# DIVERSITY

*A News Journal for the International Plant Genetic Resources Community*

Vol. 8, No. 2, 1992



**In Remembrance: WILLIAM L. BROWN**

## The Earth Summit...

UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT

Rio de Janeiro 3–14 June 1992

## World Leaders Act On BioDiversity

# DIVERSITY

*A News Journal for the International Plant Genetic Resources Community*

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*FROM THE EDITOR...*

*It is most fitting that this issue includes a remembrance of William L. Brown, a founder of DIVERSITY and my treasuredfriend. Over the last ten years, article after article-especially those that appear in this issue - have confirmed Bill's remarkable vision regarding the important role genetic resources would come to play in sustaining our complex andfragile world. In this issue alone, one can see how pivotal genetic resources have become: a landmark Convention on Biological Diversity is signed by Heads of State from around the world at an unprecedented global gathering - The Earth Summit; a National Genetic Resources Program is mandated by the U.S. Congress; a biotechnology industry moves closer to becoming another "Silicon Valley"; and grassroots groups continue to provide new models for genetic conservation and use.*

*Dr. William L. Brown's contributions to the landmark achievements and initiatives described throughout these pages are many and will be remembered always by those of us who were fortunate enough to have known this exceptional man. His dedication to conserving the world's genetic heritage for future generations will be his lasting legacy.*

*Deborah Strauss*
*Editor*

SPECIAL REPORT • THE EARTH SUMMIT

*The first reports on the Rio Earth Summit - where actions taken on biological diversity by the 180 attending governments made headlines around the world- are beginning to come in us DIVERSITY goes to press. Following are exclusive reportsfrom journalists who covered the June 3-14 Summit and its attendant activities in Rio de Janeiro, Brazil. DIVERSITY will continue to cover the news surrounding this landmark event us it unfolds over the coming months. We invite our readers to contribute their views us a way of continuing the important discussions begun in Rio. - The Editors*

# The Convention on Biological Diversity: Landmark Earth Summit Pact Opens Uncertain New Era For Use and Exchange of Genetic Resources

***by Paul Raeburn***

The Biodiversity Convention signed by more than 150 countries (for list, see p. 7) at the United Nations Earth Summit in Rio de Janeiro in June could pose a threat to the exchange of plant genetic resources, according to Dr. Geoffrey Hawtin, Director of the International Board for Plant Genetic Resources (IBPGR) in Rome.

"There are still a number of unresolved issues which may impact the use of genetic resources and their movement around the world," Hawtin said at a press briefing during the Earth Summit, formally known as the United Nations Conference on Environment and Development, or UNCED.

Hawtin explained that the vague wording of some of the provisions in the Convention (for text, see p. 6)-and in another UNCED document called Agenda 21 - could inadvertently lead to restrictions on the movement of germplasm, depending upon how they are interpreted.

For example, he referred to a section of Agenda 21 that describes the circumstances under which genetic resources should be provided by one nation to another."There are different ways that can be interpreted," Hawtin said. "In one interpretation, it would lead to extremely difficult mechanisms for getting permission to distribute materials. But the same wording could also be interpreted to mean free and open exchange. Obviously, we would like to see that interpretation, but that will require some attention."

The IBPGR director stressed, however, that the document, overall, was an important step toward better protection of plant genetic resources. "We have been involved in discussions leading up to this Convention, and we understand the complexity of the issues involved," said Hawtin. "We very much welcome this Convention and feel it will have a positive effect on the work of plant genetic resources worldwide."

*Paul Raeburn is the science editor of the Associated Press. He is currently working on a book on plant genetic resources entitled "The Last Harvest," to be published by Simon and Schuster in 1993.*

"Agenda 21 adds many additional tasks to our agenda," said Alexander von der Osten, executive secretary of the Consultative Group on International Agricultural Research (CGIAR). "We stand ready to take on the challenge." The CGIAR is a network of countries, donors and research organizations that supports 18 agricultural research centers around the world. Most of these centers, the majority of which are located in developing countries, hold germplasm collections of the world's major food crops (see story, p. 11).

The International Board for Plant Genetic Resources is part of the CGIAR system and maintains some 600,000 samples of plant genetic material in its seed banks. These represent more than 30 percent of the genetic material stored in all the *ex situ* collections in the world, Hawtin told reporters. "We believe these collections are the way in which the wealth of biodiversity can be made useful," Hawtin said. (See interview on page p. 5).

The United States and Great Britain both used the occasion of the Rio Summit to announce their own, separate initiatives on biodiversity. The United States announced a **Biodiversity Research Initiative** that will "suggest the development of biodiversity inventories and surveys to create the information base necessary for the protection of species," and "propose the creation of a U.S. center for biological diversity information." A few days prior to the Earth Summit, President George Bush also announced a **"Forests for the Future"** initiative that calls for doubling total international forest conservation assistance from $1.35 billion to $2.7 billion. In what Bush called "a downpayment on the initiative," he announced the U.S. will spend $150 million more in bilateral forest assistance next year.

***"A number of unresolved issues may impact the use of genetic resources and their movement around the world."***

British Prime Minister John Major announced what he called the **Darwin Initiative,** which went beyond the U.S. plan by helping countries not only monitor their resources but also begin to use them. The initiative builds on the work of the U.K.'s Royal Botanical Gardens and Natural History Museum. It includes proposals to clarify goals of scientific, economic, and legal research; promote international cooperation in technology; promote benefit-sharing agreements between originators and users of biological resources; and train professionals in developing countries.

## Earth Summit's Ambitious Goals

The protection and use of biodiversity was only one of many environmental and development issues addressed by the sprawling Earth Summit, which met from June 3-14 at the Rio Centro Convention Center outside of Rio de Janeiro. The meeting marked the culmination of two-and-a-half years of often difficult negotiations with an ambitious goal: to make environmental concerns a central issue in international relations.

An estimated 15,000 delegates met to complete formal negotiations and adopt two treaties and three non-binding agreements. At the same time, another 15,000 people gathered for a parallel meeting called the **Global Forum,** with participants drawn largely from non-governmental organizations (NGOs).

Both meetings interpreted "environmental concerns" in the broadest possible way, to include such problems as population growth, poverty and sustainable development along with more narrowly defined environmental goals such as protecting the rainforest and curbing atmospheric and ocean pollution."We cannot have an environmentally sound planet in a socially unjust world," said Brazilian President Fernando Collor de Mello at the Summit's opening ceremony.

The negotiations leading up to the Summit resulted in five documents. Two were legally binding: the Biodiversity Convention, and a convention to curb global warming. Three others were not legally binding, but negotiators hoped that the "soft law" they contained would have political force and would lead to binding documents sometime in the future.

The first of the three was the **Rio Declaration,** a statement of principles to guide sustainable development. The second was **Agenda 21,** an 800-page document that served as a blueprint for specific actions to combat a broad range of environmental problems. The last was a **statement of forest principles** for managing, conserving, and sustainably using tropical and temperate forests. The statement was an effort to begin the process of drafting a new global forest convention, a pact that some world leaders had originally hoped would be ready for Rio.

***"Biodiversity is the new Silicon Valley," asserted Russell Mittermeier, president of Conservation International.***

### BioConvention At Center Stage

Of the five Summit documents, the Biodiversity Convention turned out to be the most controversial and most widely discussed both in Rio and throughout the world. The text of the Convention was settled in Nairobi in May, before the Earth Summit began, so it was not expected to be a major topic of discussion in Rio.

The reason it moved to center stage at the Summit was the adamant refusal of U.S. President George Bush - alone among the leaders of more than 180 countries represented in Rio - to sign the treaty.

Bush first explained his opposition by saying that the Convention would lead to a loss of American jobs, a contention that was never satisfactorily explained by Bush, the White House staff, or the U.S. delegation.

Scientists and environmentalists strongly disagreed with Bush's initial stance. Kenton Miller, Program Director for Forests and Biological Diversity for the World Resources Institute (WRI), stated that, in fact, "Countries that get involved in biotechnology and other spin-offs of biological resources can enjoy new jobs." Miller coauthored a major report, *The Global Biodiversity Strategy*, that was released by WRI, the World Conservation Union (IUCN), and the United Nations Environment Programme (UNEP) and widely distributed prior to the final deliberations on the Biodiversity Convention (see DIVERSITY,vol.8,no.7,p.19-21).

"Biodiversity is the new Silicon Valley," asserted Russell Mittermeier, a biologist and president of Conservation International in Washington, DC, in a reference to the northern California hub of the computer industry. The appropriate use of

## IBPGR Director Hawtin Encouraged by BioConvention, but Uncertainties Remain

*Following an Earth Summit press conference by the Consultative Group on International Agricultural Research (CGIAR) that focused on the BioConvention's implications for agricultural genetic resources, Geoffrey Hawtin, Director of the International Board for Plant Genetic Resources (IBPGR), one* ***of*** *the CGIAR's network* ***of 18*** *research centers, shared his thoughts on the convention with DIVERSITY correspondent Paul Raeburn.*

*Most Earth Summit delegates focused on the pact's financing and technology transferprovisions. But Hawtin and others concerned with agricultural genetic resources focused their attention on what was missingfrom the convention: any mention* ***of*** *the 600,000 germplasm samples stored in the CGIAR's seed banks.*

"Their status remains unclear," Hawtin told DIVERSITY, "and we feel that attention should be given to them because they are vitally important to agriculture around the world."

The Convention "is not just a conservation document," he emphasized. "It's conservation and *use.* That's the approach that CGIAR and IBPGR have been pushing." The Convention encourages scientific research, he noted, "but not as an excuse for not doing anything."

When it started out," he said, "[the convention] was a 'save-the-rainforests, save-the-whales' kind of thing. As the process went on, [ *ex situ/ seedbank* conservation of] genetic resources became part of it." The Convention now "talks about *in situ* [on site] conservation and *ex situ* conservation as complementary" strategies.

Hawtin noted that the pact's framework for the exchange of genetic materials promotes unrestricted exchange. "There is a clear statement of intent on access," Hawtin stressed. Nevertheless, some of the language in the Convention is confusing, he acknowledged. In the section on access to resources, the Convention says that a nation can provide access to genetic material that originated within its borders or was acquired under the terms of the Convention. It is silent, however, on the key question of who controls access to the vast quantity of genetic resources that originated elsewhere and were collected before enactment of the Convention.

"One interpretation is that (these genetic resources) are outside of the Convention," said Hawtin. "Another interpretation is that if you sign the Convention, the only materials you can provide are those that originated in your country or arrived there under the terms of the Convention."

Such an interpretation could mean that material stored in CGIAR seed banks could not be released without the explicit permission of the country in which the material originated, Hawtin said.

Hawtin touched on the complexity of the issue, explaining that the national origin of some materials has not been determined and that some breeding materials could combine germplasm from seeds collected in many nations. He said that some governments would question whether all of these nations would have to give permission before seeds could be distributed.

Another provision in the Convention says countries should establish mechanisms "with the aim of sharing in a fair and equitable way the results of research and development" and the benefits of commercial use of genetic resources."The policy measures required to implement that could be extremely cumbersome," according to Hawtin.

The Convention also calls on nations to adopt measures "with the aim that the private sector facilitates access to, joint development of, and transfer of technology" related to plant genetic resources. Hawtin questioned how some countries will be able to influence their private sectors: "It's hard to imagine U.S. legislation that could encourage the private sector," he said.

Hawtin admits that the language on patents in the Convention is vague, but he believes it was intentionally crafted to speed the Convention's adoption. Clarification of such issues can come at a meeting -the Conference of the Parties -planned after the Convention is ratified and comes into force, he said. The Parties could meet by the middle of 1993, United Nations sources say.

biodiversity will fuel an explosion in the biotechnology industry similar to that of the computer industry, he explained.

Midway through the Summit, Bush dropped the jobs argument. In a shift, he explained that his opposition was based on the Convention's treatment of intellectual property rights.

U.S. State Department officials said later that they were also concerned with two other aspects of the Convention: its guidelines for the funding of biodiversity protection measures, and its treatment of biotechnology (see p. 8 for more on role of U.S. biotechnology industry in decision).

While the treaty includes language calling for the sharing of technology covered by patent rights, it also states that such sharing should be consistent with protection of intellectual property rights. With regard to financing, the treaty includes what is sometimes referred to as a "blank check provision." The provision requires developed countries to contribute money in an amount set by the parties to the Convention, most of them developing countries.

## Key Excerpts from the Convention on Biological Diversity

The Biodiversity Convention's 42 articles and two annexes fill 24 typewritten pages. A few key excerpts follow:

▪ **PREAMBLE:** The contracting parties, conscious of the intrinsic value of biological diversity and of the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity...

Reaffirming that States have sovereign rights over their own biological resources...

Noting that...lack of full scientific certainty should not be used as a reason for postponing measures...have agreed as follows:

▪ **ARTICLE 1:** The objectives of this Convention...are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits...

▪ **ARTICLE** 3: States have...the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States...

▪ **ARTICLE** 6: Each Contracting Party shall...develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity...

▪ **ARTICLE** 7: Each Contracting Party shall... identify components of biological diversity... monitor, through sampling and other techniques, the components of biological diversity... identify processes and categories of activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity...

▪ **ARTICLE** 8: Each Contracting Party shall... establish a system of protected areas...

▪ **ARTICLE** 9: Each Contracting Party shall...establish and maintain facilities for *ex-situ* conservation of and research on plants, animals and micro-organisms, preferably in the country of original of genetic resources...

▪ **ARTICLE 15: Access to Genetic Resources**

1. Recognizing the sovereign rights of States over their natural resources, the authority to determine access to genetic resources rests with the national governments and is subject to national legislation.

2. Each Contracting Party shall endeavor to create conditions to facilitate access to genetic resources for environmentally sound uses by other Parties and not to impose restrictions that run counter to the objectives of this Convention.

3. For the purpose of this Convention, the genetic resources being provided by a Contracting Party, as referred to in this Article and in Articles 16 and 19, are only those that are provided by Contracting Parties that are countries of origin of such resources or by the Parties that have acquired the genetic resources in accordance with this Convention.

4, Access, where granted, shall be on mutually agreed terms and subject to provisions of this Article.

5. Access to genetic resources shall be subject to prior informed consent of the Contracting Party providing such resources, unless otherwise determined by that Party.

6. Each Contracting Party shall endeavor to develop and carry out scientific research based on genetic resources provided by other Contracting Parties with the full participation of, and where possible, in such Contracting Parties.

7. Each Contracting Party shall take legislative, administrative or policy measures, as appropriate, and in accordance with Articles 16 and 19 and where necessary through the financial mechanism established by Articles 20 and 21 with the aim of sharing in a fair and equitable way the results of research and development and the benefits arising from the commercial and other utilization of genetic resources with the Contracting Party providing such resources. Such sharing shall be upon mutually agreed terms.

▪ **ARTICLE 16: Access to and Transfer of Technology**

1. Each Contracting Party, recognizing that technology includes biotechnology, and that both access to and transfer of technology among Contracting Parties are essential elements for the attainment of the objectives of this Convention, undertakes subject to the provisions of this Article to provide and/or facilitate access for and transfer to other Contracting Parties of technologies that are relevant to the conservation and sustainable use of biological diversity or make use of genetic resources and do not cause significant damage to the environment.

2. Access to and transfer of technology referred to in paragraph 1 above to developing countries shall be provided and/or facilitated under fair and most favourable terms, including on concessional and preferential terms where capabilities, by means of human resources development and institution building.

3. The Conference of the Parties, at its first meeting, shall determine how to establish a clearing-house mechanism to promote and facilitate technical and scientific cooperation.

4. The Contracting Parties shall, in accordance with national legislation and policies, encourage and develop methods of cooperation for the development and use of technologies, including indigenous and traditional technologies, in pursuance of the objectives of this Convention. For this purpose, the Contracting Parties shall promote cooperation in the training of personnel and exchange of experts.

5. The Contracting Parties shall, subject to mutual agreement, promote the establishment of joint research programmes and joint ventures for the development of technologies relevant to the objectives of this Convention.

▪ **ARTICLE 19: Handling of Biotechnology & Distribution of Its Benefits**

1. Each Contracting Party shall take legislative, administrative or policy measures, as appropriate, to provide for the effective participation in biotechnological research activities by those Contracting Parties, especially developing countries, which provide the genetic resources for such research, and where feasible in such Contracting Parties.

2. Each Contracting Party shall take all practicable measures to promote and advance priority access on a fair equitable basis by Contracting Parties, especially developing countries, to the results and benefits arising from biotechnologies based upon genetic resources provided by those Contracting Parties. Such access shall be on mutually agreed terms.

3. The Parties shall consider the need for and modalities of a protocol setting out appropriate procedures including, in particular, advanced informed agreement in the field of the safe transfer, handling and use of any living modified organism resulting from biotechnology that may have adverse effect on the conversation and sustainable use of biological diversity.

4. Each Contracting Party shall, directly or by requiring any natural or legal person under jurisdiction providing the organisms referred to in paragraph 3 above, provide any available information about the use and safety regulations required by the Contracting Party in handling such organisms, as well as any available information on the potential adverse impact of the specific organisms concerned to the Contracting Party into which those organisms are to be introduced.

▪ **ARTICLE 20:** The developed country Parties shall provide new and additional financial resources to enable the developing country Parties to meet the agreed full incremental costs to them of implementing measures which fulfill the obligations of this Convention...

▪ **ARTICLE 21:** . ..the amount of resources needed to be decided periodically by the Conference of the Parties...

That provision proved to be an insurmountable obstacle for the United States, but not for its allies. Great Britain and 18 other countries issued a declaration in which they interpreted that provision to mean that while the parties can determine the total amount of money needed, they cannot set the amount to be contributed by each individual nation (see story, p. 8).

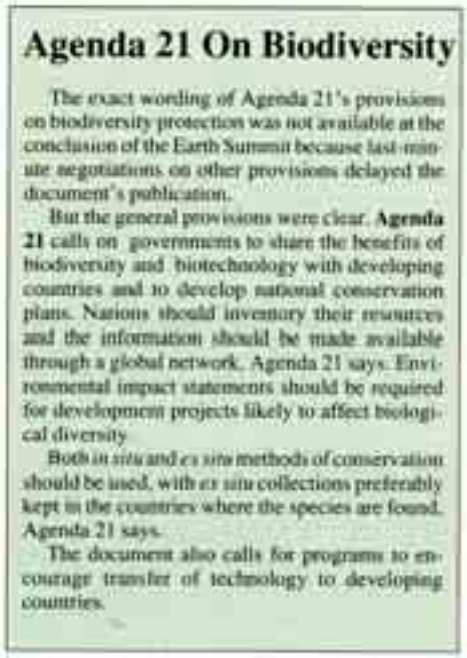
### U.S. Refusal Won't Block Use

The U.S. refusal to sign the Biodiversity Convention - while it led to enormous criticism of the United States at the Summit and played big in the international media that swarmed the 12-day event - is not likely to interfere with the use of plant genetic resources, Hawtin said.

"The Convention commits to sharing. That does not exclude countries that do not sign from following the same practice," explained Hawtin. "The United States has been one of the most liberal countries in terms of making material available. I would not expect that position to change."

[In comments following the Summit, Dr. Henry Shands, who directs the genetic resources program for the United States and was part of the U.S. team negotiating the Biodiversity Convention, reiterated the commitment of the U.S. to the concept of open exchange of genetic resources with all nations of the world. He referred in particular to the newly established genetic resources program recently mandated by the U.S. Congress that further confirms this position (see story,p.24).]

Dr. José Esquinas-Alcazar, Secretary of the United Nations Food and Agriculture Organization's (FAO) Commission on Plant Genetic Resources, said the Earth Summit raised awareness of plant genetic resource issues and gave a push to international efforts to manage them.



**Agenda 21 On Biodiversity**

The exact wording of Agenda 21's provisions on biodiversity protection was not available at the conclusion of the Earth Summit because last-minute negotiations on other provisions delayed the document's publication.

But the general provisions were clear. **Agenda 21** calls on governments to share the benefits of biodiversity and biotechnology with developing countries and to develop national conservation plans. Nations should inventory their resources and the information should be made available through a global network, Agenda 21 says. Environmental impact statements should be required for development projects likely to affect biological diversity.

Both *in situ* and *ex situ* methods of conservation should be used, with *ex situ* collections preferably kept in the countries where the species are found, Agenda 21 says.

The document also calls for programs to encourage transfer of technology to developing countries.

The Earth Summit "also made clear that the conservation and use of plant genetic resources cannot be separated," Esquinas said in an interview.

"The most important challenge that our generation has before it is to internalize the cost of conservation into the development mechanism," Esquinas said. "When you buy an apple," he asserted, "you should pay not only for the cost of production, but also for the cost of conservation of natural resources that would allow future generations to continue having apples."

Esquinas said the Summit's prominent treatment of the biodiversity issue reinforces international efforts that were already underway, such as the Keystone Center's International Dialogues on Plant Genetic Resources and the FAO's Intemational Undertaking on Plant Genetic Resources (see DIVERSITY vol.7, no.4,pp.4-5 and vo1.7,no.3,pp.7-8). The FAO Undertaking is an effort to insure access to plant genetic resources and appropriate compensation for those resources. Unlike the Biodiversity Convention, however, it is not legally binding.

### Global PGR Leaders Begin to Assess Impact

"Things could have been better" at the Summit," Esquinas acknowledged, "but this is a first step. There is still a long, long way to go." He and the FAO Commission will begin the arduous task of assessing the extent of the impact on global genetic resources from the various actions taken at the Rio Summit when the Commission convenes a special session explicitly for this purpose in Rome later this year.

Similar concerns are being brought to Dr. Michael Lesnick of the Keystone Center, who said that some participants in the Keystone Dialogue Series and others have already requested that Keystone consider holding another meeting in the near future "to look at the implications of the language contained in the Biodiversity Treaty."

