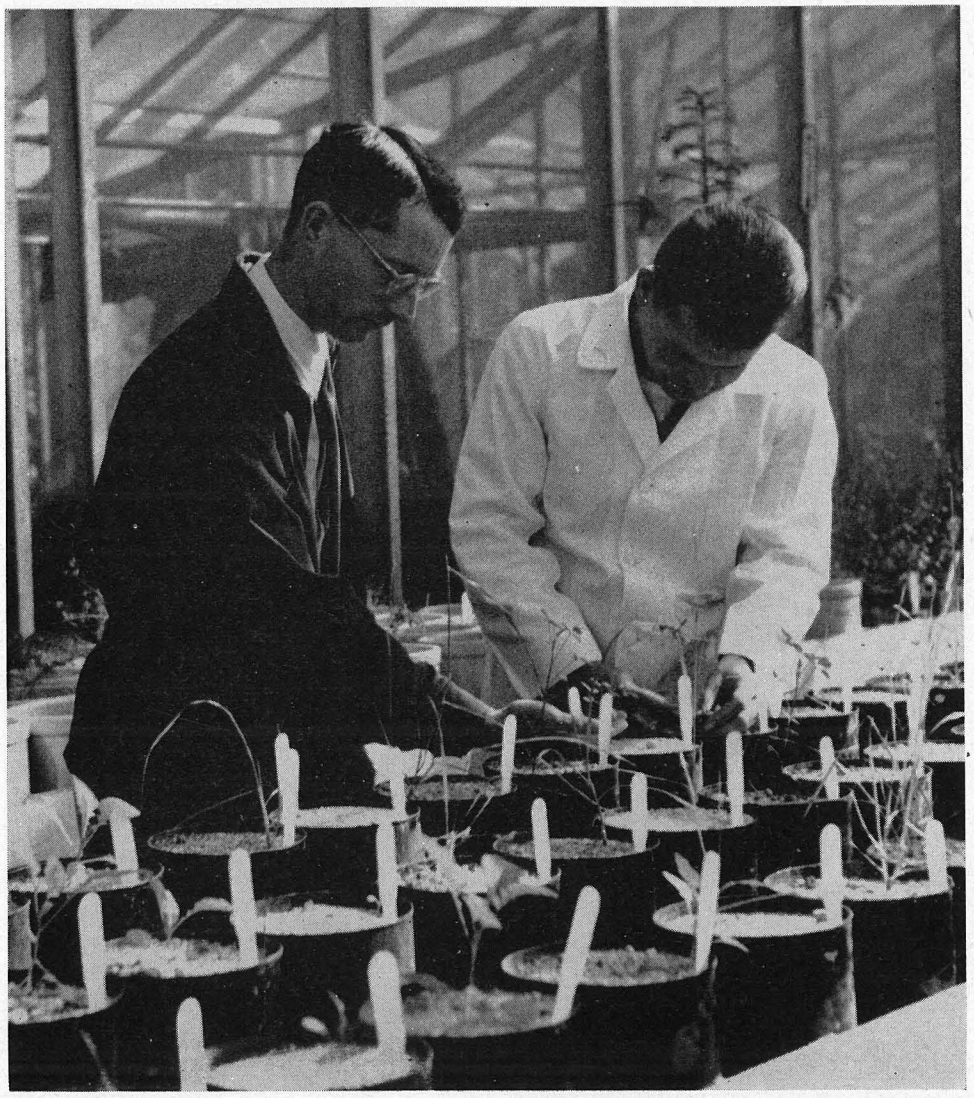


William C. Ashby and Henry Hellmers, plant physiologists with the California Forest and Range Experiment Station, study the development of plant cover in Caltech's Orlando Greenhouse.

FERTILITY AND FLOODS

Caltech and the U. S. Forest Service cooperate on a program of research to help cut soil erosion and flood damage in California's San Gabriel Mountains

RESEARCH NOW IN PROGRESS at the California Institute of Technology has shown that the proper fertilizer can increase the growth of native vegetation on our semi-arid mountains. Less erosion, reduced flood dangers, and improved water supply may result.

Most investigators had assumed that little or nothing could be done to increase plant cover in the near-desert mountain regions of southern California. It is true that lack of water limits plant growth in the dry seasons, but Institute biologists discovered that low soil fertility becomes the limiting factor when water *is* available.

They found this in a cooperative research program being conducted with the California Forest and Range Experiment Station of the U. S. Forest Service. Co-workers are Drs. James Bonner, Professor of Biology, and Henry Hellmers and William C. Ashby, Research Fellows, who are Forest Experiment Station plant physiologists.

The Forest Service is seeking ways to improve the sparse plant cover on critical areas in the rugged San Gabriel Mountains. The belief is that better cover would help cut the high rates of soil erosion and the flood peaks that occur during winter storms. Debris-laden floods sometimes cause severe damage. The silt they carry reduces the capacity and efficiency of reservoirs and stream channels. Lives may be endangered and improvements destroyed on the outwash plants not protected by flood control structures.

