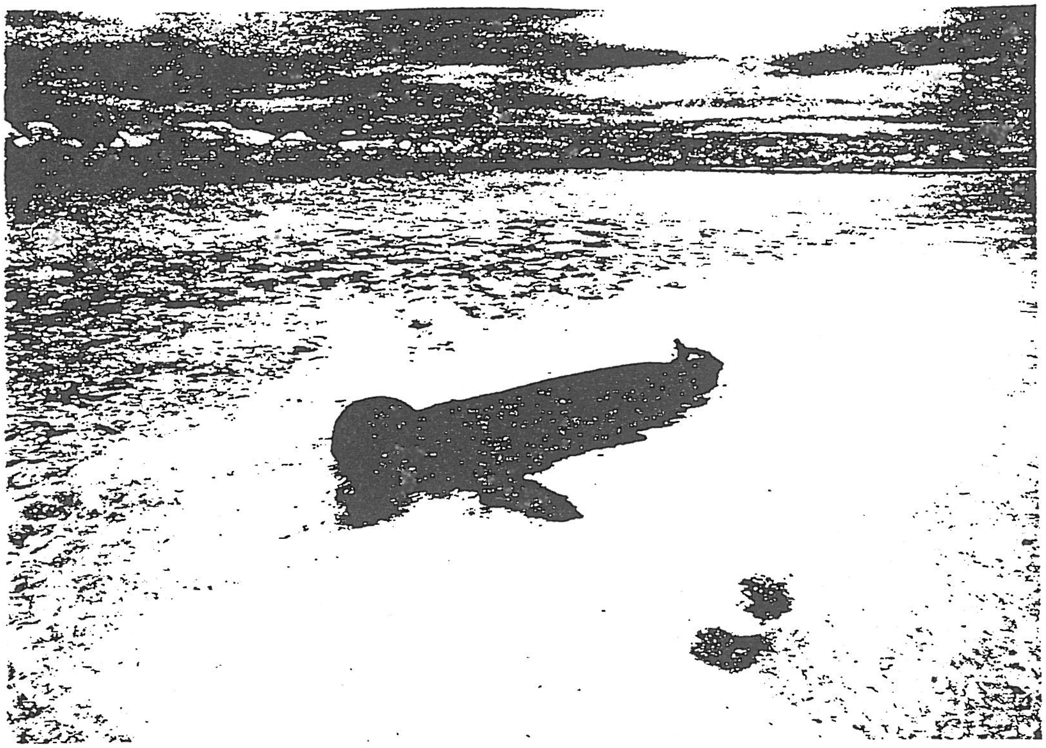


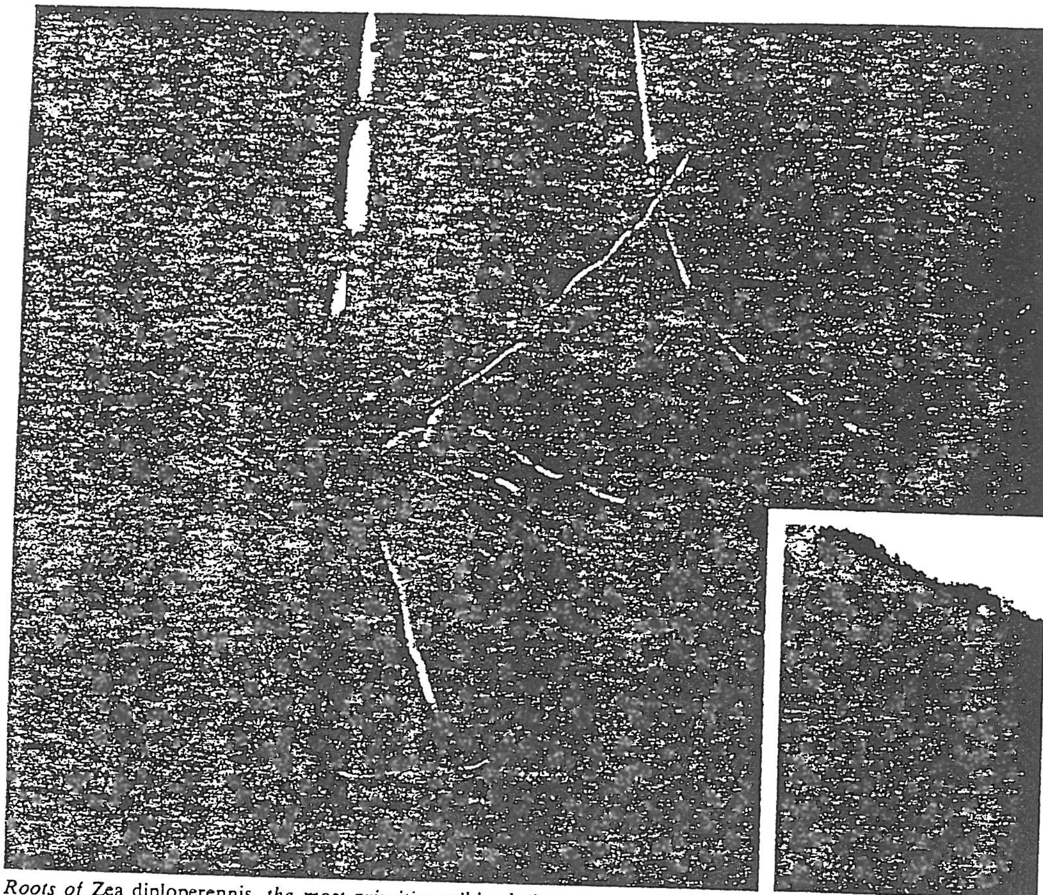
By Saving Wild Species, We May be Saving Ourselves

by Norman Myers

THE RATIONALES FOR SAVING wild species, at the onset of the movement several decades ago, were largely ethical, esthetic, and ecological. These fundamental arguments have since been joined by another, equally important one. We depend on our fellow species for our material welfare, and ultimately for our future survival, in all sorts of unsuspected ways. Conserving the planet's tropical areas is especially important to realizing the utilitarian benefits of wild species. Some 70 percent of the Earth's plants and animals exist in the tropics, which means—by and large—in developing nations. Third World leaders may be personally aware of the ethical and esthetic values of wildlife, but they also recognize that it is politically unfeasible for their impoverished populations to retain space for rhinos, giraffes, and jaguars when millions of hungry people lack land to grow their crops. If wildlife can "pay its way" in the marketplace and make a local economic contribution, then space may yet be found for threatened species.

Although some may view the utilitarian rationale for preserving species as a narrow view of wildlife's true value, there need not be a conflict between the consideration of a species' economic contributions and the belief that its continued existence needs no justification. But faced with expanding human populations, especially in developing nations, we must realize there is less and less room for wildlife that exists for its own sake.

We use hundreds of products each day that owe their existence to plants and animals. The ways in which wild species support our daily welfare fall under three main headings: agriculture, medicine, and industry.



Hugh H. Iltis

Roots of Zea diploperennis, *the most primitive wild relative of corn, showing development of perennial rhizomes. This trait is coupled with natural immunities that make the species extremely desirable to corn breeders. Inset: a stand of the maize at its discovery site in Mexico's Sierra de Manantlán.*

Agriculture

The productivity of our major crops cannot be maintained, let alone expanded, without a constant infusion of fresh genetic variability. Much of this genetic material comes from wild plants, the relatives of modern crops. Indeed, the skills of plant geneticists, even more than the use of artificial additives such as fertilizers and pesticides, have yielded one record crop after another in North America.

Of course it is difficult to separate the contributions of genetic materials from other factors that enable certain crop variants to flourish. But as a rule of thumb—an exceptionally rough rule of thumb—agriculturalists estimate that, across the board, we can attribute some 40 percent of expanded productivity to genetic breeding, and hence to the germplasm and other genetic materials on which crop breeders depend.

For example, during the past several decades, plant geneticists and agronomists have enabled American farmers to produce over three times more corn per acre, until production has now surpassed 100 bushels per acre and occasionally reaches record levels of 240 bushels. Although a good part of this increased productivity can be attributed to massive amounts of fertilizer and pesticides, agricultural experts calculate that between two-fifths and three-fifths can be credited to the continuous redesign of corn's genetic composition.

At the same time, we should recall that high productivity of modern types of corn is often accompanied by high vulnerability to diseases, environmental stresses, and other problems of modern agriculture with its "streamlined" practices. The corn varieties that thrive tend to be planted everywhere corn will grow. By 1970, the parentage of seed corn used in the United States had become dangerously susceptible to disease. No less than 70 percent of the seed owed its ancestry to only *six* in-bred lines. Not surprisingly, a leaf blight struck, eliminating one-seventh of the entire crop and as much as one-half of the crop in southern states. As a result, corn prices rose by 20 percent, and the cost to farmers passed on to consumers totaled more than $2 billion. Fortunately, the situation was corrected with the help of blight-resistant germplasms whose genetic ancestry was originally derived from Mexico. Although we cannot say that the critical genetic material was worth $2 billion, since other factors contributed to the turn-around (such as research facilities and the professional skills of plant breeders), the figure still gives us an idea of the huge sums of money that can be saved or lost.

Another new species of "wild" corn, or teosinte, was found more recently. Just a few years ago, a team of American and Mexican botanists, led by Professor Hugh Iltis of the University of Wisconsin and Rafael Guzman of the University of Guadalajara, discovered a wild plant in a remote montane forest in southwestern Mexico. This species, newly described as *Zea diploperennis*, is the most primitive known relative of modern corn. Only a few acres, no more than five or six, of the wild corn have been discovered, supporting a mere few thousand stalks. The plant's tiny relict habitat is threatened by timber cutters and settlers cultivating or grazing the surrounding land. (However, the recent efforts of Dr. Maria Luz Puga of the University of Guadalajara may result in preserving some of the corn's habitat in a scientific preserve.)

The significance of *Zea diploperennis* lies in its rhizomes, or underground stems, which make the plant a perennial. Conventional types of corn are annuals. This perennial trait offers all sorts of possibilities for America's corn-growing industry, which accounts for almost half the world's corn crop. Now that the wild species has been crossbred with traditional corn, producing a perennial hybrid, some American farmers may eventually be able to grow their corn or at least their silage without the annual expense of plowing and sowing: the crop would come up by itself, year after year, just like daffodils. The amount of diesel fuel saved would be at least two-and-a-quarter gallons per acre each year, worth some $300 million. And when we consider the associated costs of plowing and sowing, the figure could—according to economist Professor Anthony Fisher of the University of California at Berkeley—soar beyond millions of dollars each year.

But even should the new hybrid prove less productive as a grain crop, the wild corn still could offer many benefits. Since is grows at elevations between 7,000 and 10,000 feet, its montane habitats are often damp and relatively cool. It is possible, then—even if a perennial variety is not as productive—to cultivate a cross-bred corn in areas where now existing annual corns cannot grow at all: in wet soils and chilly environments. This prospect alone could expand the overall range of corn cultivation by as much as one-tenth. Even if yields in these new environments were to average only one-half of those grown in more suitable areas, the additional harvest could be worth at least $1 billion per year.

More importantly, the Mexican corn also is highly immune to or tolerant of at least four of eight major viruses and diseases that now cause a one percent loss in the world's yearly corn yields —$500 million out of a total of $50 billion. Thus, the added resistance could save hundreds of millions of dollars each year. In addition, the perennial strain may supply genes resistant to various insects, nematodes, fungi, and bacteria, which could result in yet higher savings.

All of us enjoy the exceptional productivity of modern corn in many ways and by no means only when we eat cornflakes or popcorn. Bear in mind that corn is widely used to feed cattle, pigs, and poultry, and that corn sugar is contained in a variety of beverages, from beer to soft drinks.

There are similar stories about wheat, barley, tomatoes, oranges, and other modern crops. For example, the introduction of a wild wheat strain from Turkey that is resistant to several diseases has benefitted commercial species of U.S. wheat to the tune of around $50 million per year. Overall, the U.S. Department of Agriculture estimates that the annual farm-gate value of all America's crops is worth almost $100 billion. The department also calculates that yearly increases in productivity owing to genetic improvement average around one percent. This means that the value of such advances can be set at around $1 billion a year.

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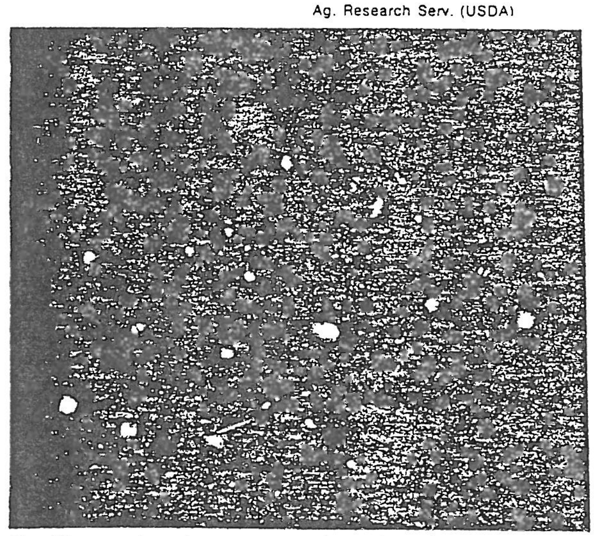

Familiar tomatoes, in a spectrum of genetic variations, dwarf their wild Andean relatives: Lycopersicon pimpinellifolium *(red, at left) and* L. peruvianum *(green, at right). The former's disease resistance and the latter's cold resistance are valued by plant breeders.*

Medicine

When we have a prescription filled at our neighborhood pharmacy, there is one chance in two that the medication we pick up owes its origins to "startpoint materials" from wild organisms. (A startpoint material is one that serves as the principal constituent in manufacturing a product, though by volume, it may amount to only a small part of the final medicine or drug.) The commercial value of these medicines and drugs in the U.S. now amounts to some $10 billion a year (1980 figure). If we extend the arithmetic to all developed nations, and include nonprescription materials plus pharmaceuticals, the commercial value tops $40 billion a year.

In 1960, a child suffering from leukemia had only one chance in five of remission. Now, thanks to drugs prepared from a tropical forest plant, the rosy periwinkle, the child has four chances in five. Commercial sales worldwide of the materials for drugs derived from this one plant currently total around $100 million a year. According to the National Cancer Institute and the Economic Botany Laboratory outside Washington, D.C., it is likely that the rain forests of Amazonia alone may well harbor several plants that contain ingredients for other anticancer drugs.

The value of plants to medicine cannot be overstressed. More than three million Americans with high blood pressure depend on regular doses of a cardiotonic compound called digoxin (300 times more powerful than digitalis), which is obtained from a Greek species of foxglove. A Brazilian plant is useful against amoebic dysentery; an ingredient from a semidesert shrub known in China serves as a nasal decongestant and as a stimulant for the central nervous system; ergot, a poisonous substance secured from a fungus, has long been used by midwives to speed labor and reduce bleeding. All in all, the plant kingdom offers agents for a broad range of medicinal and pharmaceutical products. Prime items include analgesics, antibiotics, drugs for heart diseases, anticancer agents, enzymes, hormones, diuretics, antiparasitic compounds, ulcer cures, dentifrices, laxatives, and anticoagulants.

Opposite: tropical coral reef (Bahamas) and tropical rain forest (Surinam). Tropical ecosystems, both marine and terrestrial, are surpassingly rich in organisms of interest to medical researchers. Many biochemical compounds available in these life forms serve as probes in experiments to study how the human body works.

The tropical coral reefs of the world abound with organisms that produce medicinal materials. Perhaps the most promising source of antiviral agents is a Caribbean sponge. It yields a compound effective against herpes encephalitis, a deadly brain infection that strikes many thousands of people each year. No useful drug had previously been known. Thus, much as penicillin did for diseases caused by bacteria, the sponge's compound may offer a breakthrough in treating diseases caused by viruses, including (perhaps) the common cold.

Similarly, sand fish, porcupine fish, and puffer fish yield tetrodotoxin, a toxic biocompound that blocks nerve transmission and has experimental value for medical researchers. The material is 160,000 times as potent as cocaine. The marine fish menhaden offers an oil that may aid in treating atherosclerosis; sea snakes yield an anticoagulant. Extracts from the toxin of the octopus not only relieve hypertension but could also be used as an anesthetic. The octopus paralyzes its prey by injecting a secretion from its salivary gland. Although the victim remains totally insensible, its heart continues to beat normally, indicating that the octopus's "poison" may be very helpful in modern surgery.

Perhaps the most important of all materials derived from marine life are those that serve as startpoint ingredients for anticancer drugs. These compounds come from corals, sea anemones, mollusks, segmented worms, sponges, sea cucumbers, proboscis worms, clams, and sea squirts. Some of these organisms yield extracts that delay or prevent the development of cancer in mice. Sea cucumbers and related species contain holothurin, a promising anticancer product. Even seaweeds yield compounds helpful in cancer therapy: patients treated with them find that their appetites improve, they are relieved of nausea, and they suffer less pain following surgery and radiation.

Not only do coral-reef organisms offer compounds for drugs and pharmaceuticals but, by serving as "models," they also assist scientists in basic medical research. Our knowledge of the human nervous system was acquired primarily by investigating the giant axon of squids and the neuronal apparatus of the electric eel. And we have greatly advanced our understanding of interrelationships between basic behavior and certain nerve circuits by examining the sea hare's nervous system.

Industry

The sources of many startpoint materials for industry also are found in tropical coral reefs. Seaweeds, for example, supply alginate compounds, which are used as stabilizers and emulsifiers. They contribute to literally hundreds of products—plastics, polishes, waxes, deodorants, detergents, soaps, shampoos, cosmetics, paints, dyes, paper products, fire-extinguishing foams, building materials, and lubricants and coolants used in oil drilling. Seaweed serves as a source of vitamin C, poultry meal, and meat and fish preservatives. It is used to grow bacteria, to keep toothpaste in the tube, to make ice cream smooth, to make puddings thick, and to help candy bars last longer.

Land plants make a major contribution to industry as well, and as technology advances—in a world growing short of just about everything except shortages—industry's need for new raw materials will grow, ever more rapidly. One category of products, lubricants, is exceptionally important. Because petroleum-based lubricants are increasingly expensive, there is a premium on finding substitute materials. Of 6,400 plants recently screened by the U.S. Department of Agriculture for new oils and waxes, among other products, 460 were judged to be promising. Principal candidates include a number of plants with oil-rich seeds, such as the buffalo gourd and the jojoba shrub of the deserts of northern Mexico and the American southwest, together with another plant of the same region—the guayule bush, which is a source of natural rubber. The liquid wax derived from jojoba seeds is equivalent in its lubricant capacities to sperm-whale oil and requires little refining. It is used in manufacturing high-performance lubricants, linoleum, printing ink, varnishes, shampoos, soaps, face creams, and other cosmetics.

Apart from lubricating oils and waxes, plants produce many more specialized materials, such as gums and exudates (the most well-known exudate is rubber), essential oils (such as those used for perfumes and flavorings), resins and oleoresins, dyes, tannins, vegetable fats, insecticides, and multitudes of other biodynamic compounds. Numerous wild plants offer potential for manufacturing fibers, detergents, starches, and even improved golf balls. We benefit from plant materials each time we wash our clothes, use a sunscreen lotion, paint a wall or varnish a table, travel in a plane propelled by jet engines, have the dentist make a mold of our teeth, receive a vaccination or immunization shot.

Given the rapid expansion of the global chemical industry, it is clear that we shall need many additional supplies of organic industrial chemicals. The worldwide chemical industry is already large, worth $300 billion a year. In the U.S. alone, production of synthetic organic chemicals totals around 85 million tons a year, of which plastics account for 15 million. All over the world, we now use 60 million tons of plastics each year (one-quarter of this total goes into packaging materials), together with other types of plastics ranging from Ultrasuede to artificial football-field turf. On top of our hefty appetite for plastics, we also consume large quantities of lubricants, adhesives, coatings, and thickeners.

The chemical industry continues to derive most of its raw materials from fossil petroleum. Almost one decade after OPEC (Organization of Petroleum Exporting Countries) started business, American chemical corporations obtain only three percent of their raw materials from alternative sources, like vegetable fats and oils. An American citizen now uses some 500 pounds of petrochemical products each year. But while most petrochemicals cost a mere three cents per pound in 1973, their price now, in the wake of OPEC, is around 22 cents per pound. By contrast, vegetable fats and oils, which cost about one cent a pound in 1973, have not even doubled in price. There is strong incentive for the chemical industry to move beyond the petroleum-dominated era.

Fortunately, almost all petrochemicals in question can be replaced by phytochemicals. We already use many vegetable oils—notably castor, linseed, and tung—exclusively for industrial products. In addition, a number of oils that are included in our daily diets contribute to industry as well: soybean, coconut, palm, peanut, and safflower oils.

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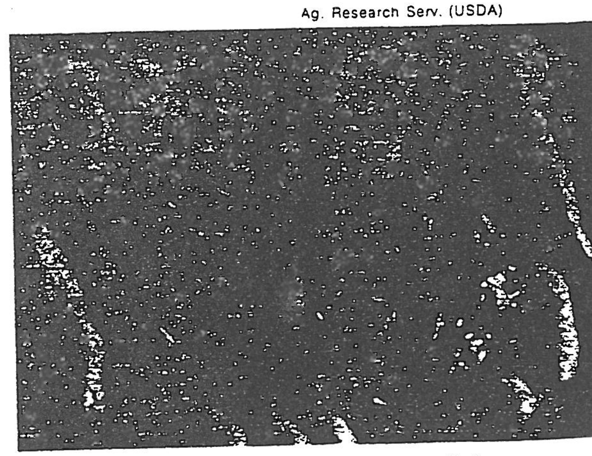
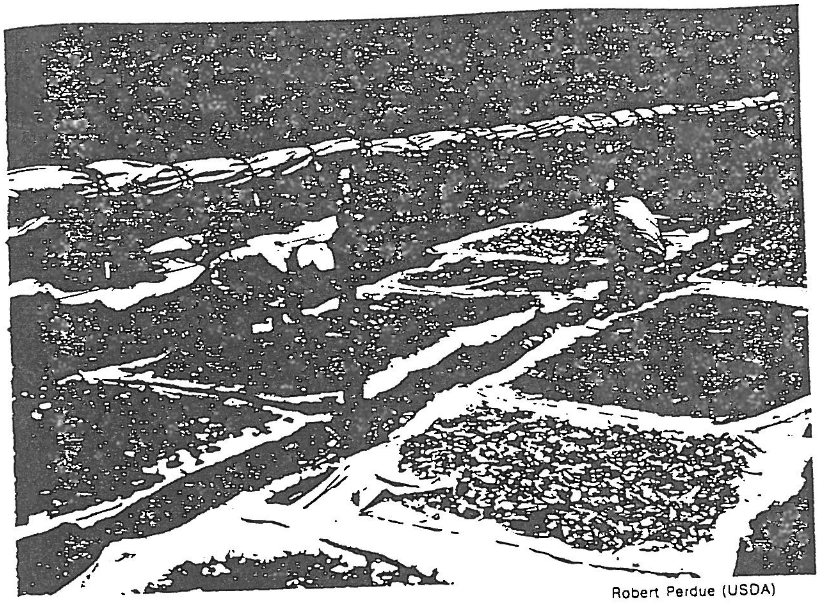
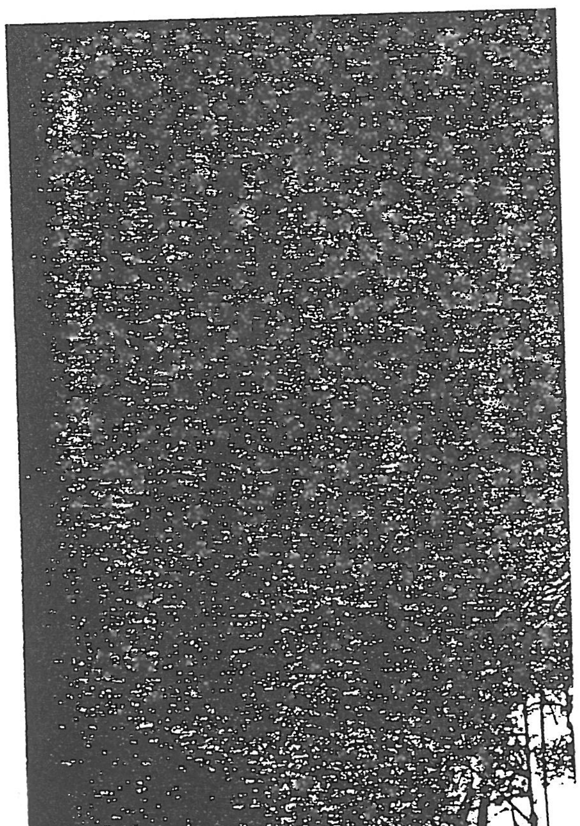


Jojoba beans, from the bush (right) and shelled (left). "Liquid wax" from the jojoba, similar to sperm-whale oil but much purer, may be used to manufacture a range of products, from automotive lubricants to cosmetics.



Robert Perdue (USDA)

At left, Kenyan plant specimens are spread to dry before American scientists screen them for the presence of anti-cancer compounds. Only some ten percent of all higher plants have been studied for such values. Below, sugar cane—a critical Third-World crop—in blossom.



Tony Arruza

ALTHOUGH WILD SPECIES contribute many thousands of different materials for the products we use each day, scientists have conducted a cursory screening of only one plant species in ten and intensive screening of only one plant species in a hundred. As for the animal world, with at least ten and perhaps 50 times more species than the plant world's estimated 250,000, scientists have done little more than consider the more prominent and obviously promising candidates. If researchers were to undertake a comprehensive and systematic analysis of *all* known species, it is certain that they would uncover vast numbers of new materials to enhance our daily lives.

Indeed, the discoveries already made suggest that we should regard the world's wild species as invaluable resources. They exist in an abundance of uniquely different forms; but we can derive few benefits from them unless we save space—natural habitats in which they can survive—for each. To do so will be a wise investment in the future survival of all species, especially our own.

Dr. Norman Myers, a consultant on environmental issues and resource economics, is the author of *The Long African Day*, *The Sinking Ark*, and *A Wealth of Wild Species: Storehouse for Human Welfare*. His next book, *The Primary Source*—on tropical forests—will be published in early 1984 by W. W. Norton of New York.