***The Earth Summit "made clear that the conservation and use of plant genetic resources cannot be separated," said Dr. José Esquinas-Alcazar.***

These meetings will probably be the first of many such efforts to determine what real effect this landmark agreement on biodiversity might have on the many national and international genetic resources programs that function within the borders of the nations that did - and did not - sign the treaty.

**Nations Signing the Convention on Biological Diversity (as of June 25,1992)**

Afghanistan
Algeria
Angola
Antigua & Barbuda
Armenia
Australia
Austria
Azerbaijan
Bahamas
Bahrain
Bangladesh
Barbados
Belarus
Belgium
Belize
Benin
Bhutan
Bolivia
Botswana
Brasil
Bulgaria
Burkina Faso
Burundi
Canada
Cape Verde
Central African Rep.
Chad
Chile
China
Colombia
Comoros
Congo
Cook Islands
Costa Rica
Côte d'Ivoire
Croatia
Cuba
Cyprus
Dem. People's Rep. of Korea
Denmark
Djibouti
Dominican Republic
Ecuador
EEC
Egypt
El Salvador
Estonia
Ethiopia
Finland
France
Gabon
Gambia
Germany
Ghana
Greece
Guatemala
Guinea
Guinea Bissau
Guyana
Haiti
Honduras
Hungary
Iceland
India
Indonesia
Ireland
Israel
Italy
Jamaica
Japan
Jordon
Kazakhstan
Kenya
Kuwait
Latvia
Lebanon
Lesotho
Liberia
Liechtenstein
Lithuania
Luxembourg
Madagascar
Malawi
Malaysia
Maldives
Maldova
Malta
Marshall Islands
Mauritania
Mauritius
Mexico
Micronesia
Monaco
Mongolia
Morocco
Mozambique
Myanmar
Namibia
Nauru
Nepal
Netherlands
New Zealand
Nicaragua
Niger
Nigeria
Norway
Oman
Pakistan
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Poland
Portugal
Qatar
Republic of Korea
Romania
Russian Fed.
Rwanda
Saint Kitts/Nevis
Samoa
San Marino
São Tomé
Senegal
Seychelles
Slovenia
Solomon Islands
Spain
Sri Lanka
Sudan
Suriname
Swaziland
Sweden
Switzerland
Tanzania
Thailand
Togo
Trinidad & Tobago
Tunisia
Turkey
Tuvalu
Uganda
Ukraine
United Arab Emirates
United Kingdom
Uruguay
Vanuatu
Venezuela
Yemen
Yugoslavia
Zaire
Zambia
Zimbabwe

# Biotech Industry Played Key Role in U.S. Refusal to Sign BioConvention

*The United States' refusal to join other world economic powers in signing the Convention on Biological Diversity was one of the major stories to emergefrom the Earth Summit in Rio. The drama played for days in the international media when leaked documents indicated that William Reilly-head of the U.S. Environmental Protection Agency and the Bush Administration's lead negotiator in Rio - had failed in a last-minute bid to convince President George Bush to sign the agreement. The leak embarrased Reilly, and also highlighted the key role that the U.S. biotechnology industry played in persuading Bush not to sign the Convention. Steve Usdin, a Washington-based journalist who attended the Summit, reports on the biotechnology industry's reaction to events in Rio.*

***by Steve Usdin***

The U.S. refusal to sign the Convention on Biodiversity delighted the American biotechnology industry, which lobbied hard against the pact.

Biotechnology trade associations and chief executives of some of the largest biotechnology companies waged a vociferous campaign to derail the treaty, fearing that it would restrict rights to intellectual property, undermine the competitive advantage of U.S. companies by forcing them to transfer valuable technology to developing countries, and set a bad precedent for negotiations on the General Agreement on Tariffs and Trade (GATT) and other trade agreements.

Industry leaders emphasize, however, that though they object to several provisions of the convention, they strongly support efforts to preserve biodiversity.

### Opposition Not Unified

But the biotechnology community was not unified in its condemnation of the treaty. Thomas Eisner, a Cornell University researcher who brokered a large research and profit-sharing agreement between Merck & Co. Pharmaceuticals and InBio, a Costa Rican bioresearch organization (see DIVERSITY, vol.7, no.4,p. 14), is an ardent backer of the treaty.

And the Committee on International Environmental Law of the Association of the Bar of the City of New York believes the biotechnology industry's objections to the treaty are based on a misinterpretation of the text. The Committee notes that the second provision of Article 16 (see page 3) specifically protects intellectual property rights (IPR) and that other sections mandate that technology transfer occur on "mutually agreed terms" - language that U.S. negotiators had insisted upon at pre-Earth Summit negotiations.

Richard Godown, President of the Industrial Biotechnology Association (IBA), said that the IBA "supports the principal of protecting [biodiversity]... However, the Convention would be counterproductive" to this goal.

"No seed company has a serious objection to the preservation of biodiversity," said Michael Roth, Corporate Patent Counsel, Pioneer Hi-Bred International, Inc. "However, we rely heavily on intellectual property rights to protect our products. There is too much language in the convention about making technology available to developing nations, in effect, on an unrestricted basis to make us comfortable that our rights would be protected."

Roth feels that Pioneer's numerous germplasm research and development initiatives in developing countries could be threatened by the treaty. If the treaty were in force, he said, Pioneer might have to transfer the rights of germplasm to the country in which it originated.

Members of the the American Seed Trade Association (ASTA), which represents more than 800 seed companies, "followed the Rio conference with a great deal of interest," said ASTA Executive Vice President Dave Lambert, referring to their concern that "a free flow of plant germplasm is available to those who would like to use it in their breeding programs, wherever they might be." He acknowledged the need for "some kind of quid pro quo in the preservation, collection, and development of these resources," and said that despite the disappointment by some over the lack of progress made in Rio, there" is now a clear recognition of the importance of IPR and the role they must play, if a workable solution to these complex problems are to be found."

***"No seed company has a serious objection to the preservation of biodiversity. "***

The decision not to sign the biodiversity treaty comes in the wake of a number of administration efforts to loosen government controls on the U.S. biotechnology industry. In February, White House officials released a "scope document" which established that biotechnology products do not pose any inherent risk and therefore will not be regulated differently than products of other technologies (DIVERSITY, vol.8, no.1, p.23). In May, the U.S. Food and Drug Administration announced that genetically engineered food products will not receive separate or special regulatory attention (see p. 26).

### Negotiations Criticized

From the perspective of the biotechnology industry, negotiations over the language of the biodiversity treaty were mishandled from their inception and efforts to correct problems were not made until the last minute, according to Richard Wilder, a spokesman for the Association of Biotechnology Companies (ABC) and a Washington, D.C.-based patent attorney.

"Things went wrong from the beginning," Wilder said. "The level of participation in the delegations, across the board, was very, very low. It was the 'B' team. The negotiators had very little idea of what they were dealing with, they were not experts in the technology or in intellectual property issues...They were not even familiar with the positions of their own governments." Wilder said that "the delegations that were most effective in getting their points of view into the convention were those that had a very negative view of intellectual property," especially those from India and Malaysia.

The IBA, ABC and several biotechnology companies exerted strong pressure on the Bush Administration before the final round of Biodiversity Convention negotiations in Nairobi in May. They moved to block treaty language that they saw as an attack on intellectual property rights. "There was a last ditch effort in Nairobi," according to Godown, "and the U.S. was faced with extreme intransigence. [The negotiators] came back and said 'this is truly against our national interest, we better throw down the gauntlet.'"

A few days before the President's trip to Rio, G. Kirk Raab, President and Chief

Executive Officer of Genentech, Inc. sent Bush a letter stating that "Sadly, the proposed Convention runs a chance of eroding the progress made in protecting American intellectual property rights. The vague language relating to 'technology transfer' and equitable sharing appear to be code words for compulsory licensing and other forms of property expropriation."

The industry claims that treaty language mandates transfer of technology to developing countries on terms that would be detrimental to American companies. Godown said "the treaty calls for the transfer of technology that results from [plants or animals discovered in a developing country] back to the country of origin on a preferential basis. The convention would tie the hands of negotiators: When they sat down to make a deal there would be an enormous slug of mandatory contract language... it would result in a bum deal for food and agriculture companies."

He pointed to the Merck-InBio research and financial deal, saying that it would have been impossible under the terms of the biodiversity convention.

### Conflicting Interpretations

But Eisner strongly supports the treaty and says that "absolutely nothing in the treaty would have prevented the Costa Rica deal." He blasted treaty opponents, accusing them of "antediluvian thinking."

Eisner praised the treaty because it recognizes the commercial interest of the countries of origin in the products made from plants and animals. He said that the transfer of technology to developing countries is ultimately in the best interests of biotechnology companies because it places screening and extraction operations near the source of materials and creates a scientific infrastructure with which they can cooperate.

American concerns about the convention did not prevent other countries with large pharmaceutical and biotechnology industries from signing the treaty. Britain, Germany, France and Japan were among the over 150 signatories (see p. 7).

Leaders of the U.S. biotechnology industry were skeptical about the motives of these countries, however. "The other developed countries with an advanced position in biotechnology certainly [signed it] with tongue in cheek," according to Godown. He said that Britain and other countries have reserved the right to interpret the agreement in ways that ran counter to its language.

The Convention must be ratified by a nation's legislative body to become binding. There is "widespread suspicion in the U.S. biotechnology industry that all of the countries that signed it will not ratify it, that it was just a public relations ploy," Godown said.

Roth said that "as the months go on by we will see completely different implementation in the countries that have signed the treaty. That reflects the fact that some of the provisions are so vague they can mean whatever you want."

Asked why the United States did not emulate its allies, Roth said "many countries have no problem signing treaties that have different possible interpretations and then issuing a statement saying what they think it means. The U.S. doesn't want a ticket to an arguing match."

## What They Are Saying: First Reactions to the Biodiversity Convention

*"Under the terms of the Biodiversity Treaty the North will have a degree of access to the biological resources of the South, and the South will have new access to the technological resources of the North. It is a two-way street. If either side, North or South, reneges on its commitments, then this agreement — the first of its kind — will fail."*

**— Mostafa Tolba**, Executive Director, United National Environment Program

*"We come to Rio prepared to continue America's unparalleled efforts to preserve species and habitat. And let me be clear. Our efforts to protect biodiversity itself will exceed — will exceed — the requirements of the treaty. [The treaty] threatens to retard biotechnology and undermine the protection of ideas...and...its financing scheme will not work...It is never easy to stand alone on principle, but sometimes leadership requires that you do so. And now is such a time."*

**— George Bush**, President of the United States

*"This will teach the United Nations not to hold a conference in an American election year."*

**— Tommy Koh**, Chairman, UNCED Preparatory Committee

*"The most significant accomplishment of the debate at Rio was highlighting the economic value of biodiversity, thereby stimulating interest in making greater investments in the area of halting genetic erosion...The failure was the diversion of disproportionate attention to issues relating to patenting and intellectual property rights rather than the pivotal role of genetic resources in protecting global food security and in promoting the livelihood security of the rural poor...Patent protection rather than promoting a better quality of life for the poor became the major obsession..."*

**— M.S. Swaminathan**, World Food Prize Laureate, M.S. Swaminathan Research Foundation

*"My sense is to stress the positive. To say there are some of these issues that require clarification is a fair statement. But where countries are asking 'Should we sign?', we're saying 'yes'. It's an excellent first step."*

**— Geoffrey Hawtin**, Director, International Board for Plant Genetic Resources

*"The Biodiversity Treaty has given itself a frontal lobotomy, ignoring the political history of the last dozen years by not using agreed-upon terms such as "farmers' rights"...by not recognizing ex situ collections that existed prior to the treaty...which leaves it open to all kinds of interpretations...by being too acquiescing on the issue of Intellectual Property Rights (IPRs), treating as a given that there will be IPR over life forms, and we don't take that as a given...the Third World may have given up so much to have gotten so very little..."*

**— Pat Roy Mooney**, Rural Advancement Fund International (RAFI)

*"The restriction and controls that are likely to be initiated [as a result of the Biodiversity Convention] on ownership of, regulation of, and access to genetic resources may prove to be more threatening to the world's food security than any of the obvious problem areas. The responsibility of scientists to preserve unique genetic diversity now becomes more important than ever..."*

**— Henry Shands**, USDA Assistant Deputy Administrator for Genetic Resources

*"Biodiversity? Well, we certainly educated people to it in the last year, haven't we...people who had never heard of it before...There is a crisis certainly in the world today of loss of biological diversity...this is a tragedy for the planet...a loss of potentially useful products. [but] we are not under any circumstances going to require that our industry share its patents or make its technology available on confessional terms...We have negotiated in the Uruguay Round of GATT to try to protect Intellectual Property Rights. We're not about to trade away here in an environmental treaty what we worked so hard to protect there."*

**— William Reilly**, Administrator of the U.S. Environmental Protection Agency, Head of the U.S. Delegation to the Earth Summit

*"The exclusion of ex situ collections from the scope of the treaty is most outrageous and is one of the principal reasons many NGO's [non-governmental organizations] are dissatisfied with the Convention. This exclusion has enormous implications for the developing countries, the world's major donors of germplasm to the international genebank system...adds fuel to our concern...takes the debate over control of genetic resources ten years backwards and for that we are most sorry."*

**— Renée Vellvé**, Genetic Resources Action International (GRAIN)

# Bye, Bye, Biodiversity: A Rio Earth Summit Diary

*Tens of thousands of people from around the world gathered in Rio for the Earth Summit. If you were there, it was a dizzying experience. To get a flavor of what it was like to he there, we asked participant Nancy Diamond to keep a diary for DIVERSITY. Following are some extracts:*

***by Nancy K. Diamond***

**30 MAY, Washington, D.C.** - Overheard on National Public Radio: "U.S. State Department says that the UNCED Biodiversity Convention is fundamentally flawed. The United States will not sign."

**31 MAY, In-flight from Miami to Rio de Janeiro-** News of the Earth Summit seems to be everywhere. *New Yorker* magazine includes a profile of (eminent Harvard ethnobotanist) Richard Schultes; TIME weighs in with its own skepticism about what the summit can achieve. My airline shows summit-bound travelers "Medicine Man," a hackneyed rainforest romance set amidst a larger drama of good guys (Kayapo Indians and ethnobiologists) and bad guys (the Brazilian government and intemational pharmaceuticals firms). I know that governments, scientists, and indigenous peoples will be in Rio, but the movie reminds me that the industrial interests seem to prefer to remain in the shadows.

Questions to keep in mind these next two weeks: What are the benefits and costs of the biodiversity treaty? Who will benefit? Who will bear the costs? If any benefits get back to local communities, how will they be divided? What is appropriate? What is appropriation?

**1 JUNE, RIO-** I go down to my hotel lobby to wait for a friend and watch the chaos. UNCED delegates are waiting for transport to their meetings 40 kilometers away in Rio Centro (where the official delegations meet). Global Forum (GF) participants and international press also mill about. Out on the street, the taxi drivers are making a killing and the heavily armed military men protecting the footbridge to the GF are trying to prevent one.

I pass through the GF's fenced gates and encounter a sea of people, trees, and tents... nearly 700 booths for grassroots, national and international environmental Non-Govermental Organizations (NGOs), and educational, labor, and religious organizations.

**JUNE 2** - I hop from meeting to meeting, sweltering tent to sweltering tent... from Planeta Femea/Women's Environment & Development Organization to the International Indigenous Commission... In contrast to coming days, today's official calendar is fairly light: 33 all-day meetings, plus ten morning-only, three aftemoon-only, and two evening-only meetings. I begin to feel that something really great is happening somewhere else and that I am missing it. This feeling persists for the entire two weeks.

**JUNE 3** - I sit in on presentations by NGOs who focus on the Brazilian coastal Mata Atlantico Rainforest. It is the first time these organizations have sat down together. What is different about this meeting is the outcome. They actually commit themselves to the idea of networking. It was a relief to see action taken after listening to a long day of debates and theorizing.

**4 JUNE** - The umbrella Biotechnology-Biodiversity Working Group criticizes the "false promises" about biotechnology in Agenda 21... Phil Bereano from the University of Washington and Vandana Shiva, a Canadian-based but Indian-born physicist and technology gadfly, argue that community-defined assessments are essential for both biotechnology and biodiversity developments. Shiva feels that rather than focusing on the South's biodiversity, it is more appropriate to focus on the North's biotechnology firms and their role in the erosion of biodiversity. She says the positive dimension of the North-South dispute is that it allows room for citizen involvement, which would be less likely if governments agreed.

**5 JUNE** - Exotic cocktail in hand, I mingle with representatives from donor agencies at an elegant Ford Foundation party. One comments on Bush's refusal to sign the biodiversity convention: "It just shows the failure of the U.S. environmental movement, and the donor community which supports these organizations, to engender enough popular support in the U.S. to push Bush to do the right thing."

***'I begin to feel that something really great is happening somewhere else and that I am missing it. This feeling persists for the entire two weeks."***

**6 & 7 JUNE** - I spend the weekend in a small coastal town. It is a relief to get away from the greenhouse-like tents, meetings, and crowds. I ask my Rio-based hosts what the Summit means to them. They tell me traffic horror stories, the result of the security measures taken to safely transport the world's leaders around Rio.

**8 JUNE** - Several officials -including Dr. M.S. Swaminathan-describe a new project on sustainable management of rainforests being initiated on nearly one million acres offered by Guyana's President.... A Guyanan audience member states that the Guyanan public and Amerindians living in the area had not been consulted prior to the land donation and remain poorly informed.

**9 JUNE** - A sparse crowd of 20 people listen to the two glib Australians from Tree Technology International, Inc. describe the world's latest miracle tree, a *Paulownia* clone. "Incredible growth rates... super hardwood... people will stop cutting forest." . . . Their goal: get governments in the South to donate land - they will plant miracle trees and keep the profits.

**10 JUNE** - A small meeting organized by Trish Shanley, who works with the Brazilian Rio Capim Project of Woods Hole Institute, includes different organizations working with communities and ethnobotany. Several people mention keen donor interest in market studies for non-timber forest products, but problems include lack of donor coordination, suitable economists, and sufficient funding for ecological and social ramifications of market development. Dr. Charles Stir-ton, Deputy Director of Science from Kew Royal Botanic Gardens, expresses a keen interest in implementing a world-wide database for ethnobotanical knowledge, particularly that which is medicinal. I raise concerns over any centralization of information - in this case, the database seems likely to mean a loss of control over the information and failure to compensate the intellectual property rights of the originators of that knowledge.

**11 JUNE** - Entering a quiet tent, I notice the spectacular feathered headdresses of the indigenous group representatives... the pale pink and black prayer wheel headdress of the Amazonas Island group, and crowns of parrot feathers, blue, green, red and yellow for others. Unlike the huge media events, this intimate gathering of Brazilians, Peruvians, etc. and a few whites is intended to hammer out an indigenous people's alternative treaty. For once, the interpretation is excellent... The meeting seems to have a different rhythm...more circular... speeches are sometimes irritatingly slow and repetitive, but overall, there is an eloquence which was not common at the larger meetings: "We are not caged animals, museum or postcard pieces; " "We have been like leaves of a tree, the wind pushes us one way or another."

**12 JUNE** - My last day. Dr. Anthony Anderson, a program officer for the Ford Foundation in Rio, briefs me on his efforts in Brazil. We break to hear George Bush deliver his Earth Summit address. Due to Portuguese dubbing, I am forced to pull my chair close to the TV to hear the faint English. I laugh when I realize that I am actually reading George Bush's lips!

I head back to the GF and sit down with a cold Guarana - the rainforest soda made by Coca-Cola. The GF has been a mixed bag. I am a little disappointed that I haven't learned more. I wonder who has. Just then, I see one of the thousands of Brazilian school kids who have toured this eco-fair dive headfirst into a garbage can in pursuit of an aluminum can which he has thrown into the wrong place.

It occurs to me that it is not necessary that I learn anything - apart from renewing my appreciation of the extent and *diversity* of the world's environmental organizations, and recognizing the great symbolic value of a huge meeting of most of the world's government leaders who have gathered together to address environmental problems.

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# Swaminathan Foundation, VIR Sign Pact on Gene Resources

India's **M.S. Swaminathan Research Foundation** and Russia's **N.I. Vavilov Institute of Plant Industry** (VIR) have signed a Memorandum of Understanding (MOU) to cooperate in conserving and sustainably using plant and animal genetic resources.

The November 25,199 1 agreement joins two of the most prominent names in the field of plant genetic resources. The Vavilov Institute is named after the world-renowned Russian plant collector who first identified the "centers of origin" where crop plants evolved. M.S. Swaminathan established the Foundation in 1988 with money he was awarded as the first recipient of the World Food Prize, referred to by many as agriculture's "Nobel." Swaminathan has served as chairman of the International Union for the Conservation of Nature and Natural Resources (IUCN) and is chairman of the Steering Committee for the Keystone International Dialogues on Plant Genetic Resources.

The MOU outlines four areas of cooperation: conservation-technique research; conservation training for scientists and grassroots-level workers; data base development and information exchange; and creation of a network of Vavilov Research and Training Centres "dedicated to the cause of saving and managing plant genetic wealth in a sustainable manner." The two organizations will work separately and jointly to fund the projects.

VIR director Victor Dragavtsev and Swaminathan signed the MOU at a workshop on Genetic Resources for Sustainable Agriculture held at the Foundation's home in Madras, India. The agreement also calls for organizing a "Biodiversity Day" every year on November 24, Vavilov's birthday, to pay homage to the geneticist and to generate awareness of the importance of genetic resources.

