



RAFI COMMUNIQUE

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RURAL ADVANCEMENT FUND INTERNATIONAL

BIOTECHNOLOGY AND MEDICINAL PLANTS

ISSUE: Modern biotechnology places premium on South's medicinal plants for the development of new drugs.

IMPACT: Without mechanisms for safeguarding the South's sovereignty over genetic resources, traditional knowledge of indigenous people, and conservation of tropical forests, we will see increased exploitation of South's biological diversity and further disruption of traditional cultures.

COUNTRIES AFFECTED: All countries, especially areas with tropical forests.

PARTICIPANTS: Transnational pharmaceutical companies as well as small, bio-drug companies in Europe, U.S. and Japan.

ECONOMIC STAKES: Value of South's germplasm for pharmaceutical industry ranges from \$4.9 billion to \$47 billion by year 2000.

"We are entering an age in which genetic wealth, especially in tropical areas such as rainforests, until now a relatively inaccessible trust fund, is becoming a currency with high immediate value." -- Dr. Winston Brill, Vice-President, Agracetus¹

With advances in biotechnology, there is renewed and heightened interest in the South's plants and microbes as a source of raw material for developing new pharmaceutical products.

The importance of plants for the development of drugs is not new. At least 7,000 medical compounds in the modern Western pharmacopeia are derived from plants. In the industrialized world, the retail value of plant-derived drugs was estimated to be at least \$43 billion in 1985.²

In recent decades, pharmaceutical companies have focused on synthetic production of valuable natural compounds. But the chemists have found it difficult to improve on nature. Of all useful plant-derived drugs, only 10 are synthesized in the

laboratory, and the rest are still extracted from plants.³ Today, with advances in plant molecular biology, cell culture and the availability of new, precise diagnostic tools for screening, the field of natural products discovery is expanding.

According to a 1988 report by the UK consultancy firm of McAlpine, Thorpe and Warriier, "the market potential for sophisticated herbal drugs in the Western world...could range from \$4.9 billion in the next ten years to \$47 billion by the year 2000 if the AIDS epidemic continues unchecked."⁴

Jungle Pharmacy

The world's tropical moist forests, covering only 6% of the earth's surface, contain at least half of all species. We know very little about the vast majority of these species, and they are becoming extinct at a rate unparalleled in human history. Rain forest plants have been likened to "complex chemical storehouses" containing thousands of natural chemical compounds with unrealized potential for modern medicine. Fewer than 1 percent of tropical forest species have been examined for their possible use to humankind. But at least 1400 plant species of tropical forests are believed to offer potential against cancer.⁵

With tropical forests being destroyed at the rate of up to 100 acres per minute, and the global rate of species extinction now estimated at 400 times faster than in the recent geologic past, scientists warn that 20-25% of the world's plant species will be lost by the year 2000.

Economist Peter J. Principe has conducted detailed analysis on the potential value of plant-derived drugs. According to Principe, in a random group of 10,000 plants, between 1 and 10 would yield a marketable drug, with a commercial value of about \$600 million annually (in OECD countries). If the present rate of plant species extinction continues, Principe calculates that 25 marketable prescription drugs will be lost in the next decade--an estimated loss of \$15 billion in the year 2000 alone.⁶ But this is just the beginning. The annual foregone benefit to the pharmaceutical industry would be \$15 billion every year after 2000.

It ⁷is difficult to put a price tag on medicinal plant species, but it helps to consider the enormous social and economic value of just a few of the tropics' medicinal plant "superstars":

Madagascar's rosy periwinkle plant is the source of at least 60 alkaloids (complex biocompounds produced by plants). The two most important, anti-tumor agents vincristine and vinblastine, have revolutionized the treatment of childhood leukemia and Hodgkin's disease. It takes 15 tons of periwinkle leaves to make one ounce of vincristine, which sells for \$100,000 a lb.⁸

Commercial sales of drugs derived from rosy periwinkle total approximately \$160 million per year.⁹

Rauwolfia is another medicinal plant superstar, a material derived from the "snakeroot" plant of monsoon forests in India. Its alkaloid reserpine forms the base of tranquilizer products and other drugs used to treat hypertension and schizophrenia. In the early 1980s, retail sales of reserpine-based products in the U.S. alone exceeded \$260 million per year.¹⁰

Gene Hunters

To what extent are biotech companies and pharmaceutical corporations combing the tropical forests and jungles of the Third World in pursuit of exotic medicinal plants? As one researcher observed, "it's difficult to name any major pharmaceutical that's not doing natural products screening--but most are very tight-lipped about it."¹¹

It is generally recognized that Japanese and European companies are more active than their U.S. counterparts. Few pharmaceutical companies are doing their own collecting in tropical forests, most contract with third party collectors. The following are just a few examples.