Experiments with native plants

The initial experiments were carried out in the Orlando Greenhouse near the Caltech campus with five plants native to the San Gabriel Range: Coulter pine, big-cone spruce, mountain oak, mountain lilac, and chamise (greasewood). Dr. Hellmers planted seeds in potted samples of each of the three major soils of the range: Wilson diorite, Lowe granodiorite, and anorthosite. He left some samples unfertilized and applied chemical fertilizers to others. One fertilizer—ammonium nitrate—was rich in nitrogen, others in calcium, potassium, phosphorus, sulphur, or a combination of magnesium, boron, zinc, copper, and molybdenum.

Plants grew well and thrived in the soils treated with ammonium nitrate, but this was the only fertilizer that consistently produced a significant response. Soils treated with the other compounds grew plants as scrubby as those in unfertilized soils. The scientists therefore concluded that lack of nitrogen limits the development of plant cover in the San Gabriel Range.

This finding is not universally applicable, they caution, because soils elsewhere might be deficient in one or more of the other elements affecting plant growth. But a knowledge of specific local deficiencies, they feel, may enable scientists to improve plant cover in other semi-arid regions where erosion is a serious hazard.

In the field

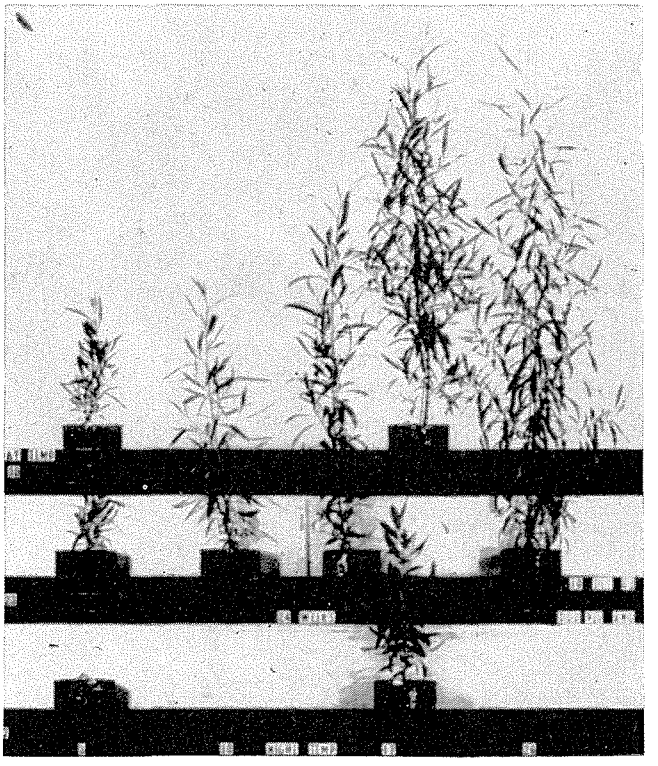
The plant scientists moved their experiments into the field after demonstrating the nitrogen deficiency in the greenhouse. They set up 14 large plots throughout the mountainous part of the Los Angeles River watershed, at altitudes of 1,000 to about 5,000 feet. Part of each plot was treated with a standard commercial nitrogen fertilizer—ammonium sulfate—because it was cheaper than ammonium nitrate. In just one year the treated areas produced twice as much new plant growth as adjoining untreated areas, and this growth has persisted through two growing seasons without more fertilization.

A good plant cover is considered to be useful in flood control in several ways: The vegetation, and the leaves and needles it sheds, protect the soil and also make it porous; the roots help hold the soil in place. Rainwater can percolate through the porous soil and fractured rock and so reduce surface runoff and erosion. Where no cover grows, the impact of raindrops loosens particles of soil and rock, and rainwater flushes this silt downhill to join many freshets and mushroom into a destructive mass of water, mud and rock.

Such silt-packed water cannot be diverted directly to community use. Nor can it be allowed to collect in and clog the spreading grounds through which mountain runoffs trickle into underground basins. Silty water must be shunted onward to the sea, lost to a water-hungry area. If plant cover could be grown on bare mountainsides, less silt would come down the slopes and the rainwater might be used for community supplies. Too, more water would seep gently through the soil during rainy seasons to raise the level of underground basins.

Search for nitrogen-fixing plants

The biologists point out that fertilizing mountain soils, perhaps by dusting from an airplane or helicopter, would be extremely expensive, even if the work was concentrated only on critical areas. They are now searching for nitrogen-fixing plants which can grow in the mountains. This is primarily the concern of Dr. Ashby. In the Earhart Plant Research Laboratory at Caltech, where any desired climate can be duplicated under controlled conditions, he is trying to find a leguminous plant that will grow in the San Gabriel Range. The legumes—clover, beans, and their allies—can collect nitrogen from the air and fix it in the soil for their own use and that of other plants in the vicinity. If a suitable legume can be found, fertilization would not be necessary.



Experiments with Hopbush, native of Arizona and other warm regions of the world, show an increase in growth with an increase in temperature, day or night. This limits it to low elevation sites that have ground water available in the summer.