## Foundation Well Positioned to Fulfill MOU

The M.S. Swaminathan Research Foundation established the N.I. Vavilov Research and Training Centre for Sustainable Management of Biological Diversity in 1991. In keeping with the Foundation's conviction that the "concept of sustainability has to be a dynamic one, leading to a continuous improvement of biological productivity on an ecologically and socially sustainable basis," its Vavilov Centre promotes community involvement in biodiversity conservation and trains rural families and scientists to work together in a "participatory research mode" on various aspects of the conservation, evaluation, classification, and utilization of genetic resources.

The Centre has programs in conservation monitoring through bioindicators and on linking conservation with sustainable utilization. It also has an information center and computerized data bank on grassroots-level conservation activities and on genetic resources for sustainable agriculture and adaptation to climate change.

The Vavilov Centre works closely with the National Bureau of Plant Genetic Resources of the Indian Council of Agricultural Research (see story, p.12, and DIVERSITY, no.12, pp.14-16), the Botanical Survey of India, the Indian Council of Agricultural Research and Education, as well as with non-governmental organizations.

M.S. Swaminathan urged the creation of a network of Vavilov Centres at the Vavilov Centenary Symposium celebrated in Moscow, November 24, 1987 (see DIVERSITY, no. 15, pp.5-6). The Swaminathan Foundation's Vavilov Centre will be the first member of the network.

The Foundation's four other programs include:

- conserving mangrove genetic resources;
- collecting endangered species from the Tamil Nadu-Kerala region;
- creating a garden for sustainable, mixed farming that features specialized gene pools to breed crop varieties possessing tolerance/resistance to a wide range of biotic and abiotic stresses and specialized genetic stocks of nitrogen-fixing tree species and plants of value in veterinary and human medicine; and
- developing molecular linkage maps of a few mangrove species.

The Foundation also encourages international idea and information exchange to solve problems facing plant genetic resources. As part of promoting the "synergy of thought and action" necessary to meet these challenges, the Foundation has sponsored several wide-ranging dialogues, including landmark meetings such as the Keystone Dialogues on Plant Genetic Resources.

For additional information, contact: Prof. V. Dragavtsev, Director, N.I. Vavilov All-Union Institute of Plant Industry, 42 Herzen St., 190000 St. Petersburg, Russia. Tel:315-50-93. Prof. M.S. Swaminathan, M.S.Swaminathan Research Foundation, Centre for Research on Sustainable Agricultural and Rural Development, 14, Second Main Road, Kottur Gardens, Kotturpuram, Madras 600 085 India. Tel: 91 44- 416923; FAX 91-41-478148.

For further background, see DIVERSITY articles on Vavilov and the founding of VIR (no.16, p.5) and Swaminathan (no.13, p.19).

## CGIAR Releases Working Document On Intellectual Property Rights

In late May, the Consultative Group on International Agricultural Research (CGIAR) met in Istanbul, Turkey, and unanimously adopted a working document on Intellectual Property Rights. In a letter to Directors of the CGIAR's 18 centers, Executive Secretary Alexander von der Osten wrote that the new document "is mainly intended to serve as information for CGIAR stakeholders," and that "it is a preliminary working document and does not constitute a definitive policy statement."

Excerpts from the two-page statement:

*. . ..The CGIAR recognizes both Plant Breeders' Rights and the concept of Farmers' Rights, in accordance with the agreed interpretation of the International Undertaking on Plant Genetic Resources. Moreover, conservation of genetic resources by the centers, and research on their use is contributing to the goals of the convention on biological diversity....*

*A fundamental objective of the CGIAR is to ensure access to knowledge, technology and materials in the interests of the developing countries. The CGIAR reaffirms that the genetic resources maintained in the genebanks of the centers are held in trust for the world community. Materialfrom the genebanks at the centers will continue to be freely available, in accordance with the 1989 CGIAR Policy on Plant Genetic Resources.*

*Modern biotechnology is becoming an important tool for the work of the centers and their collaborators. Advances in its use offer the potential for the centers and their collaborators to increase productivity in agriculture, forestry and fisheries in developing countries. In a changing research environment, the centers need to collaborate with a wide range of agencies in both the public andprivate sectors which increasingly protect their inventions through holding intellectual property.*

*Centers do not seek intellectual property protection unless it is absolutely necessary to ensure access by developing countries to new technologies and products. The Centers will not seek intellectual property protection for income-generating purposes and will not view potential returns from intellectual property protection as a source of operating funds. Should exceptional cases arise where a center might receive a financial return, an appropriate means will be used to ensure that funds are used for the conservation of genetic resources and related research.*

*On a case-by-case basis, the centers carefully consider the advantages and disadvantages, and the costs and benefits, before deeming it necessary to seek and maintain any form of intellectual property protection on their inventions. A Center's decision reflects its own priorities and concerns as well as those of its collaborators and the nations with which it works. Such decisions are motivated by the need to I) establish collaborative research with advanced laboratories; 2) ensure product development and distribution; or 3) forestall pre-emptive protection by others of acquired by a Center are exercised without compromising in any manner whatsoever the fundamental position of the CGIAR regarding the free access by developing countries to knowledge, technology, materials, and plant genetic resources.*

# New Program Aims to Conserve India's Animal Genetic Resources

*By John A. Pino, Keith M. Gregory, Eric Bradford, and Daya S. Balain*

A relatively new program to preserve the genetic diversity of India's domestic animals is receiving serious attention from scientists and the nation's public authorities. The initiative was prompted by mounting concern about the narrowing and loss of diversity among indigenous breeds and types of domestic animal populations.

India has a large reservoir of animal germplasm (see box, this page). But how much similarity or difference exists among the populations within each species and breed is not known. One thing is certain, however: The populations of India's "pure" indigenous breeds are declining as crossbreeding increases, resulting in the dilution and displacement of indigenous breeds. Population pressures on ecosystems further limit traditional grazing systems utilizing indigenous genotypes.

Except for a few commercial herds of buffalo and cattle (perhaps less than 20 percent of the total), most of India's large animals species are found in small family herds and flocks or in communal herds. In either system, cattle and buffalo are important. Cattle have tremendous cultural significance and also provide milk, the country's major source of animal protein; draft power for the majority of Indian farms; and are a major source of fuel for domestic cooking. Traditionally, cattle are not slaughtered for meat, although growing numbers are moving indiscriminately into slaughter channels. Cattle, buffalo, camels, horses, and donkeys remain a very important part of India's transportation system.

Goats are important in providing meat and milk while sheep provide meat and wool. Sheep and goats also utilize forages and crop residues that may not otherwise be used, especially in arid areas, and function as an important source of savings for small landholders or landless people.

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**The Main Program Areas of India's National Bureau of Animal Genetic Resources (NBAGR)**

1. To survey and define population or breed numbers and distribution for major livestock species.
2. To characterize breeds in each species including the definition of similarities or differences among them.
3. To evaluate each breed from information collected on potentially useful economic or survival traits.
4. To maintain and facilitate access to a breed/species data bank.
5. To assure the conservation of potentially useful unique endangered populations by establishing live herd reservoirs, and where necessary, preservation of semen and embryos or both.
6. To facilitate access to indigenous germplasm.
7. To assist in developing import and export protocols in cooperation with animal health authorities.
8. To provide coordinating leadership for a comprehensive animal breeding and genetics research program to provide technology needed to improve production efficiency of livestock and livestock products.

Although pigs are given lower priority in conservation efforts, indigenous domestic and feral animals can be found. Pig production with improved and crossbred animals is increasing.

In India, as in many Third World countries, commercial poultry production is growing exponentially. It is based on the use of modern genetically improved strain crosses and intensive management systems, although wild and indigenous fowl can still be found.

## The Importance of Indigenous Indian Animal Germplasm

India's many livestock breeds (see top box, page 13) remain an important germplasm reservoir for genetic improvement and maintaining adaptation in the country's many and changing environmental and management conditions.

In addition to their importance in India, the country's livestock, particularly cattle, have already made major contributions to livestock production in the world's tropical and subtropical climatic regions (see bottom box, page 13). The primary use of Indian cattle breeds has been in crosses with European breeds, or to form new composite breeds with adaptability to climatic and other environmental stresses of the tropics and subtropics. Further, very high levels of vigor are achieved from crossing Indian *(Bos indicus)* breeds with European *(Bos taurus)* breeds of cattle. There are other promising cattle breeds, such as the Hariana and Tharparkar, that have not been sampled and evaluated for their potential to contribute to beef and/or dairy production programs in the world's tropical and subtropical regions.

Germplasm from Indian buffalo has also made significant contributions to the livestock programs in many tropical and subtropical climatic zones, while Indian goat germplasm has benefitted goat production in many countries of the world.

## Organization of India's Conservation and Utilization Effort

The task of conserving India's wide spectrum of animal genetic diversity has been given to the National Bureau of Animal Genetic Resources (NBAGR), an agency of the Indian Council for Agricultural Research. The NBAGR was established in 1984. Initially located in Bangalore, Karnataka in the south of India, it moved in 1985 to its present location in Karnal, Hariana in north central India where it is accommodated in the facilities of the National Dairy Research Institute (NDRI). Plans call for the construction of new NBAGR office and laboratory facilities on land adjacent to the NDRT.

Important to the work of NBAGR are specialized institutes for most of the major animal species. There are several of these, some with affiliated centers. Most have breeding herds or flocks of the species for which they are responsible. Their primary mandate is to improve breed productivity, distribute breeding animals or semen, and provide information on production technology.

To carry out its mandate on germplasm identification, evaluation/characterization, utilization, improvement and conservation of indigenous breeds of cattle, buffalo, sheep and goats, NBAGR functions in a coordinating, leadership role with the species specific institutes, universities, military farms and the private sector. NBAGR will not have its own large herds, land or animal facilities, other than minimal holding pens. In some respects, NBAGR's structure parallels that of the National Bu-

reau for Plant Genetic Resources (NBPGR) of India (see DIVERSITY, no. 12, pp. 14- 16); however, *in situ* conservation of live animal populations will play a role comparable to *ex situ* gene (seed) banks in the case of plant genetic resources.

The NBAGR strategy is to execute its program of activities under a Memorandum of Understanding with the participating institutions and organizations. NBAGR will provide, as necessary, supporting funds and/or commissioned staff to the cooperating institution.

NBAGR professional staff consists of quantitative geneticists, cytogeneticists, molecular biologists and data management specialists. At present there are 14 authorized positions. These are supplemented by the professional staff of the collaborating institutions. NBAGR staff may be assigned to the other agencies to assist personnel of the cooperating institution. Initially, much of the survey and characterization data, as well as tissue samples (semen and blood), will be collected from herds established at public and private institutions (some of this work has already begun). Special training courses are being given to field data collectors. Information and tissues from non-institutional populations will be sampled directly by NBAGR staff or in collaboration with staff of cooperating institutions and universities.

NBAGR is using descriptors developed by the Food and Agriculture Organization/European Association of Animal Germplasm, with appropriate modifications to accommodate Indian needs. Globally, further definition and agreement on these descriptors is urgently needed at this early stage in the emerging global system. This would simplify the process of standardization and information exchange among national genetic resources management systems as additional programs become established. The information received by NBAGR is computerized and summarized. Not all of the collaborating institutions have computer facilities; but it is contemplated that they will all have online access to the central data bank.

**India's Domestic Animal Breeds**

In India, there are 27 recognized breeds of cattle (*Bos indicus*), totalling 197 million head; 8 of buffalo (*Bubalus bubalis*), totalling 75 million head; 40 of sheep (*Ovis aries*), totalling 54.5 million head; and 20 of goats (*Capra hircus*) with 110 million head. Other species include camel (*Camelus dromedarius* and *Camelus bactrianus*), mithun (*Bos gaurus frontalis*), yak (*Bos [Poephagus] grunniens*), donkey (*Equus asinus*), horses (*Equus caballus*) and chicken (*Gallus gallus domesticus*).

Milk breeds of cattle include Sahiwal, Tharparkar, Red Sindhi, Gir, Kankrej and Ongole. Meat breeds include Gir, Kankrej and Ongole. Draft breeds include Tharparkar, Hariana, Ongole, Nagaur, Kankrej, Kenni, Amrit Mahal, Hallikar. The main buffalo breeds used for milk, meat, and draft are Murrah, Nili Ravi, and Surti, Meshana, Zaffarabadi, Bhadawari, and Nagpuri.

In addition to characterizing bioeconomic traits, NBAGR's research program will be expanded in the near future to include genetically characterizing populations at the gene product or DNA level. This may involve assessment of traditional genetic polymorphisms such as red cell antigens, protein variants such as isozymes, and genetic variants identified by molecular technologies including RFLP's (restriction fragment length polymorphisms), RAPD's (randomly amplified polymorphic DNA's), and microsatellites.

Applying technologies to characterize populations at the genetic and DNA levels will provide a means of assessing genetic relationships between populations, permitting more efficient definition and selection of distinctive or truly unique -groups for conservation efforts. Furthermore, an understanding of the genetic relationships or distance between breeds or populations may contribute to the future utilization of genetic resources in improvement programs, in terms of selection among breeds and in utilization of heterosis. Such research in India should be particularly important in the case of buffalo, since more than half of the world's buffalo population is in India. It will also be important for cattle, sheep, goats, and camels in each of which India has a rich genetic diversity and very probably some unique stocks.

India still lacks an official policy on quarantine aspects of animal germplasm import and export. The rigid control of transmissible diseases and parasites is the basis of all quarantine policy. However, procedures under that policy are likely to change with the wider acceptance of "disease clean" embryos processed by the newly developed embryo washing technique. Thus it is expected that there will be easier and safer access to Indian animal germplasm in the future. At the same time, there is likely to be greater dilution of indigenous Indian germplasm resulting from importation into that country of semen and embryos.

Finally, germplasm conservation should be closely linked with programs for genetic improvement (adaptation and productivity). Although NBAGR recognizes this relationship, NBAGR impact in advancing genetic improvement goals has yet to be achieved. Indian officials expect NBAGR identification, characterization/evaluation, utilization, improvement, and conservation programs will be integrated into a comprehensive national program of animal breeding and genetics research aimed at improving efficiency in livestock production in India.

For more information, contact: Dr. John Pino, 1801 Crystal Drive, #414, Arlington VA 22202 USA; Tel. 703-521-4382: FAX 703-521-1129.

## India's Diverse Cattle Breeds Have Made Many Contributions

Cattle breeds indigenous to India are classified in the sub-species *Bos indicus*, while European cattle breeds that had their origin in Central Asia and Europe are classified in the sub-species *Bos taurus*.

The Brahman cattle breed was developed in the United States with genetic contributions from the Guzerat (Kankrej), Gir and Nellore (Ongole) to the Gray Brahman and with genetic contributions of the Gir, Guzerat and Indu-Brazil to the Red Brahman. The Indu-Brazil breed was developed in Brazil with genetic contributions primarily from the Gir and Guzerat (Kankrej) breeds. The Nellore (Ongole), Gir and Guzerat (Kankrej) breeds and composite breeds derived from them are used extensively in Brazil. The Nellore (Ongole) breed is used widely in subtropical regions of Northern Argentina and in other tropical and sub-tropical regions of South America. Most breeds of African cattle are classified as *Bos indicus* and had their origin in India.

The Brahman breed is used extensively in beef crossbreeding programs in the Southern United States and has been exported to all tropical and subtropical cattle producing regions of the world, including Australia, Southern Africa, and most countries of Central and South America. Further, the Brahman breed has contributed germplasm used in the development of many new U. S. beef breeds, including the Brangus, Beefmaster, Santa Gertrudis and others.

The Sahiwal breed has been exported from India into Australia and Kenya where it is used in both beef and dairy production programs. The Sahiwal breed was imported into the United States from Australia where it has been characterized and evaluated in a comprehensive research program. Thus, Indian cattle breeds have contributed germplasm to all tropical and subtropical and to some temperate climatic regions of the world, particularly for use in beef production programs and to a more limited extent for use in dairy production programs.

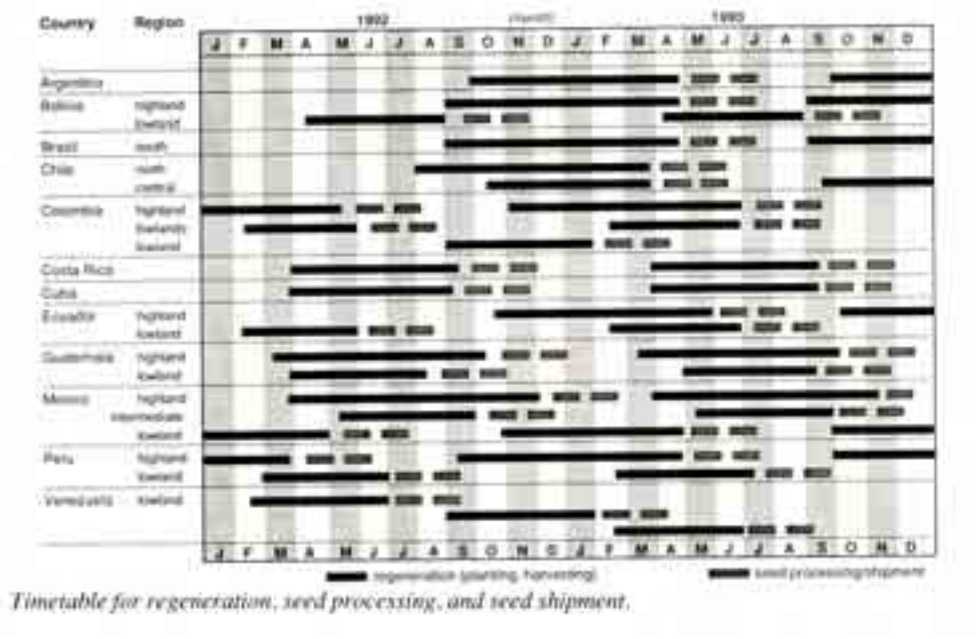
More than 90 percent of *Bos indicus* cattle are found in latitudes between 30" North and South of the equator. *Bus indicus* breeds have greater climatic adaptability to the tropics because of: 1) shorter hair coats and higher density of sweat glands and *2) Bos indicus* cattle are more selective feeders than *Bos taurus* (European) cattle and select a higher quality diet from the generally lower quality forages present in the tropics.

# Regenerating Endangered Latin American Maize Germplasm: The USAID/CIMMYT Cooperative Project

Latin American seed banks collaborating in a landmark effort to regenerate major endangered collections of maize landraces have turned the first corner in their race against time - they have figured out which germplasm needs to be regenerated and set a tentative schedule for doing it.

The developments are part of one of the most comprehensive international efforts to preserve native maize germplasm since E.J. Wellhausen and a Rockefeller Foundation team began collecting and cataloging the crop's ancestral gene pool in the 1940s. With funding from the U.S. Agency for International Development (USAID), the International Maize and Wheat Improvement Center (CIMMYT) in El Batan, Mexico is coordinating the Cooperative Project to Regenerate Latin American Maize Germplasm.

Together with the Regeneration of Maize Landrace Collections in Central and South America, a five-year cooperative effort with the U.S. Department of Agriculture's National Seed Storage Laboratory in Ft. Collins, Colorado, the CIMMYT project is expected to rescue and conserve some 7,500 endangered accessions by 1994. Dr. Suketoshi Taba, the head of the CIMMYT Maize Germplasm Bank, points out that the two efforts are complementary. "The USAID work," he says, "is the major push that will allow us to catch up with the most serious part of the regeneration backlog in the region. On the other hand, I view the NSSL project as a longer term proposition to continue regeneration work as needed."




*Timetable for regeneration, seed processing, and seed shipment.*

## Project Meets Critical Need

The idea for the regeneration project was born in March 1991, when leaders of the region's gene banks gathered at CIMMYT to assess maize germplasm conservation in the Americas (see DIVERSITY, vol.7, nos.2&3, p.45). Their conclusion: the situation was critical. Thousands of landrace accessions needed regeneration and many collections, some unique, were in danger of being lost. Part of the problem-which still exists - is the always meager operating budgets of the Latin American gene banks have come up short, casualties of the region's chronic economic instability.

The seedbank leaders drew up a proposal to salvage maize holdings in Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Mexico, Peru, and Venezuela. CIMMYT took the proposal to USAID and a grant under Project Noah was finalized in November 1991 (see DIVERSITY, vol.6, nos 374, p.38). Under the terms of the grant, each participating bank will plant out, harvest, and process its own holdings. CIMMYT will coordinate the work and provide technical support, with assistance from the NSSL. Backup samples of the regenerated material will be kept in long term storage at both NSSL and CIMMYT.

## Computers Speeds Effort

Before actual regeneration can begin, participants have had to determine *what* they should regenerate, a task which is now nearly accomplished. It involved, among other things, extensive exchange and cross-checking of information to identify duplicate holdings and remove them from a list of regeneration candidates. NSSL provided CIMMYT with an inventory of Latin American maize germplasm held at Fort Collins. The inventory was checked against CIMMYT's database and sent to cooperating banks in the region.

The banks also received copies of CIMMYT's "accession editor" software, which they are updating with basic information about their accessions and will shortly return to the Center. "The aim is not only to avoid duplication," according to Taba, "but to establish a regional network in which each project cooperator possesses a complete, electronic database on landrace collections held by the other institutes."

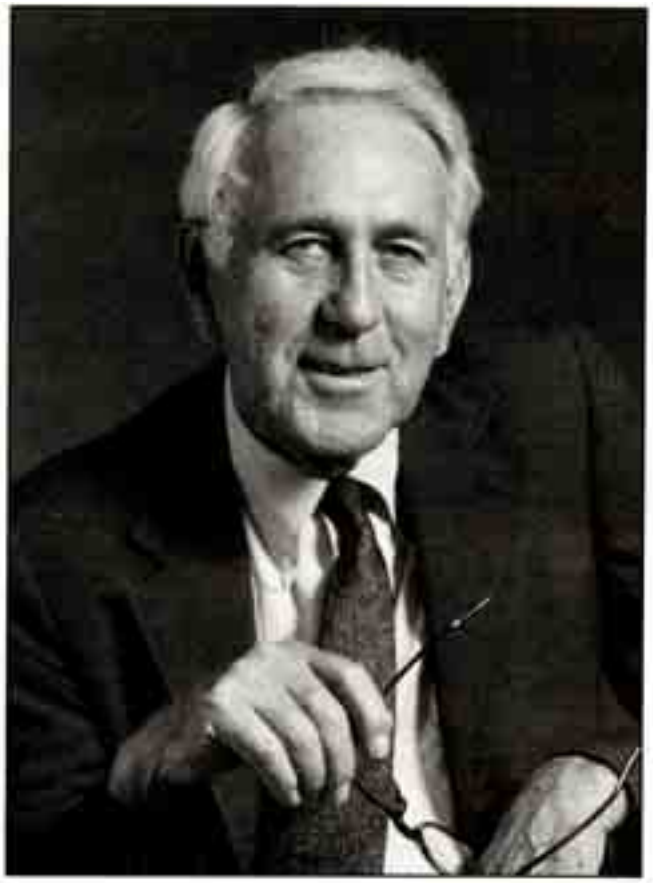
CIMMYT sent a contract for regeneration work to the 13 cooperating banks in November 199 1. CIMMYT has also set up a tentative regeneration timetable (see figure) that takes into account the distinct planting seasons for each type of germplasm handled by cooperators. Regeneration efforts begun in Mexico, Colombia, and Peru under a previous contract between USDA and North Carolina State University are being continued in this project.

***The project could serve as a model for sharing the burden of preserving germplasm resources through international cooperation.***

According to Dr. Joel Cohen, biotechnology and genetic resources specialist at USAID, the project could serve as a model in which the burden of preserving valuable germplasm resources is shared through international cooperation.

For more information, contact: Dr. Suketoshi Taba, Head, Maize Germplasm Bank, CIMMYT, Lisboa 27, Apdo. Postal 6-641,06600 Mexico D.F., Mexico. FAX: (52-595)41069.

*Researchfor this article was provided by G. Michael Listman, a science writer and editor with the CIMMYT Maize Program.*



# William Lacy Brown 1913 - 1991

## *Scientist, Executive, & Mentor: He Left a Lasting Legacy To Global Agriculture*

**BY ISABEL SHIPLEY CUNNINGHAM**

WILLIAM LACY BROWN accomplished enough in one lifetime to fill three successful careers. As a plant breeder and geneticist, he helped develop improved strains of maize that have fed hungry peole throughout the world, led key research efforts in maize genetics and evolution, and directed global research programs in other major crops . As President and Chief Executive Officer (CEO) of Pioneer Hi-Bred, Inc., he enlarged the company's research facilities and led an international expansion that made Pioneer the world leader in the production of corn. Later, Brown energetically led and served the entire profession of global agricultural science. He was one of the first to sound the alarm over the implications of the rapid loss of crop genetic resources, tirelessly supporting public and private efforts to collect, preserve, use, and share economically important plant germplasm.

To understand Brown's professional accomplishments, however, is to appreciate only a part of his stature. Despite an intense schedule, he devoted time to his family, the Society of Friends (Quakers), his community, and countless helping relationships with others. His colleagues describe him as a unique person - kind, modest, unselfish, thoughtful, and generous, but also firm, strong-willed direct, and, when necessary, tou h. Tributes that came from around the world followingh is death on March 8,199l clearly revealed that he had profoundly influenced many lives and inspired those who knew him as a colleague, advisor, and friend.

### The Making of a Scientist

BORN JULY 16,1913, AT ARBORDALE, WEST VIRGINIA, BILL BROWN grew up on an 80-acre farm in the Allegheny Mountains, an isolated place later chosen to become the site of the National Radio Astronomy Center. Today, a small telescope marks the spot where the Brown home once stood. While a strong work ethic was instilled in Bill as a youth, friends remember that he found time for solitary recreation, hunting, trapping, fishing, and swimming in the creek - when he was not herding sheep, caring for horses, gardening, or planting and harvesting corn, oats, and buckwheat.

A biology teacher who boarded at the Brown's home awakened Bill's interest in botany when he was a student at Green Bank High School. Natural science wasn't his only interest - he also participated in basketball, football, and track, remembers Alice Hannah, a classmate and Green Bank cheerleader who later became Brown's special friend and a vital part of his life after they married.

After graduating from high school in 1932, Brown entered Bridgewater College, a small liberal arts school in Virginia. Class president all four years, Brown also played on the college's basketball and football teams and, during his last semester, taught at a local school. In 1936, he received his B.A. in biology. The next year, Walter S. Flory, his botany professor at Bridgewater, encouraged Bill to follow him to Texas A&M University, where he did graduate work under the Flory's direction. "I have never known a more ethical or con enial person to work with," Flory said recently. Brown liked ed to recall that at this time he also briefly played professional basketball for the Houston Bombers, earning $50 a game.

With Flory's support, Brown transferred to Washington University in St. Louis in 1937 and continued graduate study at the Henry Shaw School of Botany as a Missouri Botanical Garden Fellow. There he studied under the direction of Edgar Anderson, an almost legendary professor who inspired many of his students. He lived in the home of Edgar and his wife Dorothy and considered them his second parents. It was the Andersons who introduced Brown to Quaker philosophy, which was to influence him deeply throughout his life.

For three years, Anderson and Brown collaborated on

*Brown was one of the first to sound the alarm over the implications of the rapid loss of crop genetic resources.*

a study of lawn grasses, particularly species of Kentucky blue- grass, for the Central Missouri area. Anderson also included Brown in his landmark study of the origins of maize. In 1940, Brown received his M.A. degree in cytogenetics and taxonomy from Washington University. Two years later, he completed his doctoral thesis, "Cytogenetics of *Poa Praetensis*" (Kentucky blue-grass), and received his Ph.D. degree in cytogenetics *in absentia*.

PORTRAIT FROM A UNIQUE COMPANY: Brown (left) with Edda G. Sehgal [center]. and Pioneer Hi-Bred founder and Vice President Henry A. Wallace in 1964. (photo courtesy Suri Sehgal)

In 1941, Brown's expertise in grasses led to his employment in the U.S. Department of Agriculture's (USDA) Forage Crops Division in Washington, D.C. As a USDA scientist, he traveled throughout the United States, developing special grasses for airstrips, which were of major im portance as World War II began. He also continued his long correspondence with Alice Hannah, his friend from Green Bank High who had spent three years teaching the children of missionaries in what was then the Belgian Congo. In 1941, six weeks after she returned from Africa, the couple married.

At the time, Brown found the Washington bureaucracy and limitations on his research uncongenial. Though he later would become a major figure in the scientific community of the U.S. capital, his frustration with bureaucracy - that he felt so greatly impeded progress-would always remain. In 1943, he eagerly accepted an opportunity to direct a sweet corn breeding program for Rogers Brothers Seed Company in Olivia, Minnesota. During the three years he spent working for the small seed company he gained valuable experience for the next step in his career.

**Unique Men Forge a Unique Company**

IN 1926, HENRY A. WALLACE - WHOSE LATER POLITICAL CAREER included stints as Secretary of Agriculture, Secretary of Commerce, Vice President under Franklin D. Roosevelt, and independent candidate for President - founded Pioneer Hi-Bred Corn Company (now Pioneer Hi-Bred International). When Wallace moved to Washington to become Secretary of Agriculture in 1933, Raymond Baker became research director of the Des Moines, Iowa-based company, and began a policy of recruiting promising young plant scientists to do research. Recommended by Edgar Anderson, Bill Brown became the first of many Ph.D.s whom Baker hired. He joined the company in 1945, beginning a 39-year association that helped position Pioneer as the premier private seed company in the world.

From the beginning, Pioneer was a unique company motivated by a sense of public service and a willingness to venture, Jean Wallace Douglas, daughter of the founder, recalls. "My father and Raymond Baker insisted on following through when they made a commitment," says Douglas. "Their aim was not to make money instantly, but to build for the future." She believes that Baker - and later, Brown - mirrored her father's policy of "taking a long look." Simon Cassidy, Pioneer's former Treasurer, remembers that Baker's intention was to recruit Brown to do "impractical research" -to explore possibilities that would not necessarily increase profits. In later years, Brown passed on the tradition, with usually profitable results.

Though Pioneer was uncertain about the best use of their first Ph.D., Brown was expected to do "fundamental studies" of chromosome-knob composition of important corn lines in the Pioneer breeding program. He worked ten hours a day with a half-day on Saturday. Donald Duvick, who retired as Pioneer's Senior Vice President of Research in 1990, said that this early chromosome identification work was of great importance in helping scientists understand the characteristics of and relationships between different types of corn.

**Way of Life Reflected Quaker Philosophy**

SOON AFTER THE BROWNS SETTLED IN JOHNSTON, IOWA, THEY joined the Society of Friends. "The foundation of his character and life stemmed from a vital faith," remembers Alice Brown. "It was nurtured at home during his youth and grew as he embraced the simplicity of the Society of Friends. He enjoyed the hour of silence in Meeting and rarely missed attending. The emphasis on simplicity, integrity, service, and worth of the individual was reflected in his way of life." Beside being active in Meeting, Brown worked locally with the American Friends Service Committee and contributed much time and energy to building the Des Moines Valley Friends Meeting House.

From the beginning, the young scientist concentrated on the collection and conservation of exotic maize germplasm. He traveled throughout the southern United States and the Caribbean during his early years at Pioneer in an effort to collect and save farmer varieties before they disappeared (especially in the U.S.). He also looked for potential sources of superior germplasm for U.S. maize production.

Wayne Skidmore, who preceded Brown as Pioneer's president and CEO, believes that an important element in Brown's success was his skill in selecting higher-yielding plants. "His interest in superior germplasm, pursued throughout his life," Skidmore said, "not only resulted in the company's development of many outstanding hybrids that increased corn production in this country and abroad, but also was to have profound effects on global germplasm policy."

Brown's study of corn varieties grown in the southern United States evolved into an experimental program carried out in the summer of 1947 on the property of the Missouri Botanical Garden. To carry out the program, the Browns and their two small children moved to the Garden's grounds, living in a remodeled barn without water or electricity. Alice cooked meals over an open fire, the family carried cooking and drinking water from a nearby spring, and bathed and did laundry in the Merrimac River.

After a few years devoted to the cytogenetics of corn in the growing Pioneer collection, Brown began to participate in Pioneer's corn breeding program with Raymond Baker as his mentor. They worked together in the field,

*From the beginning Pioneer was a unique company motivated by a sense of public service and a willingness to venture*

visited other experiment stations and kept abreast of developments in plant breeding. At the same time, Brown continued his collaboration with Edgar Anderson, studying the evolutionary development of maize, using the corn he had collected during his early years with Pioneer.

Anderson and Brown published their landmark studies, *The Northern Flint Corns* and *The Southern Dent Corns* in 1947 and 1948. Collaboration with Anderson, Roy Tuchurvena, and others resulted in a study of Hopi maize in 1952. During the same period-while he was handling a full-scale breeding program - Brown regularly wrote articles for scientific journals about the origin, evolution, and classification of maize and maize breeding techniques, evidence of his dedication to his work.

Through their association with Pioneer, Brown and Henry Wallace became friends, sharing not only their interest in hybrid corn, but also in hybridizing strawberries and gladiolus. Their collaborative work led to the first publication of *Corn and Its Early Fathers* in 1956. In a revised edition published in 1988, Brown credits Wallace, more than any other individual, with introducing hybrid corn to the American farmer. "Brown believed the expansive growth in the use of hybrid corn was the first of the 'green revolutions,"' a reviewer of the 1988 edition wrote in DIVERSITY, "perhaps of greater influence on world food production than that of the highly publicized Mexican wheats and Philippine rices." *(see DIVERSITY, Vo1.5, no.4, pp.38-39.)*

As the interests he shared with Henry Wallace reveal, Brown enjoyed spending his leisure with plants of all kinds. He eventually filled four acres with unusual trees like the bald cypress, flowers of many kinds, and extensive vegetable gardens. He liked to experiment with new varieties, especially foods that others were not growing at that time and place - "new crops" such as okra, soybeans, and kohlrabi. Tennis was his other leisure activity, and the sport became a permanent part of his schedule as long as he was able to play. Wayne Skidmore recalls that tennis transformed Brown. "He was a gentle person until you got him on that tennis court. Then he'd try to beat the heck out of you."

**Taking An international Perspective**

BROWN'S FIRST ASSOCIATION WITH THE NATIONAL ACADEMY OF Sciences came in 1952, when he was asked to serve on the National Research Council-National Academy of Science (NRC-NAS) Committee on the Preservation of Indigenous Strains of Maize, a relationship that would have far-reaching results. The committee was largely responsible for overseeing the collection, classification, and preservation of maize germplasm in the Western Hemisphere.

In 1952-53, after helping to classify the NAS maize collection from Bolivia and Chile, Brown received a Fulbright research grant to study the primitive varieties of maize he had collected in the Caribbean. These varieties were being grown at the Imperial College of Tropical Agriculture (now the University of the West Indies) in Trinidad. Brown's research eventually resulted in improved maize varieties for the southern United States and warm regions elsewhere. His *Maize of the West Indies* was first published in 1953 and revised in 1960 for publication by the National Academy of Sciences (Publication 792). Maize expert Garrison Wilkes of the University of Massachusetts comments, "Useful germplasm from that collection can now be found introgressed in a number of successful commercial lines."

Like many of those who chose to work in global agriculture, Brown traveled throughout the world, collecting adventures and many friends along the way. On a trip to Eastern Europe in 1957, for example, Brown found himself in the midst of the Hungarian Revolution. After ten days of uncertainty, his family finally heard that he had managed to reach the Netherlands where Van der Have, a firm that worked cooperatively with Pioneer, offered him refuge. The Browns reciprocated later, when Adriaan Van der Have attended Iowa State University and became their "second son."

*Brown "had a sense of social responsibility that seemed to be bred into him,"*

**Community and Corporate Leader**

BROWN ADDED ADMINISTRATIVE DUTIES TO THE JOB OF MAINTAINing active research programs when Pioneer named him Assistant Director of Research in 1958. Donald Duvick recalls that Brown gave Pioneer a sense of the importance of basic biological research to crop breeding. "And," Duvick said, "he caused an awareness of the company's social and ecological responsibilities. He had a sense of social responsibility that seemed to be bred into him."

During the same period, Brown persuaded Pioneer to establish a tropical corn breeding station in Jamaica. After this first foreign investment proved successful, Pioneer established breeding stations elsewhere in Latin America and eventually throughout the world.

During the early 196Os, Brown frequently found time to visit the International Maize and Wheat Improvement Center (CIMMYT) in Mexico. Suri Sehgal, a protege of Brown's who later became Vice President of Pioneer and President of Pioneer Overseas Corporation, calls Brown's contribution to maize improvement in Latin America "dramatic and inestimable" *(see DIVERSITY, Vo1.7, Nos.1 and 2, pp.43-44).*

Despite growing corporate responsibilities, Brown continued to serve his community. When he was elected to two terms on the Johnston Board of Education, 1958-1964, he chaired a committee that pushed for improvement of the curriculum by increasing offerings in math and foreign languages and introducing wrestling as a competitive high school sport.

Appointed to the Johnston Planning and Zoning Commission in 1959, he served for ten years. He was a powerful force in putting together a master plan for growth and development that included as much green space as possible and protected the natural floodplain. In appreciation of his service over many years, the city of Johnston named him Citizen of the Year in 1990.

Brown continued his transition from scientist to corporate executive when he became Pioneer's Vice President and Director of Corporate Research in 1965. He expanded the company's research programs, directing and coordinating breeding programs in maize, sorghum, soybeans, alfalfa, and wheat. Traveling extensively, he visited Pioneer breeding stations, government institutions, and universities engaged in plant breeding research in the United States and throughout the world, always advising, counseling, and encouraging young researchers.

In his tribute to William Brown in the *Congressional Record* on March 14,1991, Senator Tom Harkin, Democrat of Iowa, said that the early corn varieties released by Pioneer during Brown's years as scientific director "set the genetic stage for the explosion that has occurred in Iowa's agricultural productivity over the last three decades."

Recognition of Brown's growing accomplishments in world agriculture led to many opportunities for public service: The President's Science Advisory Committee on World Food Supply, Subpanel One, 1966-1968; the Governing Board, Agricultural Research Institute, 1967-1969;

Advisor to the Joint USDA-State Agriculture Experiment Station (SAES) Task Force on Corn and Grain Sorg hum Research, 1968; Chairperson, The Rockefeller Found ation Maize Germplasm Committee, 1969-1972; and the NAS Committee on Vulnerability of Major Food Crops, 1973.

*Many believe Brown's outstanding success as an administrator derived from his ideas about individual initiative.*

**A Dedicated Mentor Maintains Close Academic Ties**

WHILE OCCUPIED WITH THE RESPONSIBILITIES OF A LEADING EXecutive of an international corporation, Brown still maintained a close relationship with the academic world and published extensively. At Washington University in St. Louis, Missouri, he served as Extramural Professor of Botany, advising graduate students who were working with maize and maize relatives from 1957 until 1974.

He also served as Adjunct Professor at North Carolina State University (NCSU) and Western Carolina University. And he continued to author and co-author many books and technical papers and lecture at universities in the United States and abroad, notably at symposia in India, the Philippines, Guatemala, Mexico, and the former Soviet Union.

Throug hout his career, Brown always supported the efforts of graduate students and researchers. "His influence on shaping my life has been immeasurable and I suspect that he had a similar effect on numerous others," said David Timothy, crop scientist at North Carolina State University. "He willingly shared his genetic, racial, and population stocks of maize with other researchers. Through his influence, Pioneer financially supported numerous projects of university scientists and dozens of graduate student research stipends, usually via formal proposals, but an emergency call to him often saved a research project or enabled a student to continue his education."

**Scientist Takes the Helm, Becomes CEO at Pioneer**

IN 1975, BROWN WAS NAMED President of Pioneer Hi-Bred and President and CEO in 1976. Raymond Baker points out "how rarely a highly-trained theoretical geneticist has the opportunity to run a company like Pioneer." In Baker's opinion, Brown, whose first love was research, "proved that expansion of research programs benefitted the company and led to international growth." Early on, Brown identified the potential that biotechnology had for agriculture, establishing company programs in biotechnology and biochemistry that supported plant breeding.

Many believe Brown's outstanding success as an administrator derived from his ideas about individual initiative. Simon Cassidy, Pioneer's former Treasurer, remembers that "Bill encouraged people to undertake what they wanted to do and gave them an opportunity to pursue their own goals." Brown believed that "structure should not be allowed to overwhelm and stifle individual initiative. New ideas, innovations, and sound judgment are products of the human mind for which there is no organizational substitute. Individual performance must be recognized and adequately rewarded."

"People," Brown stated, "should be allowed to make some mistakes. Those who make no mistakes are most likely those who make no decisions. Those with capacity for continued growth invariably learn from their mistakes." This enduring philosophy guided his relationships with others.

Tom Urban, now Chairman of the Board of Pioneer, believes that Brown "was one of those rare individuals who functioned in research and in business with equal success, using the same management style for both. He was an excellent listener. After listening, he could think through a problem to a course of action. He had confidence in his decisions because he believed in himself."

Brown's management style was an outgrowth of his personal philosophy. Alice Brown says that he never sought recognition or financial gain. "Money didn't mean much to Bill; his motives were humanitarian. He truly liked people at all levels. He would come home from the office late because he and the janitor had been discussing fishing. He was no respecter of status. He recognized quality of mind and spirit and encouraged excellence wherever he found it."

**Doubts About Agriculture's Direction Influence A New Path**

AS BROWN'S STATURE GREW, SO DID HIS DOUBTS ABOUT THE PATH that agriculture was taking. Alice Brown recalls that "he became concerned about environmental problems and began to speak out about issues such as the use of nitrogen to replace crop rotation and the danger that farm chemicals might poison Iowa's water supply."

AN INTERNATIONAL PERSPECTIVE: Brown (right) with Dr. Wilfredo Salthauana at Pioneer Hi-Bred's Homestead, Florida Research Sation.

Charles Benbrook, then-staff director of the congressional House subcommittee that had jurisdiction over agricultural research, remembers that Brown expressed "regret that our tools and technology have become so sophisticated that we sometimes 'miss the forest for the trees.' I think Bill came to realize in the 1960s that the direction U.S. agriculture was heading could have some decidedly negative consequences. In the 1970s he became sure and began to look for professional opportunities to encourage a reassessment of priorities. The diverse range of activities he became involved with reflected his growing concern and willingness to challenge the status quo."

In the mid-1970s, Brown's concern for the genetic vulnerability of crop plants made him a strong advocate of collecting and conserving earths plant ge-

netic resources. Bringing his status in the corporate world to bear on these concerns, he became a member of the U.S. National Plant Germplasm Committee (NPGC) and Chairperson of the Maize Committee of the Rome-based International Board for Plant Genetic Resources (IBPGR).

In 1976, Brown was appointed by President Jimmy Carter to the first U.S. National Plant Genetic Resources Board (NPGRB), and served as its Vice Chairperson until 1982. Since the titular chairman of the NPGRB, the Assistant Secretary of Agriculture for Science and Education, was frequently unable to attend meetings, Brown often chaired this influential body, which recommended policy to the Secretary of Agriculture. Paul Fitzgerald, former chairman of the NPGC, remembers that "Brown, as a representative of the seed industry and a unique spokesperson for both science and agriculture, effectively established the Board and provided creditable linkage between the office of the Secretary of Agriculture and the PGR community."

