechnology company in Brisbane, Calif., and at Walter Reed Army Institute of Research in Washington, D.C., report that they have devised DNA segments, or probes, that can distinguish among several species of *Leishmania*. They used DNA not from the cell nuclei but from an accessory body, called the kinetoplast or micronucleus, which is found in many protozoa. "These experiments," the scientists say, "suggest that DNA probes made from *Leishmania* kDNA [kinetoplast DNA] may be useful tools for diagnosing leishmaniasis and predicting the severity of the disease."

Another probe directed to nucleic acids outside the cell nucleus is the basis of the first product released by a San Diego company called Gen-Probe. This probe detects mycoplasma in laboratory tissue-culture samples. Mycoplasma contamination is a frequent and troublesome problem in laboratories. David E. Kohne of Gen-Probe has produced DNA segments that bind specifically to the RNA in ribosomes of two genuses of mycoplasma but not to mammalian RNA. Because there are thousands of ribosomes in a cell, this technique is more sensitive than if it were to detect nuclear DNA, Gen-Probe says. Because, in addition to contaminating tissue cultures, mycoplasma infects the human respiratory tract, Gen-Probe has plans to use their DNA probe in clinical tests for respiratory tract infections.

Earth Sciences

How deep is an earthquake?

For over half a century, seismologists have known that some earthquakes originate well below the earth's outer crust. Most of these deep quakes dot the world map at collision boundaries between plates; the quakes are thought to result from the buildup of stresses in one plate as it is subducted or dragged down under another.

Several hundred earthquakes originating deeper than 650 kilometers, including some at 800 km, have been reported since the 1930s. However, according to two geophysicists who recently evaluated the earthquake catalogs, the evidence backing up almost all of the reported very deep events is weak, inconsistent with other data or nonexistent. The deepest reliable depths, they conclude in the Feb. 10 JOURNAL OF GEOPHYSICAL RESEARCH, are at 670 to 680 km.

Philip B. Stark at Scripps Institution of Oceanography in La Jolla, Calif., and Cliff Frohlich at the University of Texas at Austin also found that the number of large quakes drops quite abruptly below 650 km. But the researchers can't tell if seismic activity completely stops at 680 km or if it continues deeper, only with diminishing vigor.

Knowing the maximum depth of earthquakes is a key to understanding the structure of the mantle, says Stark. An abrupt cessation of earthquakes at one depth means that some property of the mantle, perhaps its composition, has changed there. One model consistent with an abrupt cessation holds that the lower of two convecting layers in the mantle blocks the downward plunge of the subducted plate. In contrast, Stark and Frohlich believe, on the basis of other data, that the subducting slab continues much farther. They think the change in seismicity at 670 km is due to a phase change, or rearrangement of the slab crystal structure, which might strengthen or relieve stresses in the slab, or anneal cracks.

Climate history: Blowing in the wind

In composing a picture of the earth's past climate, scientists assemble a montage of data, drawn largely from fossils in deep-sea sediments. These data can be linked to ocean circulation, which then plays a part in climate models.

The atmosphere also plays a role in climate, but until recently there was no direct way of charting its history. In the Feb. 15 SCIENCE, David K. Rea of the University of Michigan in Ann Arbor and co-workers present a marker of past wind intensity: dust, once carried by winds from the land and now buried in ocean-bottom deposits. "The size of the dust gives us an indication of how fast the winds were blowing," says Rea. "Stronger winds carry larger grains." Moreover, the amount of dust, he says, is a measure of how arid the land was — a lot of dust means dry continents.

The researchers studied dust from four drill holes in the Pacific Ocean, where winds have left dust from China, the Gobi Desert and Central America. Overall, the dust data agree with the prevailing view of climate over the last 70 million years for that region. Variations in the amount of dust deposited are in sync with the ebb and flow of ice ages. For the Pacific, however, the data indicate that glacial periods over the last few million years were more humid than interglacial times — just the opposite of what's been suggested in other parts of the world. Variations in grain size over this time also mesh with the periods associated with the earth's orbital motion, providing Rea's group with the first documentation that atmospheric circulation, like other climate indicators (SN: 11/10/79, p. 324), responds to orbital forces.

Another important finding was that grains deposited 65 million years ago were relatively large, implying strong winds during the late Cretaceous — a period usually thought to be marked by sluggish ocean circulation and warm climate.