Merck, Sharpe, and Dohme (Rahway, New Jersey, USA) is a leader in natural products discovery and routinely contracts for collection of tropical plants. The company (a subsidiary of the world's largest pharmaceutical company) is now working with a group of Brazilians to obtain what promises to be a new medicinal superstar, the anti-coagulant "tiki uba" used by the Urueu-Wau-Wau tribe of Brazilian Rondonia.¹²

Many pharmaceuticals are turning to China, where herbal remedies have been used for centuries. Upjohn (Kalamazoo, Michigan, USA) is studying ten compounds from ancient Chinese herbal medicines with the goal of developing new drugs to combat cancer, cardiovascular disease, and disorders of the central nervous system.¹³ G.D. Searle and Co. is evaluating extracts from Chinese plants used for gastrointestinal disorders.

In Europe, a small company based in the United Kingdom, Biotics Ltd., began working with the European Commission in 1986 as a commercial broker to supply exotic plants from developing nations for pharmaceutical screening. Major pharmaceuticals such as ICI, Beechams, Rhone Poulenc, Glaxo, Hoechst, Novo and Sandoz expressed initial interest in obtaining extracts from indigenous plant species.¹⁴

In recent years Biotics became the source of considerable controversy because of "gaping holes" in their contracts for obtaining Third World germplasm and inadequate means of compensating developing nations.¹⁵ As a result, the company now

"guarantees royalties or the equivalent" to the country of origin from whatever plant material is later commercialized.¹⁶ According to Biotics' literature, the company recently provided Glaxo Pharmaceutical (UK) with plants from Ghana. Collecting is planned in Africa, Asia and Australasia in the near future. According to Biotics officials, however, many pharmaceuticals are disenchanted with the prospect of going through legitimate negotiating channels, concluding it is easier to obtain their own exotic germplasm by sneaking plants out of foreign countries.¹⁷

In the United States, the single largest tropical plant collecting effort is sponsored by the federal government's National Cancer Institute (NCI). In 1986, the NCI launched a five-year, \$2.8 million program to screen thousands of exotic plants from the tropical forests of Latin America, Southeast Asia, and southern Africa. The NCI has contracted with ethnobotanists at the New York Botanical Garden, Missouri Botanical Garden and University of Chicago; each institution is responsible for supplying 1500 plants per year for anti-cancer and anti-AIDS screening. The project is designed to tap the traditional knowledge of rain forest people who use medicinal plants. But will indigenous people benefit from the use of their traditional knowledge?

According to NCI officials, the Institute is "aware of and sympathetic to the fact that the country of origin should derive some benefit" from plants which may become the sources of valuable medicinal compounds. The ethnobotanists working under contract with NCI are skilled professionals who are renowned for their sensitivity and respect for indigenous cultures. Even so, there is no mechanism in the NCI's contract to insure any form of compensation to native people or countries of origin. Should a valuable new drug result from the NCI's screening, "the [U.S.] government would probably take out a patent and license to a pharmaceutical--we wouldn't get involved in commercialization," explains Dr. Gordon Craag of the Natural Products Branch of NCI.¹⁸

The trend is not new. Plants and microbes extracted from the South today will become the patented products of biotechnology tomorrow. The potential for developing new drugs which may hold promise for curing cancer and other life-threatening diseases is great. The emotional appeal is overwhelming. Despite the unquestionable benefits which may result, there is historic disregard for the native cultures and countries from which these plants are extracted.

The Source: Traditional Knowledge

The discovery of exotic plants and their medicinal properties does not just happen by accident. The people who have traditionally lived in tropical forests are the key to understanding, utilizing and conserving tropical plant diversity.¹⁹

Madagascar's rosy periwinkle, for example, was investigated in Eli Lilly's laboratory because of its use by local people as an oral hypoglycemic agent. University of Chicago professor, Norman Farnsworth, estimates that three-quarters of all plant-derived drugs were discovered because of their prior use in indigenous medicine.²⁰

The knowledge of traditional rain forest healers (also called shamans or curaderos) often rivals even the most accomplished university-trained botanist. Referring to the knowledge of an Amazonian shaman with whom he worked, ethnobotanist Mark Plotkin of the World Wildlife Fund observes that, "because you have a PhD and the other guy can't read, it doesn't mean you know more about botany than he does."²¹

Consider, for example, that forest-dwelling Indians employ at least 1,300 plant species for medicines and related purposes.²² Over 60 species of plants are used to treat skin infections in the Amazon.²³ Worldwide, tribal people use at least 3,000 plants to control fertility.²⁴

A recent article in Smithsonian Magazine reports on ethnobotanist Mark Plotkin's recent visit to the rain forest of southern Suriname. With the help of native Tirió Indians, the article describes how Plotkin collected medicinal plants "at a rate of about one plant every ten minutes."²⁵ In a single day, he found a plant with red sap used to relieve burns, powdery leaves of another plant used to relieve skin fungi; juice extracted from a sweet-smelling plant that "makes you skinny"; a fungus used for earaches; a flowering plant used as a fever medicine; and a hallucinogenic plant. Clearly, the most efficient way to identify plants and their medicinal properties is to ask the people who use them.

But native people and oral traditions are dying even more quickly than their fragile surroundings. In the Amazon, more than 90 different tribes have disappeared since the turn of the century. Knowledge accumulated over thousands of years is not being passed on. According to ethnobotanist Plotkin:

Every time one of these medicine men dies, it is as if a library were burned down. In fact, it is worse than that. Because if the Library of Congress burned down tomorrow, it would be a tragedy, but most of the information found in the Library of Congress is found in other libraries as well. When medicine men die, this knowledge is lost, and it is lost forever.²⁶

Mining Microbes

The quest for the South's exotic germplasm is not limited to plants, nor is collecting restricted to tropical forests and land

surfaces. There is also interest in bacteria, algae, fungi and protozoa, and a wide range of marine organisms, as potential sources of valuable raw material.

MYCOsearch, a small biotechnology company based in North Carolina (USA), collects fungi samples from around the world and screens them for valuable natural compounds. The company maintains a collection of over 20,000 fungi, more than half originating from the tropics.²⁷ Pharmaceutical clients such as Hoffman La Roche, Dupont, Ciba Geigy, Schering Plough and others pay hundreds of dollars per sample for potentially valuable fungi and the promise of commercial exclusivity.

Pharmaceutical companies such as SmithKline & French (USA) and the U.S. government's National Cancer Institute are also collecting corals, sponges, anenomes and other organisms from tropical waters. Marine organisms are described as "especially promising and relatively unexplored source of drugs."²⁸ SeaPharm, a marine pharmaceutical company (Princeton, New Jersey, USA) has a \$3.6 million contract with NCI to collect in tropical seas and elsewhere.²⁹

Until recently, scientists believed that organisms were not capable of growing more than 100 ft. below ground. The recent discovery of subsurface microbial collections, located 1,700 ft. below the earth's surface has uncovered a potentially vast new frontier for discovering living organisms that may be a future source of pharmaceuticals.³⁰ When the first subsurface microbial collections were unearthed in the U.S. in 1986, twelve corporations (including Japanese and U.S. pharmaceuticals) expressed interest in buying cultures.³¹

Conserving/Utilizing Medicinal Plants for Local Development

Conserving and utilizing medicinal plants makes good social and economic sense for developing nations. The World Health Organization estimates that 80 percent of the world's people depend on traditional herbal medicines.³² Herbal medicines offer tremendous economic potential, not only as export earners but as the resources for developing locally-controlled industry which can substitute for costly pharmaceutical imports. There are several efforts underway, the following are just a few examples:

In Thailand, drug imports of (US) \$400 million account for 14 percent of the country's trade deficit. One effort to counter that trend is the Natural Products Department of the Thailand Institute for Scientific and Technological Research (TISTR), which is devoted to the development of new medicinal products based on traditional medicine.³³

In the Philippines, a joint project between the Departments of Health and Science and Technology was initiated in 1988 to establish four manufacturing facilities to produce pharmaceuticals

from medicinal plant extracts. According to Philippine sources, their products "will be sold to the public at a tenth of the present retail price" of medicines sold to treat common ailments.³⁴

In Turkey, the Medicinal Plants Research Centre at the University of Anatolia is working with domestic medicinal and aromatic plants to develop medicines and essential oils. The goal is to reduce pharmaceutical imports. Although there are 120 pharmaceutical companies and 10,000 native plant species in Turkey, the country imports 75 percent of its pharmaceutical raw materials. Assistance from the United Nations Industrial Development Organization has encouraged the³⁵ research and development of native plant-based drugs in Turkey.

In China, herbal medicines are big business. China produces more than 40,000 different kinds of traditional Chinese medicines a year, with exports totalling about \$250 million. In 1986, there were 570 Chinese factories producing traditional medicines.³⁶

Conclusion

The search for new medicinal plants is a race against time. There is no doubt that tropical forests of the Third World hold "incalculable value as an untapped emporium of germ plasm" for the development of new drugs.³⁷ The most hopeful scenario is that pharmaceutical and biotech interests will become powerful allies in efforts to stop or curtail destruction of the world's tropical forests. But much more is needed than "search and rescue" missions from the North motivated by economic interests. Third World countries and indigenous people must also benefit from their knowledge and biological treasures. Long-term conservation measures must be put in place. In the process, indigenous people must be treated with respect and given the recognition they deserve.

The International Society of Ethnobiology was established in July, 1988, in Belem, Brasil. The society is devoted to promoting the study of how "...indigenous populations uniquely perceive, utilize and manage their natural resources as well as to the development of programs that will guarantee the preservation of vital biological and cultural diversity." The "Declaration of Belem", reflecting many of the concerns raised in this issue of RAFI Communique, is re-printed below.

FOOTNOTES

- ¹Quoted in "Draining the Gene Pool" by Norman Myers in Seeds & Sovereignty, ed. by J. Kloppenburg, 1988, p. 93. When quoted, Brill was at the University of Wisconsin.
- ²Principe, Peter J., "The Economic Significance of Plants and Their Constituents as Drugs", Economic & Medicinal Plant Research, Vol. 3, 1989, p. 9.
- ³Farnsworth, Norman R., "The Value of Plants from Tropical Rainforests as Potential Drugs", undated.
- ⁴"Herbal Drugs Market Potential", SCRIP, No. 1299, April 13, 1988, p. 29.
- ⁵Myers, Norman, The Primary Source, 1984, p. 213.
- ⁶Principe, Peter J., op. cit., p. 10-11.
- ⁷Principe points out that his estimates are market value. When total economic values are considered (societal benefits), the figures are much greater.
- ⁸Caufield, Catherine, In the Rainforest, 1985, p. 220-221.
- ⁹Myers, Norman, "Draining the Gene Pool" in Seeds & Sovereignty, ed. by Jack Kloppenburg, 1988, p. 96.
- ¹⁰Myers, Norman, The Primary Source, p. 216.
- ¹¹Personal conversation with Dr. Joe Hoffman, Natural Products Dept., University of Arizona, Office of Arid Land Studies.
- ¹²Personal conversation with Dr. Ellen Simpson, Research Fellow, Biological Chemistry Dept., Merck, Sharpe & Dohme.
- ¹³Bio/Technology, Vol. 4, October 1986, p. 840.
- ¹⁴ICDA Seedling, "EEC and the Gene Drain", March, 1988, p. 9.
- ¹⁵Pat Mooney, personal conversation with Dr. Calestous Juma of African Centre for Technology Studies.
- ¹⁶Biotics Ltd., "Phytochemical Screening Program", undated.
- ¹⁷Pat Mooney, personal conversation with Steen Joffe, Technical Manager, Biotics, Ltd.
- ¹⁸Personal conversation with Dr. Gordon Craag, Natural Products Branch, National Cancer Institute.
- ¹⁹Plotkin, Mark J., "The Outlook for New Agricultural & Industrial Products from the Tropics", Biodiversity, National Academy Press, 1988, p. 114.
- ²⁰Farnsworth, Norman R., op. cit., p. 2.
- ²¹Jackson, Donald Dale, "Searching for Medicinal Wealth in Amazonia", Smithsonian, March, 1989, p.
- ²²Myers, Norman, The Primary Source, 1984, p. 209.
- ²³Plotkin, Mark J., "Conservation, Ethnobotany, and the Search for New Jungle Medicines," in Pharmacotherapy, Vol. 8, Number 5, 1988, p. 257.
- ²⁴Caufield, Catherine, op. cit., p. 223.
- ²⁵Jackson, Donald Dale, op. cit., p. 98.
- ²⁶Montgomery, Sy, "Brother to the Forest's Keepers", Orion Nature Quarterly, Summer, 1988, p. 53.
- ²⁷Personal conversation with Dr. Barry Katz, President, MYCOsearch.
- ²⁸Eckholm, Erik, "Quest for Cancer Drugs: U.S. Devises Major New Strategy", New York Times, Dec. 23, 1986.
- ²⁹Anonymous, "Plumbing Depths for Chemo Agents", Coping, Winter, 1988, p. 48.
- ³⁰Washington Insight, Newsletter for Natural Products Scientists, December 15, 1987, p. 7.
- ³¹Ibid.

- ³²Plotkin, Mark J., Pharmacotherapy (op. cit.) p. 260.
³³Bio/Technology, Vol. 4, October 1986, p. 840.
³⁴SCRIP, No. 1284, February 19, 1988, p. 19.
³⁵Development Forum, March-April, 1989, p. 9 and SCRIP, No. 1381, January
³⁶27, 1989, p. 7.
³⁷SCRIP, No. 1290, March 11, 1988, p. 20.
Schultes, Richard Evans, "The Amazonia as a Source of New Economic
Plants", Economic Botany, 33(3), 1979, p. 259.

Declaration of Belem
22 July 1988

"As ethnobiologists, we are alarmed that

SINCE

--tropical forests and other fragile ecosystems are disappearing, --many species, both plant and animal, are threatened with extinction, --indigenous cultures around the world are being disrupted and destroyed;

and GIVEN

--that economic, agricultural, and health conditions of people are dependent on these resources, --that native peoples have been stewards of 99% of the world's genetic resources, and--that there is an inextricable link between cultural and biological diversity; We, members of the International Society of Ethnobiology, strongly urge action as follows:

HENCEFORTH:

1) a substantial proportion of development aid be devoted to efforts aimed at ethnobiological inventory, conservation, and management programs; 2) mechanisms be established by which indigenous specialists are recognized as proper authorities and are consulted in all programs affecting them, their resources, and their environments; 3) all other inalienable human rights be recognized and guaranteed, including cultural and linguistic identify; 4) procedures be developed to compensate native peoples for the utilization of their knowledge and their biological resources; 5) educational programs be implemented to alert the global community to the value of ethnobiological knowledge for human well being; 6) all medical programs include the recognition of the respect for traditional healers and incorporation of traditional health practices that enhance the health status of these populations; 7) ethnobiologists make available the results of their research to the native peoples with whom they have worked, especially including dissemination in the native language; 8) exchange of information be promoted among indigenous and peasant peoples regarding conservation, management, and sustained utilization of resources."

NEWS FROM RAFI

Ethical Code of Conduct for Germplasm Collectors

In September, 1988, RAFI and Centro de Educación y Tecnología hosted a week-long seminar in Santiago, Chile for Latin American NGOs working on sustainable agriculture and genetic resources. Seminar participants drafted an "Ethical Code of Conduct for Germplasm Collectors" which will be taken up at the April, 1989, meeting of the United Nations' FAO Commission on Plant Genetic Resources in Rome. More information about the Ethical Code will appear in upcoming issues of RAFI Communiqué.

Nuestro Tesoro Olvidado

Now available for sale at RAFI's Pittsboro office: Recursos Genéticos: Nuestro Tesoro Olvidado, by Daniel Querol (in Spanish only). An important new work on plant genetic resources, written by plant geneticist Daniel Querol, former director of Nicaragua's genetic resources program. Drawing on years of field work and practical experience, Querol's book contains excellent technical information covering collection, description, storage, documentation, and evaluation of plant genetic resources. Price: (US) \$20. Write: RAFI, P.O. Box 1029, Pittsboro, NC 27312 USA.

RAFI Backgrounder on Herbicide Tolerance

For the past five years RAFI has maintained a database on the emerging biotechnology industry. We are pleased to make this information available to others in the form of a series of "RAFI Backgrounders" on selected issues of interest to the NGO community. The first backgrounder, on the subject of herbicide tolerance, is now available for sale. It includes excerpts from numerous biotechnology journals and government documents, including tables on industry research and products. RAFI BACKGROUNDERS ON HERBICIDE TOLERANCE, Price: (US) \$40. Write: RAFI, P.O. Box 1029, Pittsboro, NC 27312 USA.

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