**Matching Rhetoric With Action**

SENATOR HARKIN RECALLS HOW BROWN SPOKE ELOQUENTLY OF the need for expanded efforts to collect, characterize, and preserve plant germplasm, "the genetic heritage that man depends on most fundamentally for food, renewable fuels, and fiber. And he matched rhetoric with action.... He also argued patiently for increasing government commitment to the preservation of germplasm, a cause he pursued with great effectiveness." In the opinion of Terrey B. Kinny, former USDA Administrator of the Agricultural Research Service, "Bill Brown raised consciousness of germplasm issues on Capitol Hill and put those issues on the national agenda."

While devoting much time to public policy issues, Brown continued to serve Pioneer as Chairman of the Board and CEO from 1979 until 1981 and as Chairman from 1981 until his retirement in 1984. He considered his invitation to become a Member of the National Academy of Sciences in 1980 the most important of the many honors that came to him during this time. These included: Agronomic Science Award, American Society of Agronomy, 1979; Board of Directors, Iowa Academy of Science, 1979; Distinguished Fellow, Iowa Academy of Science, 1980; Distinguished Alumni Award, Bridgewater College, 1980; Member of National Academy of Sciences, 1980; President, Crop Science Society of America, 1982; Distinguished Economic Botanist, Society for Economic Botany, 1982; and Distinguished Alumni Award, Washington University, 1983.

**Charting New Course Through Pioneer Plant Breeding Forums**

THROUGHOUT HIS CAREER, BROWN HAD STRONGLY ADVOCATED increased support for state and federal government research and for closer cooperation between the public and private research sectors. Agricultural leaders still regard as unique his contribution to this cause through a series of Pioneer-sponsored Plant Breeding Forums that began in 1982. The Forums brought together 40 or 50 international experts from universities, experiment stations, government, and industry to identify the most important problems facing plant breeding research and to make recommendations concerning these problems.

Proceedings of the Forums were published and widely circulated among plant breeders, research administrators, and government officials (see *DIVERSITY, no.8, pp.6-7; no.9, pp.4-5;* no.10, *p.5).* They helped focus attention on priorities and needs in the collection and conservation of irreplaceable genetic diversity, funding for plant breeding, and the development of biotechnological research in plant improvement programs. A fourth Forum in 1986 focused on the international aspects of germplasm and the importance of germplasm exchange among nations.

For William A. "Skip" Stiles, Legislative Director of the House Committee on Science, Space, and Technology, the Forums were "the only time during my 16 years on Capitol Hill that anyone brought plant breeding and plant genetic resource issues to Congress in this way. I was astounded that a private company would spend time and money trying to explain these issues to people who considered them obscure. Bill Brown's unique approach to public policy reflected the man and Pioneer's history."

Gordon McCleary, a retired Pioneer executive, believes that the Forums were successful because of Brown's relationships with the participants: "He was able to bring together competing plant breeders from the public and private sectors."

Major M. Goodman of the Crop Science Department at NCSU, a maize expert of international stature who worked under Brown's tutelage during his high school and undergraduate years at Iowa State University, recalls that the Forums "were perhaps the most pleasant and effective plant breeding policy meetings ever held.... Their impact on agricultural research is still being felt. The current work of NAS on Global Genetic Resources and much of the work on the Agricultural Initiative had their beginnings in the Plant Breeding Forums."

"It's also important to remember," Goodman points out, "that the meetings were not dominated by Pioneer; indeed, other organizations (including some of their competitors) often had more re presentation than Pioneer. The spirit of public interest, which Pioneer has often shown, was one of Brown's consistent trademarks."

(To express their appreciation to Brown for this unprecedented opportunity to meet and informally brainstorm with their colleagues, some of the Forum participants-many of whom are now world leaders in their chosen fields - discovered his passion for collecting fine wines and presented him with a rare French vintage. The look of surprise on his face at the discovery of this somewhat secret avocation and his pure delight from this touching show of gratitude is remembered vividly by several Forum participants.

Another telling example of the public interest spirit that Brown brought to Pioneer was a joint effort by the company and USDA that he masterminded to evaluate maize germplasm collections in Latin America. The Latin American Maize Program (LAMP), launched in 1985, was catalyzed by Brown's concern about the future of Latin America's genetic treasures, es pecially maize germplasm. Suri Sehgal called the $1.5 million program, which continues today, "an unprecedented private and public agricultural collaborative effort." (See *DIVERSITY, Vo1.7, Nos.1 and 2, pp.40-44.)*

**In Retirement: Leading the NAS Board on Agriculture**

AFTER BROWN RETIRED AS CHAIRMAN OF THE BOARD OF Pioneer In 1984, he was able to devote more energy to guiding numerous committees, task forces, boards, and causes related to agricultural research and crop improvement. One favorite project, for example, involved restoring a variety of corn grown by a Native American tribe *(see box on the Cherokee flour corn project).*

Kenneth J. Frey, Distinguished Professor of

*"The spirit of public interest, which Pioneer has often shown, was one of Brown's consis tent trademarks."*

Agriculture at Iowa State University who served with Brown on many efforts to forge new initiatives for the fledgling U.S. plant genetic resources program, believes that in retirement Brown "provided leadership and service to the total profession of agricultural science" by increasing public and Congressional awareness of the need to support state and federal plant breeding and germplasm programs.

**Guiding the Board on Agriculture to Prominence**

WILLINGLY SACRIFICING much time from his personal life, at the age of 70 Brown accepted responsibility for a virtually new career as chairman and administrator of the NRC-NAC Board on Agriculture from 1983 until 1988 (see *DIVERSITY, No.8, pp.6-7).* Many consider his role on the Board one of the most important of his many contributions to agricultural policy and research.

Charles Benbrook, who became Executive Director of the Board under Brown, remembers that at the time "discontent was growing throughout the agricultural science community about the inadequate representation of agricultural scientists in the NAS and the lack of vigor in pursuing studies of importance to the agricultural community." The NAS responded by elevating the old board on agriculture to the status of a major unit in 1983. "The appointment of Bill Brown as chairman was of enormous significance," said Benbrook. "Bill guided the Board from dormancy to an influential position. Even more important, he shared his knowledge, wisdom, and style with the Board and its staff, stimulating the capacity and courage to explore volatile issues with a sense of mission."

During his six years as Chairman of the Board on Agriculture, Brown and his colleagues produced a series of influential reports that, Sen. Harkin believes, "have already proved far-reaching in their impact. These reports address the necessity of, and methods for, preserving plant genetic resources; the tremendous opportunities to advance the productivity and sustainability of agriculture through biotechnology; options to improve the effectiveness of soil and water conservation systems and policies; the need for a more rational, scientific approach to the regulation of pesticides; and the agricultural research and educational needs of the nation."

Brown's vision and leadership established the Board on Agriculture as a respected voice within the NAS and the agricultural community. Robert M. Goodman, a member of the Board, recalls that Brown set the tone and the agenda. "In his quiet, thoughtful, and compelling way, he drew into consideration a rich knowledge of the world as it is, and a profound vision of the world as it ought to be.... He brought out the best in everyone around him, and set an example of uncommon kindliness and caring."

Benbrook believes that Brown was extraordinarily effective because of his long-range view of issues and because he knew when to be modest and gentle and when to be firm and tough. "He was one of the kindest, most thoughtful people I have ever met; yet he was willing to take a stand and challenge powerful individuals." Benbrook emphasizes that "Bill believed deeply that science and knowledge can best serve mankind when unencumbered by ideology and politics. Our studies made under Bill's leadership reflect this orientation."

On Brown's recommendation, in 1984 the Board began what was to become a seminal study of the productivity and sustainability of American agriculture and the role of alternative farming systems. Sen. Harkin believes Brown helped to show that "the fundamental concepts behind sustainable agriculture were not only sound, but essential to effectively address food safety and environmental concerns, while continuing to move ahead in pursuit of increasingly productive farming systems."

Both Harkin and Benbrook believe Brown's increasing appreciation for sustainable agriculture came as a result of observations he made during a trip to the People's Republic of China. Benbrook recalls that Brown believed that some Chinese agricultural practices were "more solidly rooted in an appreciation, if not understanding, of ecology than many practices commonly encountered in Iowa." Harkin recalls that Brown expressed "sincere re-

## A Labor of Love: The Cherokee Flour Corn Project

THE EASING OF CORPORATE RESPONSIBILITIES IN THE EARLY 1980s allowed Brown to spend more time on a favorite endeavor: the Cherokee flour corn project he had begun while still associated with Pioneer.

The Wallace Genetic Foundation awarded a grant in 1982 to Brown, who was a visiting professor at West Carolina University (WCU), and the late H.F. "Cotton" Robinson, chancellor at WCU and a geneticist of international reputation. They undertook a two-year effort to free the maize grown for centuries by the Cherokees — a Native American tribe of the Southeast United States — from the effects of out-crossing with other corn and to return pure seed to Cherokee farmers.

Brown had collected seed and begun his study of the unique qualities of the ancient Cherokee flour corn in the 1940s, but his growing responsibilities at Pioneer postponed this cherished project. He believed that Cherokee corn originated from a strain of primitive corn that grew in northwestern Mexico and had somehow moved to North Carolina without leaving any trace along its path.

Since some Cherokee farmers were still growing this historic maize in 1981 and no one else had taken an interest in it, he decided to try to save it before it disappeared forever. In 1982 he collected seed from Cherokee farmers again and planted a field near Robinson's home. From the yield, they selected seed ears for planting that had the characteristics of the original maize. A Wallace Foundation grant in 1984 provided for a three-year continuation of the project.

Each year the purest seed was selected until, in 1988, the Cherokee farmers received white, smooth, flour kernel seed. One goal of the project was to provide a source of cornmeal with the special qualities of the flour corn for the Cherokees to use in their homes and to sell as a commercial enterprise. After testing the cornmeal for making spoon bread, pancakes, etc., in their kitchen, the Browns distributed recipes and samples of the meal in a specially designed bag. The Cherokees Boys Club began to sell the meal in 1989.

Enough seed was available in 1990 to enable the Cherokees to plant one hundred acres of the corn that these native Americans value as part of their agricultural heritage. Brown delighted in the time he could spare from pressing responsibilities to work in the fields with his friend "Cotton" and participate in preserving this unique species. *(See DIVERSITY, No.10, p.2, for gift of Cherokee corn to P.R.C.)*

*"Bill believed deeply that science and knowledge can best serve mankind when unencumbered by ideology and politics," said Charles Benbrook, who served under Brown at the Board on Agriculture.*

spect for the biological and ecological sophistication of many of China's traditional farming methods.... He sometimes challenged farm audiences to match the amazing accomplishments of Chinese farmers, who have sustained high levels of crop yields for over 2,000 years."

The NAS study led in 1989 to the release of *Alternative Agriculture,* one of the most influential and controversial agricultural reports ever published. Harkin commented that, "in addition to challenging an entire industry to reassess many of its fundamental tenets, the report provided critical guidelines to the Congress as we were drafting the 1990 farm bill."

One of Brown's most lasting legacies to the conservation of genetic resources throughout the world, Suri Sehgal recently observed, is certain to be the soon-to-be-completed global germplasm study-Managing Global *Genetic Resources:Agricultural imperatives* - that he helped launch in 1986, soon after becoming the Chairman of the Board on Agriculture *(see DIVERSITY, no.8, p.6).*

"His personal involvement in and commitment to this study of global genetic resources conservation," said Sehgal, "attracted the considerable efforts of many of the world's leading germplasm authorities in what the international agricultural community expects will be a landmark study effecting global germplasm conservation efforts for decades to come."

Brown's contributions to the Board on Agriculture were of lasting value, said Frank Press, NAS President: "Through his selfless commitment, Bill Brown set the measure and standard for the future work of the Board...." An NAS staff letter to Brown's family following his death emphasized this aspect of his service: "Brown's influence will continue because NAS and NRC are deeply, substantively, and constructively involved with critical current agricultural and technological issues of the day. He positioned the Board to address the important agricultural issues of the 1990s and to influence agricultural science and policy."

**Fostering DIVERSITY**

AWARE OF THE NEED FOR A MECHANISM TO LINK plant genetic resource professionals throughout the world, Brown was also dedicated to establishing a news journal that would foster international dialogue and cooperation in the conservation and use of humanity's plant genetic heritage. He shared this aspiration with many leaders in the agricultural world, and their joint efforts led to the publication of the first issue of the quarterly journal DIVERSITY in 1982.

Three years later, Brown organized the non-profit Genetics Resources Communication Systems, Inc. (GRCS) to publish the journal. He served as President of the Board of Directors of GRCS until he became President Emeritus in 1988. His friends and family recall the great pleasure he expressed when, in 1990, DIVERSITY was honored with the Soviet Union's N.I. Vavilov Medal for contributions to the preservation of global genetic resources.

Brown continued to garner honors throughout his "retirement." At the 1986 meeting of the Crop Science Society of America, he became the first to receive the Genetics and Plant Breeding Award for Industry, sponsored by the National Council of Commercial Plant Breeders for geneticists working in the private sector. His citation specified his "contributions to agriculture as an internationally renowned researcher and authority in cytogenetics, evolutionary botany, and plant breeding" and his "service, support, and expertise in the collection, classification, and use of exotic germplasm in preserving the germplasm base for maize." That year, Brown also received the Henry Shaw Medal from the Missouri Botanical Garden. Honorary Doctor of Science degrees came from Drake University in 1987 and West Virginia University in 1988.

The National Plant Germplasm Committee recognized Brown's contributions to the international genetic resources community in a resolution passed April 18,1990. The following week, Clayton Yeutter, then U.S. Secretary of Agriculture, awarded Brown a Certificate of Appreciation from the USDA for his "contributions to U.S. agriculture, the worldwide plant genetic resources community, and humankind" (see *DIVERSITY, Vo1.6, no.2, p.27).*

A few months later, the Resources Development Foundation (RDF) awarded the first William L. Brown Fellowship to Idah Sithole of Zimbabwe *(see DIVERSITY, Vol.6,* Nos.3&4, *p.46).* This fellowship, established by RDF with a gift from Alice Brown, provides training for outstanding biotechnologists from developing countries. According to the director, Thomas Wahman, RDF's goal is to assist talented people who are willing to focus their scientific training on a particular food-deficit region of the world, providing 'human linkage' for making technical transfer possible." Wahman believes a program "that fosters scientific goodwill and leadership in the public interest" is truly appropriate recognition of Brown.

**Family Shared Him With The World**

BROWN'S ACTIVITIES WERE LIMITED DURING THE LAST TWO YEARS of his life as he battled deteriorating health. As always, his wife Alice was his constant and devoted companion. He died at age 77 at his home in Johnston, Iowa, on March 8, 1991. In addition to his wife, two sisters, and a brother, he is survived by his son, William T. Brown; a daug hter, Alicia Brown-Matthes; and two granddaughters. Al1 had shared him with the world, without fully realizing his international stature-until his death, when hundreds of tributes poured in from North and South America, Europe, Asia, and Africa.

The unanticipated deluge of letters that William Brown's family received from throughout the world at this time paid tribute to his special qualities. These examples from colleagues with Pioneer Overseas Corporation are typical: From Bucharest, Romania: "We respected him and loved him like our father. His image will last in our memory until the end of our life." From Cairo, Egypt: "His principles, ethics, ideals, and inspiration will remain the source of our business activities..." From Manila, Philippines: "It is like losing a father. Without him we would not be what we are now. "From Szeged, Hungary: "He fully succeeded in his mission which was evident in every deed of his: to help people...."

Many people expressed their appreciation of Brown's genuine concern for others. T.T. Chang of the International Rice Research Institute praised Pioneer as a privately owned but public-minded company, "leading other agro-industrial giants because of Bill's concern for his fellowman. The world is indebted to his kindness and vision." Speaking for the disadvantaged, Mowe Mamadou of the African Groundnut Council, Lagos, Nigeria, wrote, "Bill Brown's contribution to the solution of the global food problem generally

*"His leadership helped awaken the agricultural and policy community in the U.S. to the growing importance of molecular genetics and biotechnology," said Frank Press, president of the National Academy of Sciences.*

and the peasantry of Africa in particular will remain a milestone in the race against hunger and poverty for a long time to come."

"Bill's legacy to agriculture is special," wrote Frank Press, President of National Academy of Sciences. Because Brown earned "respect from both the laboratory scientist and the pragmatic agriculturist, and through his strong vision of the importance of scientific and technical development to agriculture, Bill communicated the excitement and benefits of molecular genetics to plant breeders and agriculturists while cautioning genetic engineers about the enormous practical hurdles separating their speculations from real-world app lication.... His leadership helped awaken the agricultural and policy community in the United States to the growing importance of molecular genetics and biotechnology.... He ranks among the most distinguished contributing members of the National Academy of Sciences."

Many of Brown's friends and colleagues attended services held in Iowa, and a special memorial service held at the Friends Meeting of Washington on April 28,199l.

In a tribute that eloquently captures what made this seemingly simple man so special, Wilnmer Tjossem of the American Friends Service Committee wrote in a tribute: "While Bill's unique accomplishments in science and business are matters of record and will remain in those annals forever, what must also be cherished are his gifts of kindness, loyalty, and caring, and a quiet spirituality that, I believe, enabled him confidently to transcend so much that is woefully ordinary in life."

**About the Author**

ISABEL SHIPLEY CUNNINGHAM writes and lectures on a variety of subjects, including plant exploration. She is the author of *Frank N. Meyer: Plant Hunter in Asia,* Iowa State University Press, 1984, and is a regular contributor to DIVERSITY.

# William L. Brown

*With the generosity and thoughtfulness that have characterized the Browns always, the family chose to affirm Bill Brown's devotion to the sustainable use and conservation of plant genetic resources by establishing the William L. Brown Memorial Fund. The Fund helps to support DIVERSITY's non-profit publisher, Genetic Resources Communication Systems, Inc., which Dr. Brown co-*founded *in the early 1980s.*

AS **A SCIENTIST:** Brown directed research that led to the development of many outstanding maize hybrids and a greater understanding of the evolutionary development of maize as a crop; he supported public and private efforts to collect, describe, preserve, and share maize germplasm. "Bill Brown was a student of maize in the truest sense of the word," according to David Timothy. "He made significant contributions in original research and the application of research results or basic genetic principles to plant breeding."

AS A BUSINESSMAN: Brown rose to the top of a major corporation and guided its growth until it became one of the world's largest producers and distributors of hybrid seed corn. "Dr. Brown's 40-year career with Pioneer," Suri Sehgal says, "resulted in the organization and development of a dynamic, fast-growing, international company that is an undisputed global leader in the seed business today."

AS AN ADVOCATE FOR PLANT GENETIC RESOURCES: One of Brown's goals was to stimulate worldwide collection and preservation of folk varieties and wild seeds of crops for use in the future in combating various threats to the world's food supply. "Bill Brown stood tall among ordinary people in the plant germplasm movement in the United States," recalls Paul Fitzgerald, former Chairman of the NPGC. "He was the mover and shaker of the 1970s and early 80s. During the past fifteen years, no other person brought more positive visibility to germplasm and its importance to our future."

AS SUPPORTER OF ALTERNATIVE AGRICULTURE: Another of Brown's primary interests during the last two decades of his life was fostering alternative agriculture. "For years to come, Bill Brown's vision of the path toward sustainable, productive, and just agricultural systems will continue guiding and challenging individual scientists and research institutions worldwide." (NRC-NAS Board of Agriculture Staff letter, March 13, 1991)

AS A PUBLIC SERVANT: Brown devoted much of his life to public service - to his community, to his country, and to the world. David Timothy points out that "he gave service, guidance, and direction to many committees, task forces, boards, and causes dealing with agricultural science in general and maize in particular. He often bridged the gap between the corporate world, the academic world, and the world of science."

"Perhaps what is hard for anyone to quantify in terms of Bill's contributions," Orville G. Bentley, former Secretary of Agriculture for Science and Education, wrote, "was the experience, the wisdom, and the guidance he provided."

AS A HUMAN BEING: Bill Brown's greatness rests not entirely on what he did but on who he was - an exceptional man who develo ped scores of special relationships with others. "Throughout his career," Charles Benbrook recalls, "Bill nurtured people and ideas. He has encouraged growth, regardless of the direction, and placed his energies behind what he believed in."

# DNA Bank-Net To Use DNA Technology to Save Endangered Germplasm

*by Robert P. Adams*

DNA Bank-Net, an association of institutions dedicated to preserving DNA and using *in vitro* cryopreservation of plant cells, been has established to capitalize on recent technological advances in DNA extraction and immobilization to help prevent the loss of significant plant genetic resources throughout the world.

DNA Bank-Net's first organizational meeting - held April 16-18, 1991 in the United Kingdom at the Royal Botanic Gardens, Kew, London - was attended by 18 invited representatives. Since that meeting, over 40 institutions from 25 nations have expressed interest in DNA Bank-Net.

At the London meeting, a task force defined the functions and recommended the minimum staffing and equipment required for DNA Bank-Net's two basic types of institutional nodes: "working," or DNA dispensing nodes; and "reserve," or base nodes (see box). It is likely that some working nodes would actively acquire and/or dispense DNA from one geographic area (Africa, for example) while maintaining separate cryovats that function as a reserve node for another area (South America, for example).

A recent experience in China suggests that a third kind of node will be defined. Its function would be to acquire plant material and store desiccated (dried) materials in liquid nitrogen. This type of node, which may be called a "regional working node," may not have on site expertise in molecular biology. But it would be able to fill a gap between the centralized molecular laboratories and the strictly reserve nodes. In fact, the regional working nodes may be the primary groups that intensively collect floristic elements in a geographic region. For example, Northwest Normal University in Lanzhou already has responsibility for training teachers in northwestern China. It is likely that they will be given the responsibility for collecting endangered plant materials from the region.

### Node Requirements

The London meeting produced a number of general recommendations for establishing and operating DNA Bank-Net nodes:

- DNA should be extracted from cryopreserved DNA-rich materials only when the DNA is needed. Delaying extraction has the advantage of letting technology catch up, so advanced techniques can be used as they become available.
- Generally, working nodes should be an existing organization with adequate biochemical expertise and have an associated herbarium. An on-site herbarium is not required, but a very close, local association with a recognized herbarium is required.
- Working and reserve nodes need a strong institutional commitment so that the collection can be maintained in perpetuity, not just for the lifetime of one committed person.
- In determining the feasibility of establishing a node, consideration should be given to the availability of dependable electricity and liquid nitrogen.

Participants also expressed considerable interest in the concept of storing composite DNA samples - for example, a DNA composite of DNA from all legumes in a region - to be used for screening or retrieval of unusual genes.

*Dr. Robert P. Adams is the director of the Plant Biotechnology Center and DNA Bank-Net at Baylor University, Waco, Texas.*

#### Recommendations For Working & Reserve Nodes

**Working Node Functions:**

- Collect plant materials. (This may be the primary function of a node or be undertaken in association with another organization, such as a university or botanic garden.)
- Extract DNA.
- Prepare DNA-rich materials and/or extracted DNA in liquid nitrogen for long-term preservation.
- Perform DNA analysis/gene replication.
- Distribute DNA (genes, gene segments, oligonucleotides, etc.).

**Staff:** Taxonomists/collectors, biochemists/molecular biologists, technicians, and administrators.

**Equipment:** Storage facilities (liquid nitrogen, cryovats); extraction facilities (centrifuges, gel electrophoresis, UV spectrophotometer, etc.); DNA analysis and PCR duplication equipment (PCR thermal cycler, micro-centrifuges, etc.); distribution systems (packaging and mailing supplies); and computers (database for inventory and correspondence).

**Reserve Node Functions:**

- Long term DNA preservation in liquid nitrogen and monitoring potential DNA degradation.
- Act as a reserve buffer for working nodes.
- Replenish DNA if a working node experiences catastrophic loss.
- DNA collections stored at the reserve nodes should be split initially into at least two or three samples: one should be stored at a working node; the others at back-up reserve nodes. The reserve nodes should be in different countries and, if possible, on different continents.

**Staff:** Technicians and administrators.

**Equipment:** Storage facilities (liquid nitrogen, cryovats); computer (database for inventory and correspondance.

### The Role of Plant Collectors

The cheapest and most practical way to preserve the largest percentage of plant genes would be to utilize the plant collectors of the world's major herbaria. These professional botanists are regularly in the field collecting and are already familiar with both the vegetation of a region and the techniques of pressing and identifying plants for shipment. With just a few additional steps, these botanists could also field preserve materials for DNA use and create collections of DNA-rich materials - often leaves - with little effort.

Due to the great bulk of material that plant collectors have to process and ship, they require a quick, simple, and trouble-free protocol for the collection of samples for DNA storage. Collectors working in tropical areas, for example, cannot be expected to preserve hundreds or thousands of collections for months under tropical conditions, arrange transport through customs, and keep individual specimens frozen. Fortunately, at least as far as DNA preservation is concerned, interim preservation in silica gel or drierite is an effective way to preserve plant materials in the field and in transit for several months at ambient temperatures.

### Next Meeting Set for April 1993

The second meeting of DNA Bank Net is scheduled for April 5-7, 1993 at the Missouri Botanical Garden in St. Louis. The meeting will focus on a wide range of subjects, including: intellectual property rights and plant materials; gene amplification and utilization; and special workshops on operational problems.

For more information on the meeting, DNA Bank-Net, and proceedings from the first meeting, contact: Dr. Robert P. Adams, DNA Bank-Net, 2747 E. Willow Bend Drive, Sandy, UT 84093, USA; Tel. 801-944-9304; FAX 801-944-93 11.

# New Leadership Takes the Reins of the U.S. Genetic Resources Program

New leadership has taken the reins of the U.S. genetic resources program at a time when world concern over the loss of biological diversity has never been greater and when actions taken by the United States at the recent Earth Summit have put its policies under intense global scrutiny (see stories, pp.4-9).

On June 10, Dr. Duane Acker was sworn in as the new U.S. Assistant Secretary of Agriculture for Science and Education. In that position Dr. Acker will oversee a number of agencies* within the U.S. Deparment of Agriculture (USDA), including those responsible for genetic resources.

The issues surrounding genetic resources were on the minds of members of the U.S. Senate Agriculture Committee when it held confirmation hearings on Dr. Acker and other top level USDA officials in May. The chairman of the Senate Agriculture Committee, Senator Patrick Leahy (D-VT), is a vocal critic of Bush administration agricultural research policies and has questioned U.S. Secretary of Agriculture Edward Madigan extensively about the way that the new U.S. National Genetic Resources Program (NGRP) has evolved since the program was mandated by the Congress as part of the 1990 U.S. Farm Bill (see DIVERSITY,vol.6,no.2,pp.18-21).

## Acker To Make Genetic Resources Program A High Priority

Senator Leahy opened the late May hearing by expressing his "deep concern over the future of USDA", calling it a "dinosaur that must adapt to changes in agriculture that have been obvious for decades." The chairman then used his first opportunity to question Dr. Acker to voice his particular concern over "the narrow genetic base on which U.S. agriculture depends", a situation that was brought home to farmers, he told a packed hearing room, during the "devastating corn blight of the 1970s."

Asked by Leahy what steps he would take as Assistant Secretary "to better conserve and manage genetic resources," Dr. Acker told the Senate panel that he considered genetic resources "exceedingly important" to U.S. and world agriculture and

*Dr. Duane Acker, new U.S. Assistant Secretary of Agriculture for Science and Education.*

that the program would be "an exceedingly high priority item" in his administration.

Dr. Acker referred to his previous positions as director of the U.S. Agency for International Development's (USAID) Food and Agriculture Program and administrator of USDA's Foreign Agricultural Service and Office of International Cooperation and Development (OICD), in explaining his awareness of how important "access and linkages to genetic resources throughout the world" were to U.S. agricultural scientists.

"USDA is most fortunate to have Duane Acker as Assistant Secretary," said Wayne Denney, who as an International Relations Advisor for OICD, has worked extensively with the United Nations Food and Agricultural Organization (FAO) on germplasm issues, "he is held in highest esteem by his colleagues in the Department." Denney made particular note of Dr. Acker's "skill in international diplomacy," which, he said, "coupled with his strong scientific background, made him a very effective advocate of USDA policies at FAO."

Dr. Acker has held other leadership positions that have given him exposure to the germplasm issue, including: his service from 1983 to 1986 on the Board for International Food and Agricultural Development, the directorship of the U.S. Council on Agricultural Science and Technology, and chairmanships of the U.S. Deans of Agriculture and the Agriculture Section of the American Association for the Advancement of Science.

The new Assistant Secretary, a PhD in animal nutrition who was raised on and still maintains interests in an Iowa farm, also served as president of Kansas State University, Dean of Agriculture and experiment station director at South Dakota State University, and chancellor for agriculture and natural resources at the University of Nebraska.

Dr. Acker follows Dr. Charles Hess in the position of USDA Assistant Secretary for Science and Education. Dr. Harry Mussman has been Acting Assistant Secretary since Dr. Hess returned to the University of California-Davis in late 1991. As Assistant Secretary, Dr. Acker will become chairman of the National Genetic Resources Advisory Council for the newly established National Genetic Resources Program (NGRP). The nine-member Council will advise and make recommendations to the Secretary of Agriculture and the Director of the NGRP (see DIVERSITY, vo1.6,no.2,pp.l9-20).

## Bravos Greet Appointment of Henry Shands To Lead U.S. Program

That crucial position was filled recently, and there seems to be nearly complete consensus - a most rare commodity among the U.S. and international genetic resources communities - that no one is better equipped for the complicated task of leading and managing the new U.S. National Genetic Resources Program during these challenging times than Dr. Henry Shands.

Even when the long-awaited and anxiously anticipated announcement of the appointment to serve as the U.S. Department of Agriculture's first Associate Deputy Administrator for Genetic Resources came on May 15, Dr. Shands was typically hard at work in Nairobi, Kenya, where he was serving as part of the U.S. delegation charged with the final round of negotiating what officials hoped would be a Convention on Biological Diversity that the United States would find acceptable to sign at the Rio Earth Summit.

Dr. Shands is one of five new associate deputy administrators** named by Agricultural Research Service (ARS) Administrator R.D. Plowman to lead a newly organized agricultural research program at

* Agricultural Research Service, Cooperative State Research Service, Extension Service, and National Agricultural Library.

the flagship ARS facility in Beltsville, Maryland. He has served in the U.S. Department of Agriculture as the ARS National Program Leader for Germplasm since 1986 and during that time oversaw the increasingly expanding activities and responsibilities of the U.S. National Plant Germplasm System (see DIVERSITY, no.9,pp.8-10). As the Associate Deputy Administrator for Genetic Resources, Dr. Shands will oversee ARS program leaders responsible for plant germplasm and genome activities, animal germplasm and genome activities, microbes, insects, and aquaculture (for overview of program, see DIVERSITY, vo1.6,no.2,pp.18-21).

As the National Program Leader for Germplasm, Shands served as liaison with the key public and private research organizations that are active in plant genetic resources research and policymaking, developing a reputation for remarkably scrupulous and hard work and for being dedicated to the principle of fairness to all of those who work for him and with him.

It is these traits, say many colleagues and observers, that have distinguished his work in the international arena as well, where the issue of genetic resources - and the position the United States holds on it - has been under increasing scrutiny. In addition to his recent participation in the long and arduous negotiations involving the Biodiversity Treaty, Dr. Shands has served as head of the U.S. delegation to the FAO Commission on Plant Genetic Resources, directed the Latin American Maize Project (LAMP), and actively participated in the Keystone International Dialogue on Plant Genetic Resources (seed DIVERSITY, vo1.7, no.3, p.7 and no.15, pp.6-7).

An indication of just how effective Dr. Shands has been in trying to achieve reasonable consensus on sometimes controversial and contentious policy matters is the overwhelming praise and respect he has received from all quarters of the genetic resources community.

### "A Natural" For the Job

"Henry Shands has provided progressive yet balanced approaches to representing the United States in the world arena of plant germplasm preservation", the American Seed Trade Association's Executive Vice President David Lambert told DIVERSITY upon learning of the appointment. Calling him "a natural" to fill the new position, Lambert praised Shands' ef-

** The five new ARS Associate Deputy Administrators who will report to ARS Deputy Administrator Edward Knipling include: Howard Brooks, ADA, Plant Sciences; Wilda Martinez, ADA, Agricultural Products and Human Nutrition; Robert Oltjen, ADA, Animal Sciences; Jan van Schilfgaarde, ADA, Natural Resources Systems; and Henry Shands, ADA, Genetic Resources.

## DR. HENRY SHANDS: Looking Ahead to New Challenges

*In his first interview with DIVERSITY since learning that he was appointed to be the U.S. Department of Agriculture's first Assistant Deputy Administrator for Genetic Resources, Dr. Henry Shands shared some of his initial reactions and views on the new National Genetic Resources Program that he is charged with organizing and directing.*

**U.S. Genetic Resources Program: A Team Effort**

"I am most pleased that the selecting USDA officials have confidence to place the new genetic resources program with me, but make no pretense that the task is one that one person can do alone. It is my hope that in this position I can serve as a catalyst for a unified activity, one that recognizes the individuals who have built an effective system... much like the National Plant Germplasm System that has been strengthened by an outstanding group of scientists pulling together to make it better.

Having spent many years in research*, I try to predict and relate to the difficulties encountered and the needs of each program element. I look for innovative solutions and for managers who clearly and systematically work through the problems to solution. We have many fine managers in the NPGS and I am sure there will be a high level of interest and competency in the new areas identified in the NGRP. I look forward to working with highly motivated individuals who are interested in seeing the program come together and be useful."

**Significance of the New Program In Post-Earth Summit Era**

"The creation of the U.S. National Genetic Resources Program by legislative authority recognizes the activity as one of importance to the Nation. While the value of the program may not be determined for many years, having the genetic material available and having a safety net of resources for food security is essential. I believe that the international — and even the national — controversies today over ownership of genetic resources behooves the Nation to act responsibly with the genetic resources it has acquired and developed. The current heightened interest [from the Earth Summit] coincides nicely with our need to examine our own house and develop the national program appropriately. Continuing our openness of exchange with others will prove to be our best entree to having access to other genetic resources. The NGRP will provide a central focal point for the teamwork required from the many federal agencies responsible for various aspects of U.S. genetic resources and for international interaction."

**Challenges and Goals**

"I think molding a cohesive program with the other life forms included in the NGRP [animals, microbes,insects, and aquaculture] where the involved persons have not thought of themselves as being part of a coordinated national service program [as in the case of the established NPGS] will be a big job.

Determining what will be included in collections will always be a challenge. The issue of what and how to save will always be a difficult one to deal with. Further, the amount of input we can expect from scientists when they are restricted in funds may be a limiting factor.

First, I would like to see the NGRP identify the collection components within the new framework. This will include the Agricultural Research Service, the Animal and Plant Health Inspection Service, the Forest Service, and the participating state and non-government organizations. Second, and parallel to the first effort, will be establishing the database and having their data put into it. In some cases, that would require linkage to another database; in others, the data would reside directly in the NGRP database. Third, in areas where an expanded effort is needed, that effort must be supported by funds to accomplish the activity expected. The result of these concerted activities should make the material both visible and accessible for research and development purposes.

The most difficult task and challenge will be to become proactive in the agricultural sector. As you know, genetic resources support is rarely the highest priority for any user group. By that I mean that genebanks are called upon for unique things, often in a time of crisis. While there may be continuous residual support from many groups that do recognize the safety net genebanks represent, until a crisis occurs, there is little attention. And crises are difficult to manage since they usually involve a sudden need for genetic material that most likely has never been evaluated for the trait needed, i.e. a new disease or insect threat.

Our challenge, then, will be to maintain steady increases in funding to enable the program to build competence. This is crucial if the Nation expects to get its genetic resources house in order."

* Dr. Shands spent 19 years with DeKalb-Pfizer (now DEKALB Plant Genetics) as director and researcher in plant germplasm, plant genetics, and breeding.

fectiveness in leading the NPGS, noting its steady progress throughout his tenure and calling the soon-to-be completed U.S. National Seed Storage Laboratory (NSSL) "the crown jewel of his accomplishments" (see story, p.31).

International seed activist Pat Roy Mooney, who worked with Shands over several years on the Keystone International Dialogues on Plant Genetic Resources, called the appointment "the best thing that's happened to genetic resources in the United States."

### "Nothing But Great News"

Dr. Michael Lesnick, who organized the Keystone Dialogues, said: "The integration of all genetic resources into one program under someone like Henry Shands can be nothing but great news for those who care about plant genetic resources."

Dr. Charles Hess, former Assistant Secretary of Agriculture who chaired the now-defunct U.S. National Plant Genetic Resources Board that advised the Secretary of Agriculture on plant germplasm for more than a decade, believes that Dr. Shands' experience with that Board will provide a necessary continuity to the new National Genetic Resources Program. "He is eminently qualified for this important position," Hess said in an interview.

Said a buoyant Skip Stiles, Legislative Director for the U.S. House Committee on Science, Space, and Technology, who, as top aide to the sponsor of the legislation establishing the NGRP, Rep. George Brown (D-CA), was considered by many to be its chief architect: "Henry Shands is a person of great competence and experience...the sort of individual Congress had in mind when it created the program."

Environmental lobbyist Maureen Hinkle, an Audubon Society agricultural specialist who became an advocate for increased support for the U.S. genetic resources program long before the issue became prominent, said the promotion of Shands "elevates the issue" and brings cause for hope that more support for the program will be forthcoming.

Dr. Michael Strauss, who directed the landmark global study on germplasm for the U.S. Board on Agriculture of the National Research Council/National Academy of Sciences, said, "The appointment - the best possible choice USDA could have made - alleviates much of the concern I have had about the establishment of the new program. The hope now is that Dr. Shands is given the authority to achieve the goals envisaged for this program by the Congress of the United States."

Echoing comments heard from scientists throughout the vast U.S. National Plant Germplasm System - a myriad of research sites, germplasm collections, and sometimes competing interests located throughout the 50 United States - Dr. Steve Eberhart, Director of the NSSL, spoke of the "significant improvements" that have come about as a result of Dr. Shands' "energy, vision, thoroughness, and leadership abilities." Now, Dr. Eberhart told DIVERSITY, "the NPGS is used as a model worldwide as other nations are developing and improving their genetic resources programs."

International Plant Genetic Resources Board Research Director Allison McCusker spoke of Shands ' "wealth of technical knowledge" and his "broad vision for the development of genetic resources both in the United States and abroad."

***"Henry Shands is the sort of individual Congress had in mind when it created the program."***

Wayne Denney of USDA's Office of International Cooperation and Development, having worked closely with Shands in recent years during the heated debates over the FAO Undertaking and Commission on Plant Genetic Resources, described him as an "excellent spokesperson in support of USDA's interests in international plant germplasm issues" who "is able to strike a delicate balance between accommodating the needs of developing countries and protecting U.S. interests."

With that balance growing ever more delicate in the wake of the Rio Earth Summit and with prospects of adequate funding for the new U.S. germplasm program looking bleaker as a nervous election-year Congress continues to look for ways to cut the U.S. budget, Henry Shands may need all of the talents and attributes ascribed to him by his colleagues.. . and then some. - DS

## FDA Issues New Guidelines For Regulating Genetically Engineered Foods

The U.S. Food and Drug Administration (FDA) has released new guidelines for regulating the development and marketing of food products created with agricultural biotechnology techniques. The May 29th guidelines, intended to trim regulation of the genetic engineering industry, are the first rules to be developed under a new federal policy announced in March that aims to reduce federal oversight and spur growth in the biotech industry (see DIVERSITY, vol.5,no.l,p.23).

"FDA's statement is not a rule or regulation, it is a policy paper or notice to those companies who come under FDA regulation," said Richard D. Godown, president of Industrial Biotechnology Association (IBA).

The new FDA policy describes a scientific basis for evaluating and ensuring the safety of new foods produced from genetically engineered plants, including a comprehensive "guidance to industry" intended to help companies conduct their own internal review of new foods.

Some genetically engineered foods will receive greater FDA scrutiny under the guidelines. But FDA officials said companies will be allowed to market new genetically modified foods without seeking government approval if the modifications do not:

- cause major changes involving common food chemicals;
- disrupt concentrations of naturally occurring toxic agents; or
- introduce allergen or change nutrients.

Food producers - who have been uncertain about what regulatory climate awaits the many genetically engineered products under development in their laboratories -have been waiting for almost a decade for the FDA's statement, which was pushed through by the President's Council on Competitiveness, the highly controversial body led by Vice President Dan Quayle that seeks to cut government regulation of industry.

There are no genetically modified foods currently on the market. But industry sources say more than a dozen U.S. companies have developed an estimated 70 distinct genetically engineered crops. The FDA predicts that some of these products will reach consumers within a year.

"The first agricultural product to be affected will be the tomato," said the IBA's Godown. "In three to five years potatoes, melons, cucumbers, and squash will be modified to be disease resistent, and canola oil will be lower in cholesterol and cotton and corn will be made insect resistant."

While industry groups favor FDA's new policy, critics are concerned. "The bottom line is the FDA is not protecting health, they are protecting the industry," said Dr. Margaret Mellon, biotechnology specialist at the National Wildlife Federation, the largest environmental group in the U.S. "This is a complex technology, and we are being asked to ignore the risks."

Dr. Rebecca Goldberg of the Environmental Defense Fund told the Washington *Post* that she believed the FDA policy virtually abandons regulation of new and untested foods. She said that consumers should be made aware that they are buying genetically modified foods through the use of special labels, a policy FDA has so far rejected.

"Genetic engineers are taking genes from bacteria, viruses, and insects and adding them to fruits, grains and vegetables," Goldberg said. "They are producing foods that have never before been eaten by human beings. Without clear and consistent labeling of genetically engineered foods, consumers will have no idea what they are buying."

To address questions surrounding the new guidelines, FDA is planning two public meetings with industry representatives and consumers this summer. For information, contact: Brad Stone, U.S. FDA Press Office, 200 C St., S.W., Washington, D.C. USA; Tel. 202-245-1144.

*Reporting by DIVERSITY intern Erin DeMarines, from the Univ. of South Florida.*

**"International Cooperative Biodiversity Groups," a joint biodiversity and drug development program** sponsored by the National Institutes of Health, the National Institute of Mental Health, the National Science Foundation, and the U.S. Agency for International Development, **seeks preliminary funding applications from interdisciplinary teams of U.S. and developing country academic, nonprofit, and commercial organizations** by September 1,1992. For additional information, contact: Dr. Kenneth Bridbord, Chief, International Studies Branch, Building 31, rm. B2C32, Fogarty International Center, National Institutes of Health, 9000 Rockville Pike, Bethesda, MD 20892. Tel:301-496-2516; FAX 301 402 0779. Contact him also about the briefing session on July 31, 1992.

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**The United States Department of Agriculture (USDA) dedicates the new addition to its flagship genebank, the National Seed Storage Laboratory (NSSL) on August 18.** The $10 million building will assure that the U.S. has state-of-the-art facilities for long-term back-up storage of National Plant Germplasm System (NPGS) acquisitions, as well as for selected crops of the International Board for Plant Genetic Resources (IBPGR) and some of the centers of the Consultative Group on International Agricultural Research (CGIAR). Earlier the USDA dedicated its newly refurbished administrative and National Resources Institute buildings at the Beltsville Agricultural Research Center with a symposium on Agriculture and The Environment. The department also began construction on its National Grapevine Importation and Clean Stock Facility in Davis, California, and continued with plans for building a Crop Biotechnology Center at Texas A&M University. The Center will bring together scientists and crop breeders to focus on the best use of germplasm and on developing molecular tools for crop breeding and by identifying agronomically important genes.

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**Exchange of germplasm and breeding material is included in the 1992-94 Work Plan for collaboration between the Chinese Academy of Agricultural Sciences (CAAS) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).**

CAAS Vice President Dr. Chen Wanjin and ICRISAT Director General Dr. J.G. Ryan signed the agreement, which covers a wide range of activities including: research on groundnut viruses; development of high-yielding confectionery groundnut varieties; introduction of high-yielding, short duration pigeon pea and kabuli chickpea; and training of Chinese scientists at ICRISAT. For additional information, contact: Dr. J.G. Ryan, International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Andhra Pradesh 502 324, India.

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**Scientists at the Institute of Plant Science Research are examining wheat dwarfing genes in order to be prepared if British summers become hotter because of global warming.** Working in collaboration with Hungarian and Yugoslavian colleagues, they are examining semi-dwarfing genes of chromosome 2D derived from a Japanese variety found in the Italian variety Mara. The researchers have discovered that these genes cause the plant to flower early in the summer without needing to be triggered by increasing day length. If wheat is shorter at flowering, it avoids the worst effects of desiccation. (Reported in *Seed Trade News*, May 15, 1992, p.5 .)

**The Missouri Botanical Garden Herbarium has entered its 4,000th plant specimen, *Ancistroclaudus,*** a woody vine that researchers' hope will effectively treat HIV, the virus associated with AIDS. The plant, which may prove to be an undescribed species of the little studied genus, was collected in Cameroon by Missouri Botanical Garden botanists commissioned by the National Cancer Institute for use in its anti-cancer drug recovery program. For additional information, contact: Doug Arnold or Janine Adams, Missouri Botanical Garden, P.O. Box 299, St. Louis, MO 63166-0299 USA. Tel:314-577-5142.

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**The Fiscal Year 1993 U.S. Budget contains a $1.2 million request for plant germplasm,** including funds for acquisition, preservation, characterization, new crops, evaluation, and enhancement. Funds are part of the total USDA Agricultural Research Service (ARS) request of $721.6 million. The entire USDA budget, which must be approved by October 1,1992, is expected to be challenged this election year by lawmakers who nervous about government spending.

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**A new, winter-hardy, multi-foliate variety of alfalfa (DK133) developed by DEKALB Plant Genetics** is resistant to the five major economic alfalfa diseases: anthracnose, bacterial wilt, Fusarium wilt, Phytophthora root rot, and Veriticillium wilt. The Illinois company says that the new variety will meet needs of farmers throughout the northern two-thirds of the United States. For additional information, contact: Rod Everhart, DEKALB Plant Genetics, 3100 Sycamore Road, Dekalb, IL 60115 USA. Tel: 815-756-7333; FAX: 815-758-9390.

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**Crop Science Society of America's Plant Genetic Resources Division (Provisional C-8) is sponsoring a symposium celebrating Christopher Columbus' impact on plant germplasm.** The symposium, to be held at the society's annual meeting in Minneapolis November 1-5 is entitled *1492-1992: 500 Years of Global Germplasm Transfer*. A second symposium will examine *International Cooperation in Germplasm Activities.* For additional information, contact: Prof. James McD. Stewart (C-8 Chair), 115 Plant Science Building, University of Arkansas, Fayetteville, AK 72701 USA. Tel: 501-575-2354; FAX: 501-575-7465.

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**ARS Administrator R. Dean Plowman** told an audience of U.S. National Plant Germplasm System leaders that the large number of USDA germplasm scientists receiving department awards illustrates the fundamental role they play in US agriculture. Among those receiving awards: corn geneticist **Arnel R. Hallauer and Wayne Hanna,** whose pioneering work transferring wild germplasm to cultivated crops has the potential to revolutionize crop production systems world wide. In addition, **other organizations recognized USDA germplasm scientists:** Sigma Xi, the Scientific Research Society, elected **Freddi A. Hammerschlagg** to full membership for her work using tissue culture and gene transfer to improve plants; and the Royal Horticultural Society of England awarded the Gold Veitch Memorial Medal to retired Director of the National Arboretum **John Creech** as "one of the greatest American plant collectors of this century."

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**Richard Schultes, the Harvard University Botanical Museum's noted botanist, received the Annual Linnean Gold Medal.** An ethnobotanist who specializes in the botany of the northwest Amazon and pharmacological plants, Schultes has been awarded the Cross of Boyaca (Colombia's highest honor), the annual Gold Medal of the World Wildlife Fund, and the prestigious Tyler Prize for Environmental Achievement. His latest book, written with R.F.Raffauf, is *Vine of the Soul: Medicine Men of the Colombian Amazon -Their Plants and Rituals*, published by Synargetic Press.

## Crop Advisory Committee Update

The following U.S. Crop Advisory Committee (CAC) activities were recently reported:

**Apple-S.S. Korban, Chair:** The committee received a report on the status of the Plant Genetic Resources Unit-Geneva which includes the national germplasm repository for apples; agreed that it would be beneficial to develop and distribute a *Malus* questionnaire; was informed that a proposal to establish 5 satellite *Malus* germplasm core collections for long term evaluation had been funded by the Agricultural Research Service (ARS); discussed a report indicating that there is currently a total inventory of 3459 accessions and that a total of 1100 virus-free accessions are now in the permanent planting on seedling rootstocks, and that approximately 400 clones have been identified for discarding from the collection; received a report on a trip to China that was to seek collaboration on exploration/exchange and utilization of germplasm; discussed the role of the Animal & Plant Health Inspection Service (APHIS) in developing and enforcing quarantine regulations; received a description of the apple breeding programs in New Zealand and Sweden; discussed the need to identify gaps in the current collection; expressed concern of the reported condition of the Komarov Botanical Institute of St. Petersburg, Russia; and agreed that a new evaluation proposal from the University of Arkansas to screen for disease resistance would be submitted to ARS for possible funding.

**Barley-S. Ulrich (Chair):** The committee received a report that a new computer system was purchased for the Germplasm Resources Information Network (GRIN) which has much greater processing speed and storage space and which should be operational by the spring of 1994; discussed development of a core collection for barley; was informed that a world core collection for barley is being developed by the European Community that will consist of approximately 2000 accessions; was informed that data has been collected on several agronomic and disease descriptors which was incorporated into GRIN; prioritized needs for evaluation including (a) screening the collection for beta glucans and (b) screening the collection for protein and oil content; and received several reports on international activities in barley genetic resources.

**Clover & Special Purpose Legume-K. Quesenberry (Chair):** The committee appointed a sub-committee to study the clover and special purpose legume evaluation data in GRIN in order to update the information; discussed the difficulties that have been encountered in regenerating seed of 2 cross-pollinated annual clover species; discussed the status of developing core collections of berseem, persian, sub, white, alsike and red clovers, trefoil, Aaeschynomene and Melitotus and decided that core collections will be given the highest priority for seed increases; and discussed a report on a plant exploration trip to China.

# From the Grassroots Up: The Conservation of Plant Genetic Resources by Grassroots Organizations - "Latter-Day Noahs" of North America

*by Kevin Dahl and Gary Paul Nabhan*

In numerous discussions of biological diversity, the need to conserve potentially economic genetic resources for future generations is discussed through the allegory of Noah's Ark. According to this model, prior to an impending wave of habitat destruction, Word came down from the Top that a competent Curator should capture Minimal Viable Populations of all Organisms Considered Worthy, and sequester them away in a Genebank for maintenance until further notice that Global Change had subsided. Reflecting this myth, most genetic conservation programs have developed along similar lines as they:

- assume that threats are and will be so massive that genetic resources cannot be saved in their habitats;
- are organized from the top down, i.e., decreed necessary by national governments or international bodies of experts;
- are rescue missions for only those breeding stocks considered worthy (economic) at the time;
- do not address-let alone attempt to reduce-the inevitability of the threats; and
- attempt to capture only the minimal viable populations which may be required to conserve species *ex situ* for an undetermined period of time.

## A Different Set of Assumptions

In contrast, community and grassroots-based efforts are founded on a different set of assumptions than those that affect most institutional genetic resource conservation programs. These assumptions hypothesize that:

- the best place to maintain genetic resources is in their original natural (or anthropogenic) habitat and their indigenous cultural context;
- they are based on community concerns for continued access to seeds and continuity of knowledge between generations, and are not initiated from the top;
- their driving force is the direct use and enjoyment of plants in their present (and evolving) forms, not only for their use in genetic improvement;
- they are as much concerned with reducing threats to the remaining natural resources that allow *in situ* survival, as they are rescuing resources for *ex situ* captive breeding; and
- they are more concerned with functioning field and garden populations than with museum specimens or breeding stock for hybridization.

*Kevin Dahl is Assistant Director, Native Seeds/SEARCH and Gary Paul Nabhan is Associate Director of Research, Native Seeds/SEARCH, Tucson, Arizona.*

The goal of the study this article is based on was to provide a profile of the current status of the grassroots genetic conservation movement in North America. Its rationale, structures, values, and the particular resources it protects, therefore, can be more widely-recognized by policymakers at the national and international levels. This analysis builds on our own experience working in collaboration with several of the key grassroots organizations during the last decade. It also draws upon a written survey (available from the authors) that elicited a flood of information from both grassroots groups and individual activists. We hope that our synthesis will lead to greater understanding and cooperation between grassroots folks and the more formal sector-those governmental agencies, academic institutions, agribusiness corporations and larger conservation programs dealing with genetic conservation issues.

## Resource Diversity and Its Perceived Value

Table 1 categorizes the plant diversity maintained by the 26 grassroots efforts which have responded to our survey. Contrary to the common assumption that these groups are devoted exclusively to domesticated (agricultural) resources, the majority of the groups and individuals demonstrate active involvement with wild plant genetic resources, including species that are not in the gene pools of cultivated crops. It is also clear that their interests extend beyond food crops to medicines, ornamentals, wildflowers and multipurpose cultivars. Their choice of plant resources to steward is largely affected by what can be grown and conserved within their prevailing climatic conditions, and what can be stewarded *in situ* where they are based.

***Their interests extend beyondfood crops to medicines, ornamentals, wildflowers, and multipurpose cultivars.***

*In situ* and *ex situ* conservation have considerable overlap with respect to the efforts of these groups, since they may be doing back-up seed storage for native plants which literally grow on their doorstep. These activists define "plant genetic resources" rather broadly, more broadly perhaps, than the historic focus of the U.S. National Plant Germplasm System (NPGS) and the associated U.S. National Seed Storage Laboratory. Most of these conservationists champion "neglected economic plants" whatever their utility may be, and do not limit utility to raw materials for crop improvement.

The majority of the grassroots efforts manage germplasm from relatively few plant families (5-25); and few plant species (25-100); more than half of them maintain

over 1,000 individual accessions or plant introduction (PI) numbers, each with separate passport data. Although these organizations and individuals possess a relatively small proportion of the global genetic diversity of economic plants, preliminary assessments indicate that they still conserve many kinds of plant materials not currently found in the NPGS.

With regard to the real or anticipated value of these holdings, grassroots organizations mention a wide number of qualities characteristic of their plant germplasm, qualities they feel are no longer represented in commodities commonly found in the marketplace.

Unlike the "objective" rationales banally offered time and again by the formal sector, the grassroots sector cites their more subjective cultural, aesthetic, spiritual, and ethical aspirations for conserving plant resources. Other values associated with this germplasm are ecological, in the sense that plant ecotypes better adapted to particular biotic or abiotic stresses may require fewer consumptive resources (e.g. water, nutrients, energy, etc.) to grow compared to widely-adaptable high-yielding varieties. Additional values refer to their usefulness in contexts other than cash cropping monocultures, i.e. home gardens, field polycultures, or small mixed-crop farms.

### Perceived Threats to Plant Genetic Resources

Threats to plant genetic resources vary in their specificity, their intensity, and their duration. Remaining populations of a rare crop ecotype may succumb to a local (stochastic) drought of three months duration, or may decline along with long-term global warming. It may be devastated by the accidental introduction of an exotic pest to a region where the crop had never previously developed insect resistance, or it may be legally outlawed as a "weed" by ill-informed state or national governments. All the crops in one cultural community may lose their habitat to a reservoir inundating traditional fields; or all varieties of a single crop may be globally affected by a mutant virus. Threats may be multiple, simultaneous and episodic, or they may be sequential and synergistic.

**Table 1**
**Plant Diversity Conserved By Grassroots Conservation Groups and Individuals (n=26)**

| | |
|---|---|
| Heirlooms from around the world | 23 |
| Neglected minor crops | 21 |
| Crops native to region | 19 |
| Crops native to climate zone | 19 |
| Wild relatives of crops | 16 |
| Useful wild species | 14 |
| Fruit & nut perennials | 12 |
| Medicinal plants | 12 |
| Endangered wild plants | 9 |
| Succulents | 1 |
| Other | 6 |

In a 198 1 survey of 44 households in the traditional Indian farming village of Topawa, Arizona, it was discovered that only eight of the 29 historic fields near the village were still being planted with native crops. When asked to cite the pressures which caused them and their neighbors to abandon the sowing of their traditional crops, Tohono O'odham farmers in Topawa cited a variety of threats and problems. Only the response, "the young people are lazy, don't care" is in line with one of the expert's observation that intergenerational transmission of folklore has gone asunder.

In a similar vein, the perception of *what* is threatened differs between traditional farmers and crop geneticists. Of 15 crop geneticists and scholars of Indian agriculture who commented on threatened crops of the U.S. Southwest in a March 1991 survey, six of them mentioned Hopi crops that they considered to be threatened. They listed among their concerns Hopi cotton, amaranths, sunflowers, tobaccos, tepary beans, melons, unidentified squashes, and chiles. One expert even considered the Hopi among the two indigenous southwestern cultures with the most external pressures negatively affecting the persistence of their farming traditions.

Yet a 1989 survey of 50 Hopi farmers, not all growing traditional Hopi varieties, showed a unidirectional downward trend when compared to the results of a similar survey by Jones and Whiting in 1935. While Hopi cotton had virtually disappeared, and amaranths, sunflowers and native chiles had become less frequently grown, other crops had not fared as badly. Surprisingly, some traditional crops are now grown by a larger percentage of Hopi farmers than they were a half century ago. Nevertheless, the total number of Hopi farmers have decreased, as has cultivated acreages over the last half century, indicating that concern about genetic erosion is probably valid. These results suggest that threat assessment is tricky without good baseline data, and requires repeated monitoring in the same communities with the same methodology through time.

In contrast to much of the literature on genetic erosion - such as the *Shattering* by Fowler and Mooney (1990) - the simple replacement of native plant resources by exotic hybrid crops was not considered the preeminent force driving genetic erosion. The loss of traditional seed saving skills received as many votes as the introduction of hybrids, and many other reasons were listed that can be cumulatively called a concern about the acculturation of remaining traditional farmers and gatherers. The diversity of threats corroborates our earlier contention that, at least in the bi-national Southwest's center of diversity, "the oft-cited example of Green Revolution hybrids replacing local landraces hardly accounts for much of the genetic erosion of indigenous cultivated plants in

## The Heart of Grassroots Conservation Organizations: "Passion and Dynamism"

Formal conservation sector and nonformal grassroots conservation efforts both may be concerned about some of the same resources, may be open to some of the same strategies and techniques, and ultimately may be complementary to one another. Yet the passion and dynamism of the grassroots movement and the genius of its self-motivated individuals are irreplaceable because they define their goals differently and address threats to the resources in manners that no government organization could do.

A grassroots conservation organization may be defined as one which arises spontaneously out of personal, family, or community concern for a set of resources, rather than descending from strictly professional or governmental directives. It may include laypersons and professionals alike, but formal training does not preclude membership. It may be eventually incorporated as a nonprofit or for-profit organization, or continue to function simply as an ad hoc movement. It may persist for generations, or arise to confront a particular problem, then quickly dissolve when the issue is resolved. It may honor time-tried traditional knowledge and practices which informally serve to conserve certain resources, or develop into a sophisticated, computer-linked network of enthusiasts working to save the same resources for many different reasons, using peculiar mixes of modem technologies and traditional means.

Perhaps the most distinctive quality of grassroots organizations is the belief of their members that conservation is too important to simply be left up to "experts"; anyone willing should be able to participate in some effective action. As ethnobiologist Eugene Anderson has noted, such people seek to manage or conserve resources in a way that is informed by "an ecology of the heart," rather than being concerned only about "rational uses," "cost efficiencies" and "direct economic benefits." They acknowledge that their ethical, emotional and spiritual ties to organisms, habitats, places, processes and traditions guide them as much as do their scientific reasoning and "left brain functions."

Aridoamerica. Most, but not all, of this erosion has occurred within the last century, and is the result of several interacting factors."

### Trends in Structure and Growth

The grassroots organizations we surveyed range in size from one person to an international group with a membership of 10,000 people. The organizational nature of these groups varies - some have paid staff, others don't.

We estimate that more than 20,000 U.S. citizens play supporting roles in these grassroots efforts. Similarly, there are at least 6,500 active growers of plant genetic resources each year. These and other gardeners of heritage garden crops, wild crop relatives, and other plants of important genetic quality are undoubtedly keeping many varieties alive that without their attention would become instinct. For instance, Native Seeds/SEARCH distributes seeds of crop varieties originating from Native American farmers to as many as 4,000 gardeners annually and several other efforts also distribute native crops seeds. Since there are only 7,000 farmers in Native American communities today, native crop preservation is clearly being buoyed up by the addition of more than half that number of grassroots growers.

Most of the groups have grown in the last five years; the two largest groups more than doubled their membership in that five-year period. This growth has not come without growing pains. Two seed conservation groups in the Southwest region have stopped operating due to financial management problems and an inability to resolve management-staff differences. Their failures have been mitigated somewhat by duplicate collections in the hands of other activists. This has led other groups to plan "seed wills" that direct the distribution of their seed collection should they face a similar ending.

The grassroots conservation movement has adopted several strategies to support itself. Sales (of seeds, produce, native foods and publications), memberships and grants figure greatly in how organizations support their work. While individual activists receive some support from sales, grants and custom-growing, many fund their own projects out of personal income from other jobs, or from inheritances.

The growth of these organizations is part of a larger trend in the seed industry that started in the 1970s in which the collapse or consolidation of large seed companies left a void that was filled by the emergence of smaller, regional seed companies and nonprofit seed exchanges and suppliers. Multinational agrichemical conglomerates bought out many family-owned seed companies, dropped their collections of standard vegetables and replaced them with more profitable hybrids. These smaller concerns, many of which are involved in the seed conservation movement, can fill the demand for a diverse selection of seeds.

***There are at least 6,500 active growers of plant genetic resources each year.***

It is unclear at this point whether nonprofit organizations functioning as surrogates for now defunct regional seed companies is a stop-gap measure or a long-term trend. In reality, all the regional grassroots efforts still have different agendas from the old regional seed companies that have now been consolidated or lost.

### Strengthening the Grassroots Conservation Movement

To determine what might help strengthen this grassroots movement, we first examine what constraints these activists have found impeding their conservation work. In our survey, lack of adequate funds was the most frequently cited concern. Given the modest budgets upon which most of these organizations depend, it is not surprising that groups report insufficient funds for skilled personnel to accomplish the demanding tasks they feel are necessary to maintain high quality germplasm. Funds for operations and personnel could help stabilize the genetic conservation movement.

Other factors that would empower grassroots efforts include:

- more access to grow-out land and processing facilities;
- increased number of outreach programs for conventional farmers to adopt the use of germplasm for local applications of sustainable agriculture;
- more time, more people to help at harvest time, education, and moral support, especially among newer organizations;
- more training and interaction with colleagues;
- increased opportunities for interaction and meetings between grassroots activists and their counterparts from the more formal genetics resources community which would broaden and mature the grassroots conservation movement;
- continued staff growth including more training opportunities and conferences;
- receive adequate staff compensation and benefits so they can become long-term players in the movement;
- increased technical training; and
- training on organizational operations, such as how to raise funds, how to manage data banks, how to involve members and volunteers in activities, how to prepare budgets, how to make long-term plans, and how to organize effective meetings.

### Emerging Issues

In *Conserving the World's Biological Diversity,* McNeely et al. (1990) reaffirm that: *People form the foundation for the sustainable use of biological resources. Local communities need to be more involved in the management of biological resources, and to benefit from their sustainable use. Because groups of indigenous people in many parts of the world regard natural resources, particularly wildlife, as essential to their cultural continuity and economic well-being, they should be given particular attention in all conservation programs. Local people should be closely associated with the authorities responsible for the management of biological resources and for the establishment and management of protected areas.*

This statement provides a strong rationale for considering the diversity of cultural communities in biodiversity conservation. However, what this statement may obscure and what our report attempts to elucidate, is the role *already* played by indigenous peoples and other "lay" communities in initiating and maintaining conservation at the grassroots. In fact, the grassroots often focus attention on a threatened resource prior to recognition of the need for such actions by national or international "authorities." It makes sense to examine the emerging issues with which the grassroots sector is beginning to grapple.

Grassroots groups have been at the lead of the emerging issues in plant genetic resources for at least five years. For example, the call for a **code of ethics for international plant germplasm collectors** came from the first coalition of Latin American grassroots plant conservation organizations in Santiago, Chile, in 1987. A committee of U.S., Mexican, Chilean, and Peruvian grassroots representatives (including Native Seeds/SEARCH) wrote a first draft of a code, which was circulated to various groups in 1989. It has eventually evolved into "The Code of Conduct for International Collectors and Users of

Germplasm." When ratified by the FAO Commission on Plant Genetic Resources, it will, in effect, become the model for codes which both countries and indigenous communities will use to gauge the ethics of collectors, if it follows along the lines of the FAO's pesticide code published in 1986, which has already served as the model for codes in 20 individual countries.

Similarly, Native Seeds/SEARCH and other groups have explored ***in situ* conservation** of wild chiles and other crop relatives (see DIVERSITY, vol.6,nos.3&4, 1990,p.47) and recently initiated an Arizona Regis-TREE project for *in situ* conservation of perennials, cosponsored with other grassroots groups. These efforts have received recognition from National Research Council in pioneering the *in situ* domain in the United States.

## Farmers Rights Explored

**Farmers rights issues** were also fueled by discussions of Latin American grassroots groups, and popularized by another small nonprofit, Rural Advancement Fund International (see DIVERSITY, vol.7, no.3, p.4).

Survey respondents suggested several strategies for returning benefits derived from plant genetic resources to the original/traditional caretakers of these plants. For example:

- creating "native farmer refugee sanctuaries," i.e. providing land bases for refugees who lost their land to wars, etc. as well as educating those who have land about its true value;
- organizing farmer-curator networks (locating existing plant stewards, and finding "growers in original/traditional communities to help grow-out seed, both as food for families and communities and for future planting or for sharing with others);
- working with existing community development organizations to reach members of their communities who have agricultural land and creating demonstration plots in communities on members' land with seeds we provide as cooperators;
- showing our (outsiders') concern goes beyond money return for us, thereby asking native farmers to take a second look at their crop traditions;
- legally protecting the seeds/crops through subsidies to make up for low matket returns;
- continuing and expanding the importance of native foods and crafts worldwide through cottage industry development;
- heightening public awareness through education to show importance of old varieties;
- developing heirloom garden programs so as to increase experience of crop varieties in a recreation of the time period, cultural background, gardening techniques, plant associations, etc. that expresses their past;
- changing U.S. and Canadian agricultural policies with regard to increased attention to U.S. landraces ("heirlooms"), our so called "heritage" conservation;
- re-evaluating USDA policies toward multiline mixtures and blends, which although they are ways of presenting genetic diversity to gardeners and farmers, prohibits selling seed blends without percentages of each cultivar stated on packet and notation whether hybrid;
- developing more demonstration gardens to raise public awareness;
- developing serious collection and preservation programs for heirloom varieties, especially at historical sites;
- re-examining the issue of farmers rights versus plant breeders rights by re-establishing publicly funded plant breeding and the need for resource conservation amendments to Breeder Rights Laws;
- encouraging government policy to prevent the destruction of unique genetic material in the collections of their research stations (both national and provincial);
- proposing incentives, such as favorable tax structures, for profit companies working in genetic conservation;
- allocating more money for organic and native agriculture;
- changing current national farm policy which advocates monocultures, chemicals, bank dependences; and
- encouraging farmer equipment companies to gear down toward smaller scale, more appropriate machinery better suited toward diversity.

## An Ear to The Grassroots. . .

In narrative supplements to our survey, grassroots conservationists spoke of how they value plant genetic resources with a depth and color seldom offered in technical meetings:

- *"So much major emphasis has been put on the scientific 'use of plant genes'--'common' people don't care about this so much as how useful a plant is in their lives. We rae about the veins of the leaf and do not mention the force within the tree for which the leaf is part. If we save the veins so fervently what will happen to the tree? Will plant genes he just collected and frozen in banks like human sperm? How long? To what use?"*
- *"They delight my senses of sight, smell, taste. and touch They shade and warm me, and make me marvel at the world."*
- *"We have co-evolved with them."*
- *"They add a richness and diversity to our gardening and eating. Some have interesting backgrounds and stories which add to the richness of our experience and help put the 'culture' into horticulture."*
- *"They are the heritage of our collective ancestry, their value is immeasurable, they assure basic human freedom. If you are food dependent, you are a slave!"*

## Conclusion

It has been demonstrated that the Noah's Ark rescue missions need not be the only model for successful conservation of plant genetic resources. The grassroots movement, at its heart, is seeking not only a diversified range of plants to stabilize and sustain an ecological agriculture, it is also exploring a diversity of organizational structures, mixes of *in situ* and *ex situ* strategies and funding sources. The goals and motives of the organizations and individuals are in many ways complementary to the formal business, academic and government sectors, but at the same time, they hope to challenge the other sectors' assumptions about appropriate means and ends.

One major difference in perspective is the grassroots concern about stemming the threats to these resources, rather than assuming rescue missions for *ex situ* captive breeding are sufficient. Even when they liken themselves to latter-day Noahs, their satisfaction comes not so much from having gathered considerable plant diversity into safe harbors, but instead from finding ways to release these organisms back into their native habitats once threats have subsided or been abated.

For further information and a complete list of references, contact: Kevin Dahl, Assistant Director, Native Seeds/SEARCH, 2509 N. Campbell Ave. #325, Tucson, AZ 85719, USA. Tel: (602) 327-9123.


## Acknowledgment

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# IN REVIEW: *Plants, Power, and Profit: Social, Economic, and Ethical Consequences of the New Biotechnologies*

***by Donald N. Duvick***

*Plants, Power, and Profit: Social, Economic, and Ethical Consequences of the New Biotechnologies.* Lawrence Busch, William B. Lacy, Jeffrey Burkhardt, and Laura R. Lacy. Basil Blackwell Ltd: Oxford, UK. 1991. $39.95.

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*Plants, Power, and Profit* is aptly titled. It aims to show that power over plant biotechnology must rest with the public as a whole rather than with plant breeders, plant biotechnologists, and those who control them.

A major focus of the book is on business corporations and the increasing influence they exert on academia and on plant breeding and its products. The four authors argue that biotechnology, with its potential to dramatically reduce the time needed to produce a new crop variety, is a major factor in the increasing corporate interest in and power over public and private plant breeding.

The authors - two sociologists, a philosopher, and a molecular biologist - devote the beginning chapters of the book to historical accounts intended to show that research in biotechnology, plant breeding, and indeed all of agriculture, can have highly important effects on society and the environment. Possible consequences from such research have become so great and far-reaching, they say, that we no longer can allow agricultural researchers, public or private, to set their own agendas, particularly in biotechnology.

Research directions, say the authors, should be monitored and regulated by a review- and- assessment body, a broadly-based public agency outside the control of the research system (see box). In addition to setting the research agenda, determining priorities, and setting the course for the future, this body also should have power to forbid any research deemed likely to have undesirable consequences to society. In the authors' words, "the time has come to serve one master: the public interest as a whole."

Busch, Burkhardt, and the Lacys acknowledge that the strengthened national, biotechnology, social-impact assessment institution they suggest would "prohibit some research and seriously constrain the use of some results of research already performed." And they accept the implication that "some scientific and technological possibilities, to the extent that they are linked to undesirable social and environmental possibilities, should simply be placed outside the realm of practicable science."

But, arguing from their combined scientific, sociological, and philosophical vantage points, the four agree that "although few of us wish to admit it, science, agriculture, and society are human enterprises, and our second nature is frequently less than noble."

*Dr. Donald N. Duvick, Affiliate Professor of Plant Breeding at Iowa State University, is actively involved in national and international plant genetic resource initiatives.*

## New Forces For Change

*Plants, Power, and Profit* clearly points out the new forces for change in applied plant biology, and does so with a wealth of knowledge and detail. It shows that increased precision in plant manipulation, combined with increased globalization and integration of food production, will lead to new concentrations of power and new centers of production and economic activity, which in turn will bring on large and sometimes unexpected and/or undesired changes in economic and social structures. This is especially true for the world's poorest countries which will have the greatest difficulty in coping with these changes and so will need special assistance.

The authors point out, correctly, that assessments of future change in agriculture should move beyond considerations of only technology and production, and take into account societal and environmental needs. They say, correctly, that such global assessments should be made from a broad base of interacting disciplines. Science-based reductionist methods alone cannot solve the problems of agriculture in today's complex world-and indeed they never could. The book lays an excellent groundwork for consideration of new policies for agricultural research.

***The authors argue that biotechnology is a major factor in the increasing corporate interest in and power over plant breeding.***

But the book fails to live up to its promise, for in the end it looks only to repression based on fear of the dark side of human nature. It looks to an omniscient, omnipotent and almost Orwellian-central power to forestall or control the problems emanating from other, less wise, centers of power.

How much better if the authors had looked to constructive action based on faith in the higher qualities of the human spirit. How much better if they could have proposed (for example) effective ways to bring the new power centers for research and production together with the new power centers for protection of the poor and the environment. Such meetings, with goals of mutual enlightenment and tough but productive compromise, can result in heightened awareness of neglected or maladjusted areas in agricultural society and science. Such awareness can be the basis for joint development of proposed policies for enlightened change.

Since change is inevitable (as Darwin knew) one must strive continuously not to repress it, but rather to guide it towards socially productive ends.

## Regulating Biotechnology for the Social Good

The authors of *Plants, Power,* and *Profit* offer the following guidelines for regulating biotechnology:

- A national biotechnological review and assessment program should be initiated which has strong regulatory powers.
- The consideration and inclusion of the social, economic, and ethical dimensions of biotechnology should be at the center of the assessment and regulatory process.
- If research efforts, or the experimental release or the commercialization of particular products are likely to have demonstrable negative social and/or economic effects, it is in the public interest that these be duly noted.
- If these effects are significant, the process or product should be prohibited from use or limited in the nature and duration of its use.

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***Age-Old Maize Collections Preserved.*** D. Connolly. *FRONTLINES,* March 1992, p, 12.

***Alarm for Nature's Bounty.*** B. Rensberger. *The Washington Post,* Apr. 6, 1992 p.A3.

***Another Look at the U.S. Plant Germplasm System.*** C.J. Gabriel. *Bioscience,* vo1.42, no.3, March 1992, pp.201-202.

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***Conserving the Tropical Cornucopia.*** N.J.H. Smith, J.T. Williams, and D.L. Plucknett. *Environment,* vo1.33 no.6, July/August 1991, pp.6-ff.

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**Earth Summit: Conversations with Architects of an Ecologically Sustainable Future.** S.Lerner. Common Knowledge Press. 1991. 263 pp. $9.95 paperback. Order from: Common Knowledge Press, P.O. Box 316, Bolinas, CA 94924.

***In Vitro* Methods for Conservation of Plant Genetic Resources.** J.H. Dodds, ed. Chapman and Hall. 1990. 247 pp. £27.50. Order from: Chapman and Hall, Ltd., 2-6 Boundary Row, London, UK SE1 8HN. FAX: 071-522-9623.

**The New Royal Horticultural Society Dictionary of Gardening.** Macmillan. 1992. 3,200 pp. $795.00. Order from: Macmillan-Grove Dictionaries Division, 1526 E. 26th Street, New York, NY 10010, USA. Tel: 1-800 221-2123.

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**Plant Biotechnology and Development.** P.M. Gresshoff. CRC Press, Inc. 1992. U.S.$49.95/0utside U.S. $59.95. Order from: CRC Press, 2000 Corporate Blvd., NW, Boca Raton, FL 3343 1-9868, USA.

**Plant Breeding in the 1990s: Proceedings of the Symposium on Plant Breeding in the 1990s** Raleigh, North Carolina, 1991. H.T. Stalker and J.P. Murphy, eds. 1991. 540 pp. Order from: C.A.B. International, Wallingford, Oxon OX10 8DE, UK. Tel: (0491) 32111; FAX: (0491) 33508.

**Sampling Strategies for Conserving Variability of Genetic Resources in Seed Crops.** E. Porceddu and A.B. Damania. International Center for Agricultural Research in the Dry Areas (ICARDA). 1991. 28 pp. Order from: ICARDA, P.O. Box 5466, Aleppo, Syria.

**Sustainable Agriculture and the Environment.** V.W. Ruttan. Westview Press. 1991. 189 pp. $29.95. Order from: Westview Press, Customer Service Department, 5500 Central Avenue, Boulder, CO 80301-2847, USA. Tel: (303) 444-3541; FAX: 303-449-3356.

**Tropical Root Crops: Root Crops and the African Food Crisis: Proceedings of the Third Triennial Symposium of the International Society for Tropical Root Crops -Africa Branch.** E.R. Terry, M.O. Akoroda, O.B. Arene, eds. International Development Research Centre. 1987. 198 pp. $17.95. Order from: Agribookstore, Winrock International, Rosslyn Plaza, 1611 North Kent Street, Suite 600, Arlington, VA 22209-2134, USA. Tel: (703) 525-9455; FAX: 703-525-1744.

**Use of Plant Introduction in Cultivar Development-Part II.** H.L. Shands and L.E. Wiesner, eds. Crop Science Society of America. CSSA Special Publication Number 20. 1992. 184 pp. $30.00. Order from: CSSA, 677 South Segoe Road, Madison, WI 53711, USA. Tel: (608) 273-8080.

# Events

## - 1992 -

August 9- 13 - **43rd Annual Meeting of the American Institute of Biological Sciences (AIBS),** Honolulu, HI. Contact: Louise Salmon, AIBS Meetings Manager, AIBS, 730 1lth Street, NW, Washington, DC 20001-4584, USA. Tel/FAX: 202-628-1500.

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August 9-11 - **Annual Meeting of the Association of Systematics Collections,** Honolulu, HI. Contact: ASC, 730 11th St., NW, 2nd Fl., Washington, DC 20001, USA. Tel: (202) 628-1500. FAX: 202-347-0072.

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August 9-13 - **Caribbean Food Crops Society - 28th Annual Meeting,** Santo Domingo, Dominican Republic. Contact: Dra. Altagracia Rivera de Castillo, Executive Director, Fundacion de Desarrollo Agropecuario, Inc. (FDA), Apartado Postal 567-2, Santo Domingo, D.N. Dominican Republic. FAX: (809) 544-4724.

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August 9-13 - **Ecological Society of America Annual Meeting,** Honolulu, HI. Contact: ESA, Center for Environmental Studies, Arizona State University, Tempe, AZ 85287, USA.

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August 9-14 - **Fourth Annual Conference of the Society for Ecological Restoration,** Waterloo, Ontario, Canada. Contact: Laura Lee Hoefs, Society of Ecological Restoration, 1207 Seminole Highway, Madison, WI 537 11, USA.

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August 13 - **NE-9 RTAC Meeting,** Geneva, NY. Contact: Dr. Stephen Kresovich, Supervisory Geneticist/Research Leader, USDA/ARS, Regional Plant Introduction Station, Plant Genetic Resources Unit, New York Agric. Exp. Station, Geneva, NY 14456-0462, USA. Tel: (315) 787-2333. FAX: 315787-2397.

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August 15-21 - **17th International Congress for Genetics,** Birmingham, UK. Contact: Derek Smith, Secretary-General, Research Sup. and Industry Liaison, University of Birmingham, Birmingham, B 152TT, UK.

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August 18 - **Dedication Ceremony, National Seed Storage Laboratory,** Boulder, CO. Contact: Dr. Steve A. Eberhart, Director, National Seed Storage Laboratory, Fort Collins, CO 80523, US. Tel: 303-484-0402.

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August 20-24 - **Asia-Pacific Agricultural Biotechnology Conference,** Beijing, China. Contact: C.B. You, APAB, Beijing Intl. Conv. Ctr., Room 1008, 8 Beichendong Road, Chaoyang Dist., Beijing 100101, P.R. China.

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August 23-28 - **Congress of the European Society of Agronomy,** Coventry, England. Contact: Dr. A. Scaife, ESA Congress Office, Horticulture Research International, Wellesboume, Warwicks, CV35 9EF, UK. Tel: 0789 470382. FAX: 0789 4705522.

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August 25-28 - **First International Scientific Meeting of the Cassava Biotechnology Network (CBN),** Cartagena de Indias, Colombia. Contact: Dr. William M. Rota, CIAT, Apartado Aéreo 67 13, Cali, Colombia. Tel: (57-23) 675050 ext.443. FAX: (57-23) 647243.

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September 1-5 - **40th Annual Congress of the Society for Medicinal Plant Research,** Trieste, Italy. Contact: Organizing Secretariat, The Office, Via S. Nicolo 14, 34121 Trieste, Italy.

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September 7- 11 - **Sixth European Ecological Congress,** Marseille, France. Contact: Dr. D. Bellan-Santini, Centre d'Océanologie de Marseille, Station Marine d'Endoume, Rue Batterie des Lions, 13007, Marseille, France.

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September 13-17 - **International Workshop on Conservation, Characterization & Utilization of Cocoa Genetic Resources in the 21st Century,** Port of Spain, Trinidad. Contact: Prof. John Spence or Mrs. Frances Bekele, The Cocoa Research Unit, The University of the West Indies, St. Augustine, Trinidad, West Indies. Tel./FAX: (1) 809-491-5588.

September 13-19 - **The Agricultural Research Institute's International Conference of Agricultural Research Administrators,** McLean, VA. Contact: The Agricultural Research Institute, 9650 Rockville Pike, Bethesda, MD 20814-3998. USA. Tel. 301-530-7122. FAX: 301-571-1837.

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September 14-18 - **International Society for Tropical Crop Research and Development (ISTCRAD) International Symposium on Tropical Crop Research and Biotechnology,** Trivandrum, India. Contact: Dr. N.K. Nayar, Organising Secretary, International Society for Tropical Crop Research and Development, College of Agriculture, Vellayani, Trivandrum 695 522. Tel: 0471-69911. Telex: 0435-309 JAS IN, Trivandrum-695 010.

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September 21-25 - **Etnobotanica** 92, Cordoba, Spain. Contact: Secretaria, Etnobotanica 92, Apdo. 3.029 (Jardin Botanico de Cordoba) 14080 Cordoba, Spain.

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September 22-25 - **Genome Sequencing Conference,** Hilton Head, SC. Contact: Susan Wallace, P.O. Box 541, Rockville, MD 20848, USA. Tel: (301) 480-0634. FAX (301) 480-8588. E-mail: swallace@loglady.ninds.nih.gov.

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September 23-25 - **Genome Mapping of Wheat and Related Species -Third Annual International Public Workshop,** CIMMYT Headquarters, Mexico. Contact: Calvin 0. Qualset, Director, UC Genetic Resources Conservation Program, University of California, Davis, CA 95616, USA. Tel: (916) 757-8920. Fax: (916) 757-8755.

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September 28-October 3 - **EUCARPIA Symposium on Understanding Genetic Diversity from Vavilov to Molecular Genetics,** St. Petersburg, Russia. Contact: Prof. Victor Alexandrovich Dragavtsev, Director, N.I. Vavilov All-Union Scientific Research Institute of Plant Industry (VIR), 44 Herzen Str., St. Petersburg 190000, Russia.

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October 12- 15 - **International Workshop on "Evaluation and Utilization of Biodiversity in Wild Relatives and Primitive Forms for Wheat Improvement,"** Aleppo, Syria. Contact: Dr. A.B. Damania, Genetic Resources Unit, ICARDA, P.O. Box 5466, Aleppo, Syria.

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October 18-20 - **Texas Seed Trade Association Annual Convention,** San Antonio, TX. Contact: Donald W. Ator, Exec. Vice President, P.O. Box 1430, Pflugerville, TX 78660- 1430, USA. Tel: (5 12) 990-5212. FAX: 512-990-1088.

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October 19-25 - **Third International Botanic Gardens Conservation Congress,** Rio de Janeiro, Brazil. Contact: Dr. Peter Wyse Jackson, Botanic Gardens Conservation Secretariat, Descanso House, 199 Kew Rd., Surrey TW9 3BW, UK. Tel: 81 940 00471. FAX: 81948 4363.

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October 26-30 - **Consultative Group on International Agricultural Research (CGIAR) Centers Week,** Washington, DC. Contact: CGIAR, c/o World Bank, 1818 H Street, NW, Washington, DC 20433, USA.

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October 31 - November 1 - **ASHS - CSSA - Joint Plant Breeding Symposium:** Applications of RAPD Technology to Plant Breeding, Minneapolis, MN. Contact: John W. Dudley, Department of Agronomy, University of Illinois, Urbana, IL, USA. Tel: (608) 262-6975.

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November/December - **Second International Course on Fodder Tree Legumes-Multipurpose Species for Agriculture,** Queensland, Australia. Contact: R.C. Gutteridge, Course Coordinator, The University of Queensland, Overseas Projects Office, Department of Agriculture, Queensland, Australia 4072. Tel: (07) 365 2651. FAX: (07) 365 1188.

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November 1-6 - **Annual Meeting of the American Society of Agronomy, the Crop Science Society of America, and the Soil Science Society of America,** Minneapolis, MN. Contact: ASA/CSSA/SSSA, 677 South Segoe Road, Madison, WI 53711, USA. (608) 273-8080.

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November 5-7 - **Applications and Prospects of Biotechnology for Arid and Semiarid Land,** Lubbock, TX. Contact: Tom Mabry, $IC^2$ Fellow, $IC^2$ Institute, 2815, San Gabriel, Austin, TX. USA. Tel: (512) 471-1900. FAX: (512) 471-3878.

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November 9-11 - **Plant Genome I,** San Diego, CA. Contact: Scherago International, Inc., 11 Pen Plaza, Suite 1003, New York, NY 10001, USA. Tel: (212) 643-1750, FAX: 212-643-1758.

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November 10-15 - **The Third International Congress of Ethnobiology,** Coyoacan, Mexico. Contact: Javier Caballero, ISE Organizing Committee; Apartado Postal 21-585, Coyoacan 04000, D.F. Mexico. Tel: (52-5) 548-9785 & 550-5057. FAX: (52-5) 548-8207. Email: Cabani.Unamvmi.Bitnet.

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