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About the Institute

The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

UNIVERSITY OF COLORADO

BOULDER, COLORADO ***** 80309

Department of Environmental,
Population and Organismic Biology

April 27, 1977

Copy of Rogers' initial report

Dr. Veronica Fye
Assembly of Life Sciences
National Research Council
2101 Constitution Ave.
Washington, D.C. 20418

Dear Dr. Fye:

I hope this report makes it by Friday, and if not, I'm sorry. This is a bad time of year for us and secretaries around the campus--we and they are madly finishing up the term. That partly explains the very poor condition of this report. But since it is to be completely reworked by you, I doubt that things will end up as they are now written.

You should have received a paper by Dr. Farnsworth, Pharmacy, Illinois, by now. He sent me a copy, so that if you do not yet have one, I can send one to you. I think his paper is useful, and you can probably add it in somehow.

I am sending a rough draft of a paper by Dr. Robert Bye of our department, with an interesting idea for conservation of both people and crops. I think this is an interesting, and quite different approach which should be given an airing.

If you need anything else, give me a call.

Sincerely,

David Rogers
David J. Rogers
Professor of Biology



1. Aside from a relatively few well known plant species, the numbers that are really endangered is only a guess. This is true because of the lack of sufficient numbers of specialists to specify the ones that are really endangered as species, or are endangered only for one ecotype (ex. = Monterrey pine). Majority of smaller shrubs or herbaceous species are so poorly known throughout their whole range that species conservation is more of a guess than a real understanding. In some cases, inventories, lists, and compendia of rare and endangered species have been compiled (Weber and Johnston, 1976). These have varying degrees of accuracy. The definition of species is in such a state that one man's species is another's variety.
2. Conservation of species, other than those already in cultivation is only feasible via conservation of natural areas. Attempts to bring the wild species into cultivation is fraught with difficulties, and would, in some likelihood, if successful, maintain only some segment of the genetic resources of the species. Conservation should not be considered as complete control of all natural phenomena--fires of natural cause should probably be allowed. Species should withstand droughts, or if not, probably should be allowed to die. Size of areas to maintain a species in a state of health--genetically diverse--is a variable requiring knowledge of the plants, species by species. Minimal areas probably are not less than several thousand hectares, but such a generality cannot really be defended. Even an area of the size mentioned, if completely surrounded by civilization, could not be considered to be a healthy ecosystem. Accommodation for people must also be considered in any conservation or maintenance system. Even if the land is restricted in use, it probably could support some type of man-oriented effort--grazing, water-shed management, soil conservation, etc.

3. Cooperative efforts to expedite conservation of ecosystems.

Though public funds will govern public-owned areas, there needs to be coordination of these with a number of other types of land holdings, private and corporate, local, county, state or federal. Numbers of institutions of higher learning possess larger or smaller reserves of land either with conscious programs of conservation, or sometimes only through benign neglect. Couple these together and we probably have a larger capability than is generally recognized. Such efforts need to be known, and help given to the institution where needed to preserve some segment of the ecosystem. The types of institutions most amenable to cooperative activities for genetic resources conservation are those with a long history of such activities, supported in large part by their own financial resources. These are botanical gardens, (for example the Missouri Botanical Garden, St. Louis, owns a very large reserve some 30 to 40 miles west of the city, and there are several prime examples of upland second-growth mixed hardwood forests, river-bottom habitats, and some areas that are being allowed to return to natural forests from abandoned farmland). There are other organizations, land-holdings, etc. that need to be informed of the importance of their work nationally, and given an opportunity to volunteer their activities in a network system that would help to conserve a variety of habitats throughout the country.

The Morton Arboretum, Lisle, Illinois, maintains a portion of native prairie on their grounds. This endeavor, maintaining a native stand, is much more complex than one might expect -- the "native" prairie changes without any particular interference from man, so that attempts to maintain the "status quo" of a native area is very difficult, requiring large land areas and continuous monitoring.

Food crops important in the lesser developed countries.

1. Diet (food). With a few notable exceptions (such as white potatoes--species of the tuber-bearing section of the genus Solanum; sugar cane--Saccharum spp.; tomatoes--Lycopersicon spp.;) the food plants of the lesser developed countries have not suffered from the same problems of genetic resources loss as some of those crops used in the temperate zone. For example, it is doubtful that inroads into the genetic diversity of the cultigen Manihot esculenta has been nearly so serious as that for Triticum, where the newer cultivars produced in highly advanced crop breeding programs have had the effect of shoving out a large number of so-called land (or primitive) races. Only very recently have efforts been started to conserve genetic resources of any of the major crops and there are still no efforts to conserve those of lesser significance, such as the fruit and nut crops (of which there are very large numbers). Much less there is very little effort towards improvement of these lesser crops. Those vegetables, and many legumes, that are consumed by local peoples in the tropics (which is equivalent to "lesser developed") are practically an unknown quantity when it comes to such matters as intensive cultivation in the same type of endeavor as that done for cultigens in the temperate zone.

The above does not indicate that there is no need for conservation of genetic resources. Clearly the same processes that destroy large land surfaces by road-building, new farming areas, urban construction, et al. are very likely destroying genetic resources of these crops and the related wild relatives. However, the status of these is very poorly known, and only in the case of a very few (such as the common bean, cowpeas, and corn) are any efforts being made to conserve genetic

resources. Zea mays has had the longest record of collection and maintenance of the tropical cultivars, and even in this case, the intensive initial efforts made in about 1943 onward have not ensured the complete collection of genetic resource material and certainly it has not been maintained consistently).

2. crops of the lesser developed countries affecting the economies.

The variety of crops that provide the cash for many of the under-developed countries around the world is very large, ranging from beverages, to fibers, to elastic substances, to medicinals, and to lumber. In the latter category, the largest lumbering areas of the tropics that are being exploited ruthlessly are the so-called dipterocarp (Dipterocarpaceae) forests of the Indomalaysian regions. Large areas are being completely destroyed, and the countries in which this ruthless exploitation occurs are not sufficiently strong (in a political sense) to enforce any kind of forestry methods on the companies who extract the timber with extremely wasteful procedures. In other areas, an equally disturbing process is at work. Herein, large plantings of single genotypes are planted in plantations to the exclusion of all other trees. Where teak (Tectona grandis) is planted, no other plant can live--the dead leaves of the teak act as a sort of herbicide to any other vegetation. Similarly, Eucalyptus forests are (and have been for many years) being planted in pure stands, and the foliage inhibits growth of many native species. Usually, the commercial interests are responsible for the single genotype planting schemes--it is not so profitable to plant a mixed culture because of variations in growth pattern of the plants, as well as variations in the products.

Rubber, still an important crop in many parts of the world, is

seriously attacked in land where this species is native. All of the Hevea brasiliensis Latin America plants are subject to the disastrous disease (Dothidella ulei) of the leaves, preventing any large scale plantings in the Western Hemisphere. Since petroleum products are the starting point for production of synthetic rubber, it becomes more than a botanical problem to maintain a pool of diverse genetic resources for this important species.

In the temperate zone, many examples of genetic loss in the forests can be cited. The one best known in the US is the chestnut blight that destroyed the species in most of its range. The American elm is another species seriously threatened through most of its range by a serious virus disease. Attacks of various insects in both angiosperm and gymnosperm forest trees are well-known, and are still not given sufficient research effort to develop resistant trees to any of these diseases. Clearly the long cycle time for reproduction in forest species prevents an easy identification of those potential selections of the species that may have desirable resistance. Whatever the circumstances, means to preserve genetic resources of these threatend species should have top priority in any conservation program. It should be pointed out, as well, that man himself acts as an agent for the dispersal of some of the disease organisms.

An example of the value of species not in cultivation that provides a very potent argument for conservation of wild materials is the grape. Vitis vinifera, the Asiatic-European wine grape, is highly suseptible to a root-attacking insect, phytophthera. (There are controversies about the proper name for the parasite, not yet fully settled). The disease, apparently of American origin, has had serious effects on the wine

industry here and abroad. The only known resistance to the disease occurs in native American species, found growing as natives in much of the North American continent. Wine grapes are also susceptible to other types of plant diseases, and require use of wild stock for grafting. However, these species are being seriously reduced by the inroads of man and his destructive tendencies, and unless efforts are made to conserve these species, there will be a serious effect on the largest economic fruit crop in the world. Probably two types of measures are needed for the American species of Vitis: one is an active collection of representatives of the wild species, maintained in viticultural collections, and the other, conservation of regions in which the species are found as natives.

The above examples merely are illustrative of the variations of the problems of conservation of genetic resources, particularly of plants of major importance to man's economy. The range of wild species with no known economic significance is great. However, we are never certain that some wild species will not become significant in our culture. Examples of these are many, but I cite one set of conditions that gives some of the basis for making these statements. The requirement for new sources of energy, particularly for coal, and particularly in the regions of the western part of the US, cause some very serious problems of maintenance of environmental quality where strip mining is done. In the west, which is not supplied with large quantities of water, reclamation of strip-mine tailings is a horribly difficult problem. Selection of plant material for reclamation is extremely difficult, because most of the native species that probably are best adapted to the natural conditions in the west are very poor colonizers of disturbed

habitats. Those that might be most useful have not been tested. Our best resources for plant materials where conditions similar to those found on the mine tailings exist, are frequently derived from other regions. Most often, the plant materials that fit these requirements are natives (frequently weedy) in other parts of the world. Conservation with plants of this type is naturally, a very risky business, because the chances of introducing plants that produce more problems than they solve is very high. But with respect to conservation of genetic resources, we have an example of the complexity of the environmental problems that man has produced for himself, and an example of the need for much more intensive research into them than has so far been available. Conservation of some of the best known genetic resources are maintained by the USDA Regional Plant Introduction Stations. These are limited, however, and many more such species are required for the various localities that will be mined with more intensity as our supplies of fossil fuel, both foreign and domestic, decline.

----Note to Dr. Pye. I address myself to part vi of B3, and the item following it, where each of us is to provide some contributing element. In this, I am as much concerned with methods by which the conservation of G.R. can be affected, via organization and management as I am with the actual conservation. I speak of botanical gardens, public and private, as well as the various commercial seed houses, of which there are a large number.

In most countries botanical gardens formerly were the institutions in charge of introduction and spread of all types of plants, including those of commercial or food-producing interest as well as those of floricultural or other horticultural value. These institutions, at least in the United States, are today more likely concerned only with a relatively few of those plants of commercial or food producing importance, and much of their emphasis is on plants of floricultural importance. However, to make this generalization is to oversimplify the functions of botanical gardens, both public and private. Many of the larger institutions are interested in the distribution and classification of wild plants, both at home and abroad. They form a network of institutions that are concerned with inventories of the world's plant resources. The botanical gardens and allied museums (herbaria) exist either independently, or more frequently, in conjunction with some large university where botany is taught as a major scientific discipline. Through these institutions, we have the best opportunity to know what needs conservation, where the plants grow (geographic and environmental data) and where one may find any samples of the plant material, if these exist in some conservation program. Larger botanical gardens frequently maintain and

propagate plants which they are willing to distribute to other institutions upon request. Lists of these are index semina.

There are other sources of plant material that frequently is not recognized as genetic resource conservation, but still provides a broad range of plant materials that would otherwise not be generally available. These are the commercial seed companies. Throughout the US, these companies provide many vegetables, fruits, flowering plants and curiosities raised for some particular interest, such as the sensitive plant (Mimosa pudica) the telegraph plant (Desmodium gyrans), the Venus fly trap (Dionaea muscipula), and many others. The seed companies are not interested in long-term conservation of genetic resources themselves, because their market demands new cultivars with differing qualities from time to time. They usually do not store viable seeds of those cultivars that are no longer popular. However, these institutions may maintain certain breeding stock which contains much of the genetic constituency of a particular cultigen, and thus, does maintain some of the genetic diversity for those species kept. However, this does not address the overall problem of conservation of genetic resources, where genetic drift is an important problem, nor do these institutinos constitute organizations whose primary objective is conservation.

Another resource for maintenance of genetic resources in cultivated plants with interest in many differing types of plant materials are the amateur (the term amateur is not quite right here--there are some professionals) societies that sponsor various cultigens, such as the African Violet Society, the Iris Growers, etc., etc. By encouraging each of these societies to consider, as a part of their mission, the conservation of genetic resources in their cultigens, much could be accomplished

towards the goal of overall genetic resource conservation.

Add to the above all the agencies for environmental protection, both private and government, and a very large part of the organizational requirements for conservation can be met at little more than the cost of a central office charged with assuring that the various endeavors for conservation are consistent in their efforts. Certainly there will be gaps in conservation no matter how many organizations are involved, but this merely indicates that one of the most significant requirements for assurance of conservation is a well-designed and managed data system.

Note to Dr. Pye:

In this section, I find that I have repeated myself in the earlier writing I have done. That is, most of my concern has been with the management of individuals, organizations, and plants because these eventually dictate what must be done. I have not been all-inclusive in describing plant materials that need conservation, but have given examples to illustrate one or another type of management problem. So, you may have to do some sorting out of my stuff, to see what can be pieced together here in this segment.

C. 1. Technical problems and solutions?

The number of higher plants for which we have specific knowledge about the mechanisms and means to conserve them is very small. At most, only about 10,000 species of plants are actually husbanded by man, and of these, only a very small percentage are actually raised in gardens, farms, woodlands, etc., and of this small number, even a smaller number are actively conserved (or indeed have been tested to find out about conservation over long periods).

Various tactics have been employed for genetic resources conservation of plants. Unicellular organisms pose the least problems--lyophilizing may be practised, even on algae, and failing lyophilizing, test-tube pure cultures are very frequently successful. Single-cell cultures of multicellular organisms has been successful in a number of cases, where regrowth from meristematic tissues have been the source of cultures. But in a number of woody plants there has yet to be demonstrated that whole new plants can be produced from tissue cultures. Perennial fruits are but one example of the need for investigation. Some methods of maintenance of crowded, rooted cuttings have been proposed to serve

conservation purposes in these plants--apples, pears, peaches, various citrus, and nut trees--but these types of culture are still space consuming and demand considerable attention to keep alive and healthy. Large acreages set aside for the culture of single cultigens is usually unsatisfactory for several reasons--economic, pathologic, management, etc. Technically trained individuals are also required, and there are not enough to cope.

Facilities for conservation of considerable numbers of accessions of seed-bearing cultigens exist in the US. The different types of storage requirements, for a variety of cultigens however, have not been thoroughly investigated (in production size quantities, though many have been tested in pilot programs). Roberts (see 1975, for example) has been concerned for many years with means and methods of seed storage, and has produced the most significant understanding of seed storage problems. Peter Thompson at Kew Gardens is probably the outstanding authority on long-term maintenance of seeds of wild species, but his experience has not covered a large segment of the plant kingdom. Knowledge of the conservation of ferns and fern allies is minimal, though a number of these are maintained in botanical garden collections. Members of the Cycadaceae are usually well represented in various botanical gardens. Pollen and seed of many gymnosperms are preserved in forestry establishments around the world. Aside from a few species used in gardens (largely in Japan) bryophytes have little known needs for specific conservation. In these cases, however, there has been so little attention paid to these organisms concerning conservation that there may have been serious losses, but not reported. The cases (or need) for bryophyte collection depends upon definition of endemism,

and in these circumstances conservation of natural areas would be the method selected.

Administration of conservation procedures is perhaps the most needed area (if I understand administration correctly). There are so few networks of conservation efforts established that they have not had the opportunity to have the same impact as have other, older biological endeavors. An emergency exists, but nothing can be done about it until such administrative frameworks exist. Geographically, I can think of no means by which a single nation can participate isolated from all others. Some efforts must be made at least to coordinate efforts for such conservation, and the program of UNESCO, Man in the Biosphere, is certainly an important program involved in efforts to accomplish some conservation. The United Nations Environmental Program needs to be expanded and strengthened. The IBP programs were certainly important to "raise the conscience" of the public to the needs, but these international endeavors are precursors to ongoing organizations that must focus on conservation. Today, there are no physical organizations whose main duty it is to accomplish this. One may suggest that the Consultative Group for International Agricultural Research, through a newly formed structure within it, the International Board of Plant Genetic Resources, is set up to accomplish something in this vein, but that structure is so poorly organized, and so incorrectly directed that it cannot provide the necessary guidance, and certainly cannot carry out any long term function. It is a "straw man" with no operating arm. For a limited number of crop species, the United States Department of Agriculture is the most organized, functioning body across the country. The largest mission of this body, however, is to conserve genetic

resources of species that are largely not within the borders of the continental US, and therefore must be directly dependent on the good will of other parts of the world to supply the needed plant and animal materials for conservation. Unless some new body is formed, with an obligation to all living organisms, at least as an organizer and coordinator of individual ongoing activities both privately, commercially, and governmentally, in all types of institutions, without regard for the usual barriers between differing groups (i.e. agricultural versus wild plant interests), the conservation of genetic resources will certainly fail.

iv. Genetic Drift--initial sampling.

There is no positive way to accumulate by collection all variations that exist in even those species that are best known--the cultigens. Sampling can only be statistically organized, to ensure as near complete representation of genetic resources as possible, but because of the enormous number of ecological zones there is little chance that there can be maintained all the germ plasm for any one species. What will be maintained will certainly be only a segment of the initial population structure, and we must realize that this is true. Genetic drift is due not only to man's selection of some part of the genetic material of a species, but to inevitable processes of natural selection.

There is implied herein that the processes of conservation are continuing ones, that there is no completion date when we can safely say that we have conserved things. We must recognize that there is a long time commitment required, and that continuous monitoring of the genetic resources must be done. Some efforts by plant breeders (in such outbreeding crops as Zea mays) is to "bulk" (or mix) collections of

similar accessions, and by such tactics cause a mixed gene population to be preserved. The actual effect of this tactic may, or may not, be a partial answer to the problems of genetic drift.

The role of agencies, publications, etc.

I have mentioned that a number of institutions have begun the process of automating their data storage and retrieval systems for systematic collections. These institutions will continue this work under any circumstance, but at the moment, there is no overall coordination between different organizations. Many different computer programs are being used, on a number of different computer machines of differing manufacturers. There have been many arguments about whether one program or other serves the purpose better, but the argument is usually directed to the wrong problem. The most important agreement needed is with respect to some minimal set of descriptors for the accessed materials. If the arguments could be directed to establishing the proper descriptor set, there would be more advances, because all that is required for most sophisticated computer-aided programs is a set of data that have been structured to fit in certain ways, with different computing machines accepting different structured data. Standardization of the data structures on magnetic tape would go far to solve many problems.

Organizational structure for the purposes of conservation of genetic resources would be nearly the same as there exists today with respect to any large, multi-disciplined biological function. There will have to be a direction given by some set of offices, and these must have expert data management teams, guided by biologists who have had experience in systematic work. This is perhaps the single most important recommendation that I make: the management of the conservation process and of the data of genetic resources, must be by biological scientists. Individuals with systems training in the computer sense can act as consultants, but, by and large, if they are not well trained in

systematic biology, they will not be effective in the processes outlined above.

A monitoring group for conservation and for management of the data should be established. It will be necessary to maintain some continuity for a long time, because the process of conservation will not be a short-term function. The National Academy of Sciences itself should have a standing committee to govern the functions of both conservation and the data management. Various branches of government, in whatever departments the institutions are located, would still have responsibility for various parts of the overall activity--HEW, Interior, Agriculture, etc., would all continue their respective functions. To ensure that certain activities or groups of organisms do not get lost, and that there is no duplication of effort these governmental bodies should be in constant communication. These could share a common data bank of genetic resources conservation material and thereby go a long way towards preventing the problems of oversight or duplication.

The type of publications needed for conservation need not be any other than a report series for conservation methods, for groups of organisms conserved, and for information exchange among the individuals and organizations carrying out conservation functions. The governing organization, if one is established, should supply these functions. Types of reporting mechanisms should be examined and established when the objectives of such organizations are known. Provision for long term maintenance of the data files must be made. Many previous governmental efforts have not included such provisions, and much valuable work has been lost as a result. Some of the most serious of these were the great World War II efforts to collect quinine, rubber and other commodities in

tropical America. Other efforts with guayule (Parthenium argentatum) during World War II suffered a similar fate.

Data management for conservation of genetic resources.

The conventional wisdom with respect to describing data on conservation of genetic resources, and that describing the genetic resources themselves is that somehow, some way, each individual will take care of the data which he has obtained and uses, and no particular effort need be made centrally to organize, direct, collate, store and use these data. Such an attitude leads us to the point today where, if there were data, we would not know where it is, what its quality or quantity, what confidence we can have in it, and how it would fit into a larger scheme of knowledge about our organisms.

Today, the most useful knowledge about genetic resources resides in the holdings of museums and herbaria (and similar institutions for microorganisms), where whatever information we have on the organisms themselves is maintained. It is not always easy to retrieve data or information from these institutions, because there is usually only one way to enter the stored resources, and that is through the names of the organisms. If one wishes to retrieve all the names of the plants for a certain region, for example, it would be very difficult to derive such a list from the museum or herbarium because of the single entry organization of the institution. However, we must use these institutions because they possess the best possible data banks about organisms to be found in any institution. There is a movement among many such institutions to place data about their holdings into computerized storage and retrieval systems (see, for example, the SELGEM system of the Smithsonian, or the TAXIR system used at the USDA Regional Plant Introduction Station at Washington State University, Pullman, Washington). But the major problem is that of understanding the need for such systems--biologists

sometimes have not fully appreciated the need for a data management system. It would be instructive to all to know how much actual time and money goes for data management even though not specified. It would be further shocking to administrators of funds to know what casual attitudes many scientists have toward their principal product, data.

Data management is, or should be, an integral function associated with conservation of genetic resources, because if we don't know what we have, and what we are doing now, we cannot possibly know whether conservation is being accomplished, or whether we are merely paying lip service to some general concept. We cannot prove, by recorded data, that any particular organism is, or is not, being lost. Aside from large plants or animals whose existence is usually within the range of civilized man's observations, we cannot say with certainty that this or that species of plant is indeed on the verge of extinction. We have witnessed several cases in which some organism was declared extinct only to find that it showed up alive and well in some other unexpected part of the world. There are several examples, but among plants, perhaps the most famous one is that of the dawn redwood, (Metasequoia glyptostroboides) known as a fossil in the US for a long time, and thought to be extinct, was found during World War II in China, and shortly afterwards brought out and cultivated in many places around the world. It is no longer considered an endangered species. But the point is that we should not use these types of examples as an excuse not to be more scientific in data recording, storing, etc. The best institutions for these purposes are clearly those with the longest record of management of plants and animals--zoos, botanical gardens, museums, herbaria, live-culture collections, etc. What is important is that simultaneously there be as

critical and powerful an organization for the purposes of data mangement as there is for the actual conservation of the organisms.

There are a number of outstanding agencies, public and private, that maintain information storage and retrieval systems of the published literature of biology such as USDA, Library of Medicine, BIOSIS, Chemical Abstracts, etc. BIOSIS, which publishes a number of different types of information sources, cannot accept the responsibility for management of raw data becuae the financial arrangements of this organization require that it recover its cost, and there is little assurance that there is a sufficiently steady market for raw data pertaining to genetic resources to make it profitable for this organization to maintain. Other institutions of great interest are the National Agricultural Library and the National Medical Library. Both of these organizations are publicly charged to keep up with, disseminate, information about the published literature in their respective disciplines. It is likely that their missions are such that some very isolated works in pure biology are not incorporated into their information storage and retrieval systems. These institutions, too, cannot cope with unpublished data that should accumulate with conservation of genetic resources, in which the data are merely descriptions of the actual plants or animals that are maintained or conserved in one way or other.

The data of importance to be kept are those describing the what, where, who, when and why of the conserved species, or conserved regions. Data about the organizations and individuals carrying on conservation work is also important. Both of these types of data should be dynamic, continuously updated, maintaining new records, checking validity of old ones, etc. There are critical needs for standards of description,

as exist in chemistry and physics. The needs for designing and establishing networks for exchange of data are great and unfulfilled. Many institutions need not only funding to update their system of recording and storing, retrieving and transmitting, data and materials, but also encouragement that their efforts are appreciated and needed. Continuous research into means and methods of data management for all types of biological data is required. Not only information storage and retrieval systems are needed, but programs for determining diversity within species and in areas of growth, multivariate analysis such as clustering methods, computer-aided graphics for mapping, contouring, etc. also are important. As important as any other aspect of data management is a first-class training program for students and research workers alike, to insure that proper procedures are understood by all, and the significance of accurate observation and recording is carried out. There are many new means for gathering data, from remote sensing to electron microscopic to protein analysers, but the means for using these data are, in many places (and particularly in the financially depressed groups that carry out conservation of genetic resources) primitive. This is a bottle neck in the whole process which, if not overcome, will certainly lead to eventual failure of any program of conservation that we may wish to install.

Though we are charged with discussions to conserve genetic resources, I cannot start this type of discussion without considering the major problem--man is the major destroyer of other genetic resources. Until man controls his own numbers, there will be little opportunity to conserve anything but a minor group of plants or animals that feed or clothe him. The major reason for maintenance of large numbers of species that are not in the category of direct suppliers of need to man is that we never know what the next set of needs will be, nor from what new source we will derive some important product. Man's own inventiveness is far surpassed by naturally occurring organisms, which can probably supply at least the precursors to many needs of today and tomorrow. But that is not all--there must be reverence for life, and man must not be so egocentric that he cannot see the rights of other species.

What should be conserved? We can document those plants and animals that are of immediate use, and say which of these serve purposes for research or testing in medical programs or genetic studies, but these are already fairly well known, and our major problem is to specify which wild materials need to be conserved. Rarity of occurrences may yield some bases for designating conservation, but this may be a problem that is beyond us to solve (in economic terms). Perhaps "primitive man" (or those people we so designate, whether they are more "primitive" than we is a question of definition) provides some response to the problems. Their lives are more directly related to plants than ours. I have invited Dr. Robert Bye of the Department of EPO Biology, University of Colorado, Boulder, to make recommendations on this type of conservation program. His discussion is included. Dr. Norman Farnsworth of the College of Pharmacy, University of Illinois, Chicago, has agreed to write about

needs for the conservation of medicinal plants.

Most conservation must be based on areas wherein reside certain types of animals and plants and this is more meaningful if for no other reason than we can suggest these more readily than we can individual species. The species that reside in varying habitats probably possess similar properties to those in similar habitats elsewhere, even though species composition may be different. This common observation has been made many times over, as, for example, the eastern slopes of the Rocky Mountains have an environment similar to that of the eastern slopes of mountain chains in several other parts of the world, and species from one can usually be readily grown in another.

I cannot herein specify, therefore, any one more important plant for conservation than another. Priorities have been set to conserve certain cultigens because either there are insufficient funds, investigators, or facilities, to conserve all of them. The priorities are, however, very hotly contested, and there is no agreement by large numbers of biologists, each of whom has some other basis for desiring something preserved. But priorities must be established, and these quickly, but not in haste as has so often happened. Priorities can be established, but this committee does not have the time nor funds to do so.

Who makes the decisions? Today, whatever decisions have been made were made by biologists of a wide spectrum of interest, many in the government's employ, many from private organizations such as the Sierra Club and other conservation-minded groups. There is little use recounting here what is done by various national governmental agencies such as EPA, ERDA, and others. Their roles are already well advertized. The main difficulty with the decision-making process is the ad hoc nature of the

decisions. Seldom are there sufficient real data to make a choice, and it is only by the "seat of the pants" type of knowledge that we really make decisions. There is a crying need for better documentation of genetic resources, even in our most common groups of food plants. There are few methods and data to describe the variability or diversity of any one species, which might be one index of what needs conservation.

How efforts should be organized. The role of various societies has not been explored by our committee, but it is certain that without general inclusion of the scientific societies, we can expect little advance. Much of the work will have to be voluntary, but some assistance (if nothing more than establishing certain guidelines for data gathering) should be given by some central agency. The NSF program in conservation needs great expansion of its fundings to give better support to a well-balanced conservation effort. I have noted earlier that the NAS itself should consider a standing committee to govern conservation efforts. Without such a role, no coordination is likely to occur. There is a crying need for some working body to be established, under the governance of the NAS, where coordinative procedures are brought together, and where data management (or at least the major descriptive data banks of both species and people) is done. My observations and experience in the international field of conservation of genetic resources of crop plants, is that no real conservation has been fostered by a group that only advises and lacks an operating arm to carry out its recommendations. If that is true for the international scene, it is equally true in the US.

UNIVERSITY OF COLORADO

BOULDER, COLORADO 80302

Department of Environmental,
Population and Organismic Biology

May 18, 1977

Dr. N. R. Farnsworth
Dept. of Pharmacognosy and Pharmacology
University of Illinois
P.O. Box 6998
Chicago, Ill. 60680

Dear Norm:

Thank you so much for your very good and very prompt contribution to the genetic resources committee of the NRC. It is much appreciated. I hope that you have already been notified of its receipt in Washington.

Sorry it took me so long to get around to sending this letter.

Sincerely,

David J. Rogers
Professor of Biology

April 18, 1977

Ms. Veronica Pye
National Research Council
2101 Constitution Avenue, N. W.
Washington, D. C. 20418

Dear Ms. Pye:

Enclosed please find the report requested by Dr. Rogers, concerning the most important medicinal and related plants used currently in the United States that should be considered with regard to a need for conservation.

If you feel that the report needs further explanation or expansion, please feel free to contact me.

Sincerely yours,

Norman R. Farnsworth
Professor of Pharmacognosy

NRF:h

Encl. (1)

cc: Dr. D. Rogers ✓

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

OFFICE OF THE
EXECUTIVE DIRECTOR

September 21, 1976

*replied
9/28/76*

Dr. David J. Rogers
Department of Biology
University of Colorado
Boulder, CO 80302

Dear Dr. Rogers:

The Division of Biological Sciences of the Assembly of Life Sciences recognizes several areas of responsibility. Of these, one concerns the whole area of Resources, under which broad heading is encompassed the present and future adequacy of research materials, equipment, genetic stocks, natural areas, laboratory animal resources and reference collections. We are fortunate in having obtained funds to undertake the first step in a study of germplasm resources, which we hope will generate momentum for future, more specific studies.

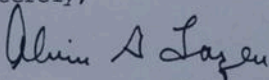
In common with most Academy studies, the task will be undertaken by a committee of about twelve specialists. The group will be asked to examine the issues surrounding germplasm resources in the larger sense of that term, to summarize the events of the last several years, identify critical problems, and propose plans of action that would deal with them effectively. The term germplasm, as used here, includes animal and human cell-lines, crop plants, livestock, microorganisms, natural communities, and research organisms. A concise report should be prepared within about a year.

It is my privilege, on behalf of Dr. James Ebert, Chairman of the Assembly, and with the approval of President Handler, to invite you to accept appointment as a member of this committee. We hope very much that you will feel that

you can undertake the responsibility, and enclose a response sheet for your convenience in replying. Should you need additional details, please feel free to contact Dr. Veronica Pye, Staff Officer of the Division assigned to this project, whose telephone number is 202/389-6201.

On the chance that you may not be entirely familiar with Academy policies in this regard, the point should be made that while no honoraria are provided committee members, travel and subsistence expenses are reimbursed, and travel insurance is provided. A brief paper describing the Assembly is also enclosed.

Sincerely,

A handwritten signature in dark ink, appearing to read "Alvin G. Lazen". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

Alvin G. Lazen, Ph.D.
Associate Executive Director

Enclosures

The Assembly of Life Sciences

RUSSELL B. STEVENS

Division of Biological Sciences, National Research Council Assembly of Life Sciences, Washington, D.C. 20418

To comprehend the Assembly of Life Sciences, one must have some feel for the nature of the National Research Council and for the related elements that, for want of a better term, are often referred to as the "Academy complex." While hardly accidents of history, much of the present structure and activity of these institutions reflects the manner in which they developed and the historical context within which they grew. Recent formal documents summarize the matter in the following terms:

The National Academy of Sciences (NAS) is a private, co-operative society of distinguished scholars in scientific and engineering research, dedicated to the furtherance of science and its use for the general welfare. Its charter, an Act of Incorporation passed by the U.S. Congress and signed by Abraham Lincoln on March 3, 1863, named the first 50 members of the Academy; empowered it to create its own organization and bylaws; and called upon it to serve as an official adviser, upon request and without fee, to the Federal Government on any question of science or technology.

The National Academy of Engineering was established in December 1964, under the charter of the NAS, as a parallel organization of distinguished engineers, autonomous in its administration and in the selection of members, and sharing with the Academy of Sciences its responsibility for advising the Federal Government.

Most of the activities undertaken by the two Academies are carried out through the Commissions and Assemblies of the National Research Council, which draws on a wide

cross section of the nation's leading scientists and engineers for advisory services to government agencies and the Congress.

The Institute of Medicine was chartered by the National Academy of Sciences in the summer of 1970 to deal with problems associated with the delivery of adequate health services to all sectors of society—a goal that is increasingly viewed as a basic human right. In pursuit of this goal, the Institute conducts studies of policy issues related to health and medicine; prepares position statements on these issues for public consideration; cooperates with the major scientific and professional societies in the field; identifies qualified individuals to serve on study groups in other NAS-NRC units; and disseminates information to the public and the relevant professions.

The Research Council was organized by the Academy of Sciences in 1916, at the request of President Wilson, in the interest of national preparedness. It served the double purpose of encouraging a broader participation by American scientists and engineers in the Academy's service to the nation and—more importantly—of "bringing into co-operation" the scientists and engineers of industry, academic institutions, and the Federal Government.

THE PLACE OF THE ASSEMBLY WITHIN NRC

Organization takes two quite distinct forms within the National Research Council. On the one hand—viewed in detail—a table of organization is no more than a cross section of what is going on at the time when the table is devised. On the other—

a more general view—the NRC has been recently restructured into a cluster of eight relatively large units, four of which are titled Assemblies and four Commissions. Initially thought of as distinctly different, they are increasingly alike in their operations. If there is a dimension on which the Assemblies and Commissions can be distinguished from each other, it is that the former deal more directly with the scientific disciplines, the latter with interdisciplinary matters.

Figure 1 suggests not only the general nature of the NRC, but shows something of the place of the Assembly of Life Sciences (ALS) within that body. Historically, ALS was formed by merging the earlier Division of Medical Sciences with the biology component of the former Division of Biology and Agriculture. The strictly agricultural activities of that Division are now incorporated in the Commission on Natural Resources. Not long thereafter, the Advisory Center on Toxicology, formerly in the Division of Chemistry and Chemical Technology, was made a part of the new Assembly.

THE ASSEMBLY

It would be misleading in the extreme to regard the organization of the Assembly as fixed, even to the extent that academic colleges and departments are fixed. Quite the contrary, Assembly structure primarily reflects Assembly function, which is a kaleidoscopic array of highly diverse activities, differing greatly in size, duration, funding level, and manner of operation. In a very general sense, however, it consists of a large Division of Medical Sciences,

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

DIVISION OF BIOLOGICAL SCIENCES

October 22, 1976

MEMORANDUM

TO: Members of the Committee on Germplasm Resources

FROM: Veronica I. Pye *Veronica Pye*

SUBJECT: First meeting

The first meeting of the Committee on Germplasm Resources will be held on Saturday November 6th and Sunday November 7th at the Academy building in Washington, D.C. Details about the arrangements for this meeting are enclosed. An article by Dr. Russell B. Stevens outlining the role of the Assembly of Life Sciences within the National Research Council is also enclosed for your perusal.

The task of the Committee is to review the problems of the preservation and utilization of germplasm resources. The specific charge is

"...to examine the issues surrounding germplasm resources in the larger sense of that term, to summarize the events of the past several years as they relate to the issues, to assess the organizations and institutions that have embarked on activities addressed to one or more of the issues identified, and to propose a plan of action whereby some of the more critical problems can be effectively dealt with."

The study is expected to take approximately one year to complete. It would be helpful if you could give some thought as to what these activities and problems are and how they might best be addressed, particularly within your own discipline and sphere of interests.

I have compiled several lists which may be of some use. They give the literature we have on hand in our files. Much of it was obtained in response to a circular letter that I sent to all persons listed in the Journal of Heredity

articles giving information about Genetic Stock Centers and Newsletters/Bulletins. Some of the replies received pointed out specific problems that certain of these centers are now facing. This information will be distributed at the meeting.

Most of you will have seen the recent editorial in Science (see enclosure). The sentiments expressed in this article show that the study to which you are about to contribute is very much needed and is taking place at a time when scientists in many fields are realizing the full implications of the need to conserve germplasm resources.

Enclosures

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

100 Constitution Avenue Washington, D. C. 20418

DIVISION OF BIOLOGICAL SCIENCES

COMMITTEE ON GERMPLASM RESOURCES

First Meeting

Dates of Meeting: November 6, 1976
November 7, 1976

Location: National Academy of Sciences
2101 Constitution Avenue
Washington, D.C. 20418

Room: NAS 200 Tel. 202/389-6830

Time: The meetings will start at 9:00 am both days. It is anticipated that the meeting will draw to a close by mid afternoon (3 pm-4 pm) on Sunday and travel arrangements may be made accordingly.

Accommodation: Hotel reservations have been made for all Committee members that requested them. You should by now have received a letter of confirmation giving the address and telephone number of the hotel, and the dates of the reservation.

Lunch: Arrangements for lunch on Saturday have been made at the NAS refectory. A reservation at a nearby restaurant will be required for Sunday.

Miscellaneous: Please sign in with the receptionist/guard at the Academy. You will be directed to NAS 200. Details concerning reimbursement of travel and subsistence and other related administrative details will be dealt with in the early part of the meeting.

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

DIVISION OF BIOLOGICAL SCIENCES

COMMITTEE ON GERMPLASM RESOURCES

November 6-7, 1976
NAS 280

AGENDA

November 6

9:00 am	Introductions and Welcome--Chairman Elizabeth S. Russell
9:15 am	The Role of the ALS within the National Research Council--Russell B. Stevens
9:30 am	Discussion of Bias Statements--Veronica Pye
9:45 am	Administrative Remarks--Veronica Pye
10:00 am	Discussion of the charge to the Committee and the ways in which this charge may be carried out.
Noon	Lunch
1:00 pm- 5:30 pm	Resumption of discussions

November 7

9:00 am	Allocation of areas of interest and specific tasks.
Noon	Lunch
1:30 pm	Summaries and Conclusions Set date for next meeting

It is anticipated that the meeting will draw to a close between 3:00 pm and 4:00 pm on Sunday.

Species Preservation

In 1973 Congress passed the Endangered Species Act to ensure that the well-being of endangered species will not be jeopardized by the activities of federal agencies or departments. The recent publication of an official list of threatened and endangered plant and species* represents a first step toward attaining this goal. To prevent harm through habitat destruction, further federal effort is being made to designate habitat requirements of endangered species. In the private sector, industry is preparing environmental impact statements (EIS's) to assess, among other things, whether proposed projects represent threats to endangered species.

There are compelling justifications for preventing needless extirpation of species†. We have a common evolutionary heritage with other organisms, and find inspiration and beauty in many of them; thus, in some sense we are impoverished by the elimination of other species. More pragmatically, species are genetic and chemical resources that are useful in plant breeding, pest control, and biomedical research. Clearly, loss of species reduces this resource base.

Present efforts in the public and private sectors are a welcome beginning, but may be insufficient to guarantee long-term preservation. They are essentially negative in their concern not with preservation, but with preventing decimation of species. Further, in the case of plants and many inconspicuous animals, few of the field personnel working on EIS's have the training and experience required to recognize these species in the field.

A longer-term, more positive approach seems essential. The only sensible basis for protection of endangered species is preservation of sufficient suitable habitat. If such habitats were carefully chosen on a regional basis, they could, in addition to harboring endangered species, represent prime examples of natural communities. The search for endangered species and analysis of their habitat requirements would have to be carried out by trained field taxonomists and ecologists. It might be best to begin by systematically screening public lands. Such habitats as might be found could be set aside to be managed, if necessary, specifically for preservation of endangered species.

Such an extensive search and study effort would take many years of field-work, and it would be costly. Yet, only through such efforts can we know which species really need special attention for their preservation. In addition, this approach could reduce the cost of EIS's in several ways. Substantial sums of money are now being spent to determine whether endangered species reside on sites proposed for construction. The approach outlined here could eliminate the need for this aspect of EIS's, which could have the additional benefit of allowing EIS writers to focus directly on the more complex aspects of assessing potential impact. Further savings should result from an improved efficiency of locating sites acceptable for new construction. Once the locations of preserved habitats have been made public, it could be determined at the outset whether a particular site is unacceptable in terms of risk to endangered species, instead of discovering this after an impact assessment study is completed. Finally, preserved natural habitats would provide a standard for judging the quality of habitats to be destroyed or significantly altered by a particular project.

In the long run, it would seem prudent to approach the problem of species preservation as part of the broader problem of regional habitat preservation.—P. A. HARCMBE, *Department of Biology, Rice University, Houston, Texas 77001*; and P. L. MARKS, *Ecology and Systematics, Cornell University, Ithaca, New York 14853*

*"Threatened or endangered fauna or flora," *Federal Register*, vol. 40, No. 127, part V, July 1975. †N. Myers, "An expanded approach to the problem of disappearing species," *Science*, vol. 192 (1976), page 108.

DIVISION OF BIOLOGICAL SCIENCES

Committee on Germplasm Resources

*Dr. Elizabeth S. Russell, Chairman
The Jackson Laboratory
Bar Harbor, ME 04609
207/288-3373

Dr. Barbara Bachmann
Human Genetics Department
Yale Medical School *Microbes*
333 Cedar Street *E. coli*
New Haven, CT 06510
203/432-4620

Dr. Kurt Benirschke
Department of Pathology, M-012
University of California,
San Diego *200 specimens*
La Jolla, CA 92037 *endangered sp.*
714/452-4322

*Dr. Robert W. Briggs *amphibians*
Department of Zoology *Rana, axolotls*
Indiana University
Bloomington, IN 47401
812/337-3788

Dr. Richard H. Goodwin
Box 1445 *ecosystem*
Connecticut College *preservation*
New London, CT 06320
203/873-8514

Dr. Judith Grassle
Marine Biological Laboratory
Woods Hole, MA 02543
617/548-3705, ext. 263
marine invertebrates

Dr. Burke H. Judd *Drosophila*
Department of Zoology
University of Texas
Austin, TX 78712
512/571-5044

Dr. Charles F. Lewis
National Program Staff - PES
Agricultural Research Service
U.S. Department of Agriculture
BARC-West
Beltsville, MD 20705
301/344-3884

Dr. Peter Mazur *cryobiology*
Biology Division *conservation*
Oak Ridge National Laboratory
Oak Ridge, TN 37830
615/483-8611, ext. 3-7483

Dr. David L. Nanney
Department of Genetics and
Development *Protozoans*
University of Illinois *Paramecium*
Urbana, IL 61801 *Tetrahymena*
217/333-2308

Dr. Thomas H. Roderick *Rodents*
The Jackson Laboratory
Bar Harbor, ME 04609
207/288-3373

Dr. David J. Rogers
Department of E.P.O. Biology
University of Colorado
Boulder, CO 80309
303/492-7187 or 7687

*NAS Members

Indefinite terms--starting September 1, 1976.

Dr. Veronica I. Pye, Staff Officer
202/389-6201

October 29, 1976

Dr. Veronica I. Pye
Staff Officer
National Research Council
Division of Biological Sciences
2101 Constitution Ave.
Washington, D.C. 20418

Dear Dr. Pye:

Thank you for sending the information on the new committee. I am very sorry that I shall not be able to attend the first, important meeting. I enclose a few points that I feel should be dealt with somewhere in the deliberations of the committee, but have no idea when or in what setting these are most appropriate. Let it be said that my concerns and interests have been largely with the higher plants, and in this group, those of most immediate concern of mankind, economic plants. But this does not make me an agriculturist-- I am a systematic botanist by training and interest, and therefore concerned with all the plants. I firmly believe that botanical gardens are of the utmost importance in dealing with conservation of genetic resources, for by actual demonstration, these types of institutions have carried on over a longer period of time in this function than any other group of organizations interested in plants.

I do not know whether the above is helpful or not. I trust that it is. I wish the committee the best of luck and success, and hope to join forces with it at the next meeting. As far as my calender is concerned, I project no heavy commitments from January through March, other than normal teaching loads, which I think can be worked around (particularly if you continue to meet on weekends).

Sincerely yours,

David J. Rogers
Professor

DJR:js

enc.

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

DIVISION OF BIOLOGICAL SCIENCES

October 20, 1976

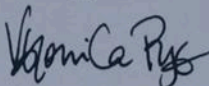
Dr. David J. Rogers
Department of EPO Biology
University of Colorado
Boulder, CO 80309

Dear Doctor Rogers:

The dates for the first meeting of the Committee on Germplasm Resources have been set for November 6th and 7th. I realize that this means that you will be unable to attend, however it was virtually impossible to arrange a more convenient date before the middle of December. Unfortunately it is rare that we can arrange for all members to attend committee meetings. I will send you a full report of the proceedings. Would you send me a calendar for January through March, indicating the days you would not be able to attend another meeting? I will arrange the second meeting so that you will be able to attend. If there is anything that you particularly wanted to bring to the Committee's attention at the first meeting, I will be pleased to see that it is on the agenda and discussed. I would require detailed information from you on any such matters as soon as possible.

I look forward to hearing from you.

Sincerely,



Veronica I. Pye
Staff Officer

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

DIVISION OF BIOLOGICAL SCIENCES

October 6, 1976

MEMORANDUM

TO: Members of the Committee on Germplasm Resources

FROM: Veronica Pye *Veronica Pye*

SUBJECT: Date for the first committee meeting

First, I would like to thank you for agreeing to serve on this committee. I'm sure it will be both an interesting and productive study. We have received replies from nearly all of the invitees, but the committee roster is still not quite complete. Rather than delay the first meeting any further I am sending you a calendar, please indicate the dates on which you would not be able to attend a meeting in Washington, D.C. Please phone me about convenient dates if you are able to attend a meeting in the latter part of October, this will allow more time to make the arrangements.

Travel vouchers for reimbursement of travel and subsistence costs will be distributed at the meeting. In addition the Academy provides accident insurance for committee members while traveling on authorized Academy business both within and outside of the United States. Coverage is automatic and unless otherwise specified the death benefit will be paid to the spouse or the estate. Unless you wish to make other arrangements to change the beneficiaries, no forms need to be completed. We will be happy to assist you with hotel reservations when the meeting date is set.

Enclosures

Partial Listing

COMMITTEE ON GERMPLASM RESOURCES

- * Dr. Elizabeth S. Russell, Chairman
The Jackson Laboratory
Bar Harbor, ME 04609
(207) 288-3373

Dr. Barbara Bachmann
Human Genetics Department
Yale Medical School
333 Cedar Street
New Haven, CT 06510
203/432-4620

Dr. Kurt Benirschke
Department of Pathology, M-012
University of California,
San Diego
La Jolla, CA 92037
714/452-4322

*Dr. Robert W. Briggs
Department of Zoology
Indiana University
Bloomington, IN 47401
812/337-3788

Dr. Richard H. Goodwin
Box 1445
Connecticut College
New London, CT 06320
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Department of Zoology
University of Texas
Austin, TX 78712
512/471-5044

Dr. Charles F. Lewis
National Program Staff - PES
Agricultural Research Service
U.S. Department of Agriculture
BARC-West
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Dr. Peter Mazur
Biology Division
Oak Ridge National Laboratory
Oak Ridge, TN 37830
615/483-8611, ext. 3-7483

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University of Illinois
Urbana, IL 61801
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Dr. David J. Rogers
Department of E.P.O. Biology
University of Colorado
Boulder, CO 80309
303/492-7187 or 7687

*NAS Members

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

DIVISION OF BIOLOGICAL SCIENCES

December 21, 1976

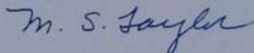
Dr. David J. Rogers
Professor of Biology
Department of Environmental,
Population and Organismic Biology
University of Colorado
Boulder, Colo. 80309

Dear Doctor Rogers:

I have made reservations for your trip to Washington on United's flight #632 leaving Denver at 12:00 Noon and arriving at Dulles Airport at 5:15 pm on Friday, January 28th. There is limousine service from Dulles into town. Your return reservation is on United's flight #167 leaving Dulles at 5:20 pm Sunday, January 30th, and arriving in Denver at 7:10 pm. The tickets will be sent to me on December 30th and I will send them to you registered mail.

You also have confirmed reservations for a single room at the Park Central Hotel, 705 - 18th Street, N.W., Washington, D.C. 20036, for the nights of January 28 and 29. We have had to guarantee the reservations and therefore would appreciate it if you would notify the hotel directly should you have any change in plans (Tel: 202/393-4700).

Sincerely,



(Mrs.) Margaret S. Taylor
Secretary to Dr. Russell Stevens

Dr Rogers. I am also sending you the material distributed at the meeting in the same package.

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

DIVISION OF BIOLOGICAL SCIENCES

November 12, 1976

MEMORANDUM

TO: Members of the Committee on Germplasm Resources

FROM: Veronica Pye *Veronica Pye*

SUBJECT: Minutes etc.

I enclose a brief set of "formal minutes of the last meeting. In addition you will find a lengthier version which consists of my own notes on the discussions. The reason for the two is that the minutes are kept in the Public Access File, whereas the discussions are privileged information available only to the Committee. I personally find the longer version helpful as a "memory-jogger"; should you not wish to receive this version in the future please let me know. I would be grateful for any corrections, etc.

The next meeting will be held on January 29th and 30th. Due to the fact that many meetings are being held that weekend, I have arranged for a meeting room in the Joseph Henry Building, JH-200A. This building is located at 21st and Pennsylvania Avenue, N.W., about six blocks from the main building.

I will arrange for three guest speakers to be present at that meeting. Please let me know as soon as possible if you require help with hotel reservations. The inauguration takes place the preceding weekend and there may be many out of town visitors.

Enclosures

Done 12/10/76

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

DIVISION OF BIOLOGICAL SCIENCES

Committee on Germplasm Resources

Minutes of the Third Meeting
March 12-13, 1977
Washington, D.C.

Members Present:

Elizabeth S. Russell, Chairman	Burke H. Judd
Barbara Bachmann	Charles F. Lewis
Kurt Benirschke	Peter Mazur
Robert W. Briggs	David L. Nanney
Richard H. Goodwin	Thomas H. Roderick
Judith Grassle	David J. Rogers

Staff:

Nancy Muckenhirn
Veronica I. Pye
Russell B. Stevens (Saturday only)

Guests:

Dr. Tom Gilbert, National Park Service/MAB Program
Dr. Eugene Hester, Fish and Wildlife Service
Dr. Robert Jenkins, Nature Conservancy
Dr. Stanley Krugman, U.S. Forest Service
Dr. Ed Kennedy, Biological Abstracts
Dr. Richard Saunders, North American Salmon Research Center

Dr. Russell opened the meeting at 9:00 am. The minutes of the last meeting were approved without alteration. A mistake in the material distributed prior to the meeting was pointed out, the date of the ALSEC minisymposium on Germplasm Resources was May 1975, not 1977 as indicated.

Dr. Hester spoke about the Department of the Interior's programs from the point of view of frozen stocks, preservation of natural ecosystems and endangered species.

Dr. Stanley Krugman spoke about conservation of forest germplasm and how such programs must necessarily differ from those aimed at short-lived homozygous crop plants.

Dr. Tom Gilbert outlined the Man and the Biosphere Program, in particular the project entitled "The Conservation of Natural Areas and the Material they Contain."

Dr. Ed Kennedy talked about information transfer, especially of references, citations to articles. The feasibility of modifying such systems to handle raw data was discussed.

Dr. Richard Saunders spoke about fish germplasm with particular reference to salmonids. The effect of environmental changes associated with industrialization on the depletion of fish stocks was discussed.

Dr. Robert Jenkins described the origins, structure and aims of The Nature Conservancy. He outlined the State Heritage Programs and said he hoped such programs would lead to the publication of a National Atlas of Diversity.

The meeting drew to a close at 5:30 pm. Saturday.

Sunday, March 13, 1977

The Committee reconvened at 9:00 am.

Dr. Roderick elaborated on the Genetics Society questionnaires and asked for comments on the format, questions posed and potential mailing list no later than April 30.

The Committee then discussed what form its final report should take. The audience for such a report was identified as:

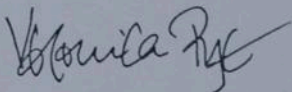
- i) the intelligent and concerned layman
- ii) Government officials
- iii) Scientists

A detailed list of contents was drafted and writing assignments allocated.

The date of the next meeting was set for June 4 and 5. The first draft of the manuscript will be reviewed at that

meeting. The meeting drew to a close at 3:30 pm, there being no other business.

Respectfully submitted,

A handwritten signature in dark ink, appearing to read "Veronica Pye", with a stylized flourish at the end.

Veronica I. Pye, PhD.

March 23, 1977

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

DIVISION OF BIOLOGICAL SCIENCES

January 6, 1977

MEMORANDUM

TO: Members of the Committee on Germplasm Resources

FROM: Veronica Pye *WP*

SUBJECT: January 29-30th Meeting

Enclosed is an agenda for the forthcoming meeting. Representatives from NIH, NSF, ATCC and an expert on live-stock will join the Committee at various times on Saturday. In addition Dr. David Rogers will give a brief outline, similar to those we heard at the last meeting that he was unfortunately unable to attend.

An article entitled "The Conservation of Non-Resources" which appeared in the American Scientist is enclosed for your use, at the suggestion of Dr. Bachmann.

Since our last meeting the Academy has changed its travel reimbursement rules. The three main differences are:

1. The maximum rate for actual and necessary expenses has been changed to \$50.00 per day.
2. The quarter system has been introduced. This means that if you start your journey to D.C. at 7:00 pm on the day preceding the meeting only 1/4 of a full day's allowance may be claimed, i.e. \$12.50. The return journey works the same way.
3. The mileage for private automobile use is now 15 cents a mile.

The forms that will be distributed at the meeting will reflect these changes.

Also enclosed is an identification card for your signature. You may be asked to show this to obtain the special hotel rates.

Enclosure

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

DIVISION OF BIOLOGICAL SCIENCES

Committee on Germplasm Resources

Minutes of Meeting Held January 29-30, 1977

Present:

Dr. E. S. Russell (Chairman)
Dr. Barbara Bachmann
Dr. Kurt Benirschke
Dr. R. H. Goodwin
Dr. Judith Grassle
Dr. Burke H. Judd
Dr. Charles F. Lewis
Dr. Peter Mazur
Dr. T. H. Roderick
Dr. David Rogers

Absent:

Dr. Robert W. Briggs
Dr. David Nanney

NRC Staff

Dr. Nancy Muckenhirn (ILAR)
Dr. Veronica Pye
Dr. Russell B. Stevens (Saturday only)

Invited Speakers (Saturday only)

Dr. Clair E. Terrill, USDA/ARS
Mr. William Sievers, NSF, Environmental Biology Division
Dr. Richard Donovick, Director, American Type Culture
Collection
Dr. Leon Jacobs, Assistant Director, Collaborative Research,
NIH

Dr. Russell opened the meeting at approximately 9:00 am.
The minutes of the meeting of November 6-7 were approved
without alteration. Dr. David Rogers was introduced to the

rest of the Committee. Drs. Briggs and Nanney sent their regrets as they were unable to attend the meeting due to bad weather conditions.

Dr. Terrill described the situation concerning the preservation of germplasm from livestock. He dealt with cattle, sheep, swine, rabbits, goats and poultry from the point of view of food production, present efforts to conserve germplasm, breeds and strains that are in danger of being lost and research needs.

Dr. Mazur reported on the CIBA symposium held in London January 21, 1977 on Cryobiology.

Mr. William Sievers outlined the Research Resources Program's (NSF) interest and responsibility for germplasm resources and handed out information about NSF funding of Living Organism Stock Centers. These centers are considered to be a research tool for basic research. Throughout his talk Mr. Sievers emphasized NSF's reliance on guidance from specialists and said that every effort would be made to support collections deemed of high priority.

Dr. Richard Donovan reviewed the museum functions of the American Type Culture Collection and also gave figures for the numbers of cultures they distribute. He gave a short history of the ATCC.

Dr. Leon Jacobs spoke about the related activities that NIH is engaged upon or supports. He listed these activities by Institute. It was generally considered that NIH activities were more concerned with ensuring a numerical supply of certain animals rather than with conservation per se.

The meeting on Saturday ended at approximately 5:00 pm.

On Sunday Dr. Rogers outlined the difficulties in conserving the germplasm of tropical crop plants. He also spoke about the need for efficient and useful data management and the role of habitat preservation.

In the discussion that followed storage methods were discussed, as were the various steps involved in germplasm maintenance. Several problems were identified and noted.

The meeting objectives were discussed for the March meeting and tasks were assigned.

1. Committee members were requested to compile a list of contents for the final report. (This should reach us by February 21st.)
2. Committee members were requested to create an organizational chart of their own area of specialization. Similar charts will be provided for federal and private organizations.
3. Suggestions were made for invited speakers at the March meeting.

The date of the next meeting was set for March 12th and 13th, 1977.

Respectfully submitted.

Veronica Pye
Veronica I. Pye, Ph.D.
Staff Officer

April 27, 1977

Dr. Veronica Pye
Assembly of Life Sciences
National Research Council
2101 Constitution Ave.
Washington, D.C. 20418

Dear Dr. Pye:

I hope this report makes it by Friday, and if not, I'm sorry. This is a bad time of year for us and secretaries around the campus--we and they are madly finishing up the term. That partly explains the very poor condition of this report. But since it is to be completely reworked by you, I doubt that things will end up as they are now written.

You should have received a paper by Dr. Farnsworth, Pharmacy, Illinois, by now. He sent me a copy. I think it says some useful things in it, and you can probably splice it on.

With this report, I am also sending a rough draft of a paper by Dr. Robert Bye of our department, on an interesting idea for conservation of both people and crops--this is probably a little different attitude than has been expressed in other places, but it is one that I think has merit.

Sincerely yours,

David J. Rogers
Professor of Biology

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
NORTHEASTERN REGION

U.S. National Arboretum

Washington, D.C.

29 Nov. 1976

20002

Dear Dave:

Here is my outline of a project I have had
in mind for a number of years. Thinking about it
doesn't get it done. But if I were twins,
my shadow could tackle this project.

As ever,

Gred

—

Answered 12/6/76

An Encyclopedic Work on the Origin of Cultivated Plants. (A plan)

by J. H. Meyer
6 Nov. 1976

Purpose:

To bring together the latest information on the history, origin, genetics, taxonomy, and uses of the world's major (and some minor) crop and food plants. The plan would be to assemble the information in an encyclopedic format, with a list of pertinent references for each entry.

The aim would be to provide concise, accurate, up-to-date information in encyclopedic form, of the major and some minor crop plants in the United States and others which are not grown here, but form an important item of commerce, such as coffee, tea, cacao, bananas, coconut, vanilla, and a host of others.

The book would contain information on:

Centers of Origin:

Primary and secondary centers of ~~origin~~
genetic diversity, following the basic
concepts of Vavilov.

List of Plants:

A list of plant names be developed,
perhaps 1500-2000 - a minimum
of 1000. They would be listed in
alphabetical order by Latin name
generic name, but a cross reference
list to common name would also be
included.

History:

Each entry would include the latest
information, in capsule format, on
what is known on the history of the
plant (Zea mays, for example),
with information on center or
centers of genetic diversity.

Maps would be provided to show distribution of primary centers and also secondary centers of genetic diversity. As we know, ~~the~~ secondary centers (such as Ethiopia) may be of more importance than the primary center of origin.

4. Genetics:

Important information on the genetics and germ plasma potential would be provided. The genetic attributes of the plant and how this has contributed to the importance and development of the plant. The genomes of Gossypium (Cotton), races of wheat, barley, rice, etc. would be mentioned.

5. Taxonomy

The nomenclature of many cultivated plants is simply chaotic, mainly because taxonomists cannot be bothered about such everyday plants that have been interfered with by man and are not altogether God's own productions. Information should be provided to show how the wild forms differ from the cultivated forms of the species.

Each plant would be listed by its correct Latin name plus synonymy. Keys would be provided as a basis for identification. Identification is often a major problem in dealing with cultivated, and for this reason this encyclopedia would, if necessary, have a Taxonomic base.

for groups, such as Coffee, I have been to Ethiopia twice for purposes of collecting Coffea arabica germplasm. I would be in a position to contribute information on that group.

Hopefully, one could solicit others - taxonomists, geneticists, and others to contribute information.

Dr. Don Rogers, who is on the today's panel, is the world authority on Yucca or Manihot, and he might be prevailed upon to contribute information on this important economic group.

The idea would be to invite specialists, make one main editor, to contribute information.

I can see a project of this kind centered in Washington where there is a library and herbarium facilities.

are available. However, such a project is possible in a university or center with such facilities. But it would be highly useful to have a base with an herbarium specializing in cultivated plants.

BOTANICAL GARDENS, ARBORETA AND GENETIC RESOURCES CONSERVATION

The role of botanical gardens and arboreta as institutions of fundamental importance in genetic resources conservation is frequently overlooked by those in agriculture, but these institutions have long played a central role in these functions. The distinction between botanical gardens and arboreta is that (theoretically) the arboreta grow only woody shrubs and trees and botanical gardens are not confined to one type of plant or other. In practice, however, the differences are very small. Commonly, these institutions are thought to be only for the purpose of display of beautiful plants. While this is one important role (and through it, conservation of important germplasm) most of these types of institutions are much broader in objective and function. The living collections at botanical gardens range from the very rare plants (such as endemic or threatened species confined to small geographic areas) to those of some other type of importance, either scientifically or commercially. Frequently botanical gardens or arboreta are the owners of acreage in nearby countryside where conservation of natural areas is practiced. The planting objectives of each garden are different, and because this is true, a wide range of plant materials is maintained across the country. Usually a botanical garden will attempt to reproduce several different types of habitat in their greenhouses or outdoors, such as deserts, marshes and bogs, aquatic, forest, prairie, both tropical and temperate zones. Because of this diversity, a large sample of genetic resources of native and cultivated plants are maintained.

Most botanical gardens and arboreta have several types of research programs. Not only are they concerned with the classification of the diversity of plants on the earth, but they do research in such areas as conservation, physiology, genetics, horticulture, and others. Moreover, their library and

museum (herbarium) functions are the best documentary institutions in the world. By combining systematic research with the library and herbarium activities, we are today aware of the destruction of our environment. Botanical gardens and arboreta are also engaged in a function that is highly important in conservation, and that is seed exchange. Most of these institutions have certain types of plants they are willing to share with other institutions, and sometimes, these seed exchanges are the only place in the world to find some particularly valuable or interesting plant. Usually, the institutions publish "index semina" which is a catalogue of the viable seeds available for exchange.

A vital role of many botanical gardens is public education. Normally, the educational efforts are directed to the lay public, rather than to specialists. This very important activity is one of the means by which the public's awareness of the problems of destruction of genetic resources has been heightened, and by which more influence can be generated to support programs in conservation.

Financial arrangements to support botanical gardens is varied, from public federal funds (in a very small number of cases in the United States) through state, county and city funds. Many are associated with large universities. Almost all such institutions have additional private endowments, and in some outstanding cases, the only funding is from private resources. Needless to say, almost all such institutions today are in dire financial straits. They are usually considered as "luxury" or "expendable" