Peace and the Green Revolution

Development of new strains of wheat has postponed world famine and merited a Nobel Prize

Culliton

Dwarf wheat in India: The Green Revolution a reality.

The 1968-69 crop year on the Gangatic and Indus plains in India and West Pakistan ordinarily would have produced a famine. The monsoon was shorter than normal and winter rains were nearly nil; temperatures during March, when grain was filling, were five to eight degrees above normal.

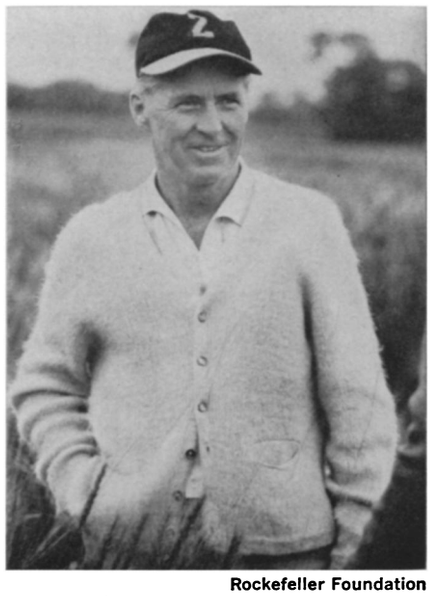
But there was no famine. Instead, the Pakistani wheat crop was about 14 percent higher than in the preceding year and the Indian crop eight percent. With or without drought and bad growing weather, wheat yields have been increasing comparably in Mexico, Turkey and Afghanistan. A pessimistic 1967 report on world hunger by the President's Science Advisory Committee is a happily outdated document as its Malthusian predictions fail to come true and the specter of mass famine is averted—temporarily, at least.

The truly revolutionary change in world food production has come largely as a result of uniquely hardy and productive new varieties of wheat (and rice and maize as well). Dr. Norman Ernest Borlaug, director of the Rockefeller Foundation-financed International Wheat Improvement Program in Mexico, is the man who has led the revolution, and last week the Nobel committee named Dr. Borlaug winner of the 1970 Nobel Peace Prize.

The multi-faceted Green Revolution which in the past six years has become a reality (SN: 7/6/68, p. 19 and 4/5/69, p. 335), is a complex and largely unexpected phenomenon. Dr. Borlaug perceived some time ago that the slow erasure of ancient and unproductive agriculture traditions in underdeveloped countries could not begin to keep pace with growing needs. Needed, he said, "is not a slow, steady increase of yields, but a revolution in production." The vision is being realized, and Mexico and Pakistan have already shifted from grain-deficit nations to nations that are self–sufficient in grain production. India is headed in the same direction, and now there is actually a danger of a world glut of wheat.

How it happened is a complex story, and Dr. Borlaug, an American plant pathologist, deserves credit not only for the scientific innovations involved in his work but also for organizational talents that were able to effect such a wide-scale change in such a short time. The feat was accomplished in the face of a pessimistic attitude which declared uneducated farmers unable to adapt quickly to the new ways.

The scientific basis for the change began in 1943 when the Iowa-born Dr. Borlaug began to experiment with varieties of wheat. There were numerous problems with conventional varieties. They were subject to fungus diseases, such as black stem rust. Protein content was not as high as desired. They were too highly specialized in terms of growing season, and a variety which succeeded one place would not succeed where the growing season was different. And they were not "fertilizer-responsive"—a point of diminishing returns was reached in fertilizer application which caused any additional growth to cause "lodging," or falling over.



Rockefeller Foundation

Dr. Borlaug: Buying 20 to 30 years.

Dr. Borlaug gathered wheat varieties from all over the world and began to cross them, as well as to produce mutations artificially. An extremely important input was the Japanese "Norin" dwarfs discovered by Dr. S. C. Salmon of the U.S. Department of Agriculture. The dwarfs have very short, stiff stems and a high resistance to lodging.

Out of Dr. Borlaug's work came today's dwarf wheats which are the mainstay of the Green Revolution. The two- and three-gene dwarfs—incorporating two or three genes for dwarfism and stiff stems—are remarkably resistant to lodging, and they allow application of 120 pounds per acre of nitrogen fertilizers, compared with an earlier 100 pounds. The new varieties also are disease-resistant, highly versatile (which suits them for varying growing seasons) and high in protein. Yields in India and Pakistan have shot up from 11 bushels per acre to an average of 50, with reports of yields of up to 150 bushels in some areas.

Dr. Borlaug, working with agricultural scientists in the underdeveloped countries, sought to disseminate seed produced in Mexico to these nations. The expectation had been that tradition-bound farmers would resist. Instead, farmers eagerly lined up for the new seed. In India, acreage planted to the new varieties rose from a mere 15 in 1964-65 to 11 million in 1968-69; in the same period, Pakistani acreage increased from 10 acres to 6.5 million.

There are problems. The socio-economic division between the formerly destitute farmers who have adopted the new strains and their field workers became exacerbated to the point where violent labor disputes occurred (SN: 4/5/69, p. 335). But the balance of payments situation in the formerly grain–deficit countries is much im-

proved and industrialization is proceeding more rapidly.

Whatever these side effects, the main impact is an obvious benefit to mankind: the deferment of a giant collision between once near static food supplies and a growing population. But Dr. Borlaug himself emphasizes it is only a deferment. The Green Revolution, he says, "offers the possibility of buying 20 to 30 years of time . . . in which to bring population into balance with food production." After that, the inexorable Malthusian forces will once again begin operating—unless man uses the time to achieve broad scale population control. □

PHYSICS, CHEMISTRY NOBELS

Magnetism to metabolism

Work on the behavior of magnetic matter in two quite different realms of nature, astrophysics and solid-state physics, brought the 1970 Nobel Prize in Physics this week to a French physicist and a Swedish-American physicist.

Dr. Louis Néel of the University of Grenoble in France gets one-half the award for his work on the magnetism of solids. He is especially renowned for his work on the way the magnetic fields of atoms and groups of atoms inside a solid align to give different forms of over-all magnetic behavior to the solid.

The Swedish Academy of Sciences cited Dr. Néel particularly for his work on ferromagnets and antiferromagnets, and on ferrites, compounds of iron that are magnetic without being electrically conducting. His work has many important applications in the technology of electronic devices.

Dr. Hannes Alfvén, formerly head of the Institute for Plasma Physics at the Stockholm University of Technology and now a teacher at the University of California at San Diego, was chosen for his work in magnetohydrodynamics, the study of the magnetic behavior of electrically conducting fluids.

The most widely studied conducting fluids are the plasmas of ions and electrons used in attempts to produce controlled thermonuclear fusion. Since controlled fusion experiments usually try to confine plasmas by means of magnetic fields, detailed knowledge of plasma behavior under such influences is necessary. Dr. Alfvén once headed Swedish research in nuclear fusion, but left that post over a policy disagreement in 1967.

Most recently Dr. Alfvén has concentrated on another aspect of magnetohydrodynamics, the behavior of plasmas in astrophysics. Ionized gases are found in the atmospheres of stars and in clouds that pervade the galaxies. Since magnetic fields are also present in these places, magnetohydrodynamics is basic to the understanding of the evolution of both galaxies and individual stars. Dr. Alfvén has put forth a theory in which the centers of galaxies consist of large clouds of two kinds of plasma, one made of ordinary particles, the other of antiparticles. The violent interaction of the two is supposed to govern the evolution of the galaxy. The Nobel citation refers to Dr. Alfvén's "fundamental work and discoveries in magnetohydrodynamics with fruitful applications in different parts of plasma physics."

At the same time that the Swedish Academy revealed the physics award, it announced that the Nobel Prize in Chemistry goes to Dr. Luis F. Leloir, a 64-year-old Frenchman who is a naturalized citizen of Argentina. Both awards are worth $78,400 each.

Citing Dr. Leloir's contributions to science, the Academy said: "Few discoveries have made such an impact in biochemical research as those of Dr. Leloir. His work and the work inspired by him has given us real knowledge in wide fields of biochemistry, where earlier we had to resort to vague hypotheses."

Specifically, Dr. Leloir's findings involve the complex processes by which the body metabolizes carbohydrates or sugars, converting one sugar to another in biosynthetic systems. His contributions began with the discovery of a sugar nucleotide called uridine triphosphate. He went on to show that this energy compound reacts with sugars to form a second product, uridine diphosphate, a complex sugar compound which is an important intermediate in carbohydrate biosynthesis.

From reactions involving these agents, the body synthesizes glycogen, a substance that permits storage of carbohydrates for future use. In addition UTP and UDP are vital to the synthetic processes by which glycolipids and glycoproteins are made. These latter materials are the building blocks of cell membranes and thus are essential for maintaining all normal cellular activity.

Dr. Leloir's research dates from the late 1940's when he first showed that the conversion of one sugar to another depended upon the activity of a third substance which turned out to be UTP. Said one of his colleagues after hearing of the award, "It is no surprise he got the Prize. We've been predicting it for years." Dr. Leloir, himself, seemed to have mixed feelings about the publicity. "I am certainly very honored," he said, "but the Prize will cause me problems. I will not be able to work in the same kind of peace and quiet that I used to." □

MILLIONAIRE ECONOMIST

An obvious Nobelist

There is a basic economic tenet holding that, "Them as has, gits." That principle was borne out this week when Dr. Paul Samuelson, whose ubiquitous textbook, "Economics," has made him a millionaire and his name familiar to millions of undergraduates, received the further prestige of a Nobel Memorial Prize in Economics and the $78,400 that goes with it.

This year's award is only the second given for economics, and in casting over the profession for those worthy of the Prize, the Swedish Royal Academy of Sciences must have found Dr. Samuelson an obvious choice. Both through his textbook and through his other articulate and voluminous writings, both technical and popular, he has educated a generation of students, Government officials and even industrialists on the principles of the state's power to regulate and stimulate a nation's economy through its fiscal activities.

But the Academy chose to emphasize Dr. Samuelson's considerable theoretical work in economics rather than his popularizing and public roles. The award was made for his developing "static and dynamic economic theory" and for contributing to "raising the level of analysis in economic science."

The work on dynamic theory, as Dr. Samuelson explains it, refers to the process by which supply and demand approach an equilibrium point. If the supply of a good is equal to the demand at a certain price, then it is quite clear that the system is in equilibrium and will stay there. But the conditions are shifting; the equilibrium is disturbed, and which way the system will move—whether toward stability or toward wider and wider swings—depends on various factors. In his 1947 book, "Foundations of Economic Analysis," Dr. Samuelson was one of the first to describe the processes by which this equilibrium-seeking system works.

Among the effects of the economic analysis that Dr. Samuelson helped develop has been the ability to forecast economic events with greater accuracy, partly because of computer analyses that developed with it.

"Everybody does a much better job than we did 20 years ago," says Dr. Samuelson. "Our statistical methods have improved, but also we know what kind of information we want to get and now we get more of it."

Dr. Samuelson calls himself a "new" economist; he is concerned that the public sector of the economy has been "suppressed—so that we have public squalor along with private, really decadent, opulence."