Scientists Who Make a Difference

Some researchers stay locked in their laboratories, looking for clues that will unlock the mysteries of science. But those who make a real difference see not only the pieces of the puzzle before them but also the connection between these pieces and other aspects of life. These are the real leaders.

Five scientists exemplify this breadth of vision. They are but five of the 12,500 scientists in the land-grant university agricultural research system, scientists working in cooperation with USDA's Cooperative State Research Service. These scientists work in some of the high-priority areas that were identified in USDA's National Initiative for Research on Agriculture, Food, and Environment. The initiative calls for Federal support of competitive grants to fund agricultural research in critical food, fiber, and environmental areas.

Arthur Kelman: Explaining Bacteria That Attack Food Plants

University of Wisconsin plant pathologist Arthur Kelman, a member of the National Academy of Science, was the first chairman of the Board on Basic Biology and chaired the committee that drafted an influential report on introducing recombinant-DNA-engineered organisms into the environment. The report led to the establishment of rational policies to regulate biotechnology. Arthur has dedicated his scientific career to the study of bacteria that cause diseases in plants—to the study of simple phenomena that have eluded explanation.

One of the bacteria that he has spent years studying is *Pseudomonas solanacearum,* a scourge in warm climates for its attacks on a variety of plants, including tomatoes, potatoes, peanuts, and bananas. Time-consuming and costly methods are required to keep many pathogenic bacteria alive for study, but Arthur discovered that scientists could keep *Pseudomonas* alive and virulent for study simply by storing it in water. This technique has been used now for more than 40 years.

Arthur also has an interest in *Erwinia* bacteria, which devour such plants as potatoes. Not many scientists like to handle slimy and smelly rotting materials, but Arthur thrives on dissecting the mystery of why and how *Erwinia* works.

Scientists had assumed that bacteria in the soil were the major source of *Erwinia* contamination. Arthur discovered, however, that potato tubers, before they were planted, generally were contaminated with *Erwinia.* The *Erwinia* bacteria isolated from tubers were of two related groups, the so-called subspecies *atroseptica* and *carotovora.* At one point, Arthur thought that he was able to tell the two subspecies apart by the characteristic odor of cultures. He became so excited about this possibility that he spent an entire weekend smelling plates of *Erwinia.*

Although many people have rather routine lives, some have the nerve and dash to be different, and their lives can be exciting. Arthur and the other scientists described in this chapter are noted not only for their contributions to agricultural science but also for their courage to stand out from the crowd.

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Ron Sederoff: Bringing Biotechnology to the Forest

Ron Sederoff, of North Carolina State University, is another agricultural scientist forging his own way. Once, Sederoff was speaking to a university advisory committee on pine tissue culture. As an invited guest from the genetics department, he had been talking about the research potential in forest biotechnology.

It was a gray day and a difficult afternoon of talks before a group that was made up mostly of wood products industry representatives who supported the university's program. The program had been working on improved tree seedlings and plantlets for 7 years, but it was slow going. The plantlets were more resistant to rust than the seedlings, but they grew more slowly. The research team needed to learn more about roots.

Ron paused and bowed his head and said very quietly, "I intend to be the first to isolate a gene from pine."

"What did you say?" somebody in the crowd called out.

Ron raised his voice a little and announced, "I intend to be the first to isolate a gene from pine," and he abruptly sat down. The break period that day was punctuated with excited talk about Ron's pronouncement. The group was clearly impressed.

About a year later, Ron and his colleagues had taken molecular genetics in pine trees a major step forward. They had proven that methods for identifying, isolating, and splicing genes from pine trees would work. Ron and his colleagues Anne-Marie Stomp, W. S. Chilton, and L. W. Moore demonstrated that foreign genes could be transferred into cells and tissues of pines using the crown gall bacterium, *Agrobacterium tumefaciens*. Although simple in themselves, these experiments implied that genetic engineering of pine trees was possible.

Ron and other men and women who work indoors, wear white lab coats, and study molecules in test tubes are part of a new breed of forest biologists. They study genes and grow trees in test tubes from pieces of plant tissue barely visible to the naked eye, and they are as comfortable with molecules, which are invisible without magnification, as they are with whole trees.

Frederick Bliss (seated) and graduate student Mark Lewis discuss plant transformation procedures.

Frederick Bliss: Breeding Better Beans

For scientists like Frederick Bliss of the University of California-Davis, the scientific quest began in childhood. As a child on a Nebraska farm, Bliss learned from his grandfather, a German immigrant, about the skills and concern that go into budding and grafting fruit trees.

As an internationally known plant geneticist and horticulturist, Fred has focused on the genetics, breeding, biochemistry, and quality of legumes. He and his associates have investigated the genetic regulation of seed protein synthesis and the improvement of nitrogen fixation. These advances continue to be translated into practical applications, such as the development of new bean varieties with more protein (of improved quality), an enhanced ability to fix nitrogen, and resistance to insects that attack seeds in storage.

Like most scientists, Fred admits that knowledge sometimes is uncovered by accident. Clues pop up and a whole new picture emerges. It was like that with the new bean varieties that Fred and his colleagues hope will soon be released to farmers.

For 20 years, he had been studying seed proteins in common beans to increase protein and improve their nutritional content. In 1988, scientists at CIAT (Centro Internacional de Agricultura Tropical) reported finding wild beans that were resistant to the bruchid weevil, a pest that causes untold damage to stored beans in Africa and Latin America. Fred and his research team found that the resistance in these wild beans to the bruchid weevil was caused by one of the interesting proteins, arecelin, they had been studying.

Knowing that the protein was not present in cultivated bean species, Fred and his team believed that adding arecelin to other species would provide protection against insect damage and increase the food available to subsistence farmers. They set out to produce a modified version of the bean variety Sanilac that contains the arecelin gene, and tests show that the modified versions are resisting the bean weevil.

"This is one of the reasons research is so rewarding," Fred remarks. "The breeding of new plant varieties is challenging and pushes our creativity to the limits."

John Waldrop: Catfish Are Good for Consumers, Farmers, and the Environment

If creativity is sparked by new ideas, then John Waldrop is a very creative person. Whether working as an agricultural economist or a volunteer chef, John focuses on catfish.

As a researcher at Mississippi State University's Agricultural and Forestry

Experiment Station, John is interested in the conservation of natural resources. He became interested in the aquaculture industry when he learned that catfish production can help avoid erosion and runoff problems and that producers can make use of heavy clay soils that are often unproductive for row crops. The freshwater ponds used in catfish farming also help restore wildlife habitat.

"The catfish industry fills a need," he declares. "It's right in line with society's demand for food that is healthy, pure, safe, and pollution free. Even the ingredients in catfish feed are environmentally safe."

When John is not trying to evaluate the economics of new technology for commercial catfish production, he is cooking catfish.

As part of an earlier catfish education program, he gained acclaim as a chef by cooking the dish for people representing all of the continental United States and 24 foreign countries.

Once the dish of common folk, the catfish has made its way to the finest restaurants from coast to coast. The secret of its rise in popularity is simple: availability, economics, easy preparation, and good taste.

All researchers know that if a product does not taste good, consumers will not eat it—no matter how nutritious or economical it is. But as John has helped to prove, catfish does taste good. The mild flavor now comes in many forms, and catfish dishes can suit even the most discriminating diner.

John is not an advocate. He stresses that his job is to evaluate the economic viability of an aquaculture enterprise. "I can tell you how to be efficient and what the economic consequences of your actions may be," he says, "but I can't tell you whether to try raising catfish."

Philip Nelson: Can-Do Attitude

Some idealistic college graduates set out to change the world, but few actually do. Purdue University's Philip Nelson did. He changed the food processing industry.

Food processing is in Philip's blood. It is what he knows and what he likes. Philip grew up in Indiana, where his family grew tomatoes and owned a processing plant.

Everything had to be done in a few short weeks, and often processors had to guess on the need for can size. If too many processors guessed the same, the market became glutted. Philip started thinking about how to solve those problems and he studied them while a student at Purdue.

Because of consolidation in the food processing industry, the Nelson family business closed, and he went back to graduate school.

He says he does not recall any real obstacles along the way, but he does remember dropping a beaker of acid in a chemistry lab right after he started graduate school. "It ruined the only pair of shoes I had, and I wanted to quit school. But my wife and others encouraged me to forget obstacles and move on," he remembers.

Now Philip keeps a crumpled piece of paper in his desk that says, "Failure is not the falling down, but the staying down."

Philip has been determined. He has never forgotten those can size problems, and his determination has revolutionized the processing industry. By focusing on the development of a big can—a large tank—that could partially process tomatoes, hold them, and then process the product that the market wanted throughout the rest of the year, Philip advanced the cause of aseptic processing.

Aseptic processing uses high temperatures over short periods for sterilization. The product is sterilized outside the container and cooled, then the container is sterilized, and the two are brought together in a sterile environment. In traditional canning methods, food is cooked and processed right in the container.

With Philip's bulk storage system, no chemical additive or refrigeration is required for storage, and acidic fruits and vegetables can be stored indefinitely.

In addition to the holding tanks that range from 40,000 to 250,000 gallons, Philip has developed a 20,000-gallon rail car that requires no refrigeration.

The bulk storage system he invented is used by processors worldwide, from Japan to Morocco. The citrus industry also has adopted it for storing fresh orange juice.

The railcar allows tomatoes that are grown and made into paste in California to be shipped to the Midwest for making catsup.

Philip says, "Being able to give a part of yourself to someone else is important."

One of the ways Philip gives of himself is through working with students and passing on the "excitement of science." "The satisfaction," he says, "is in knowing that scientists can have an impact on human well-being."

That is something that Philip shares with the other scientists in this chapter—making the world a little better and a little more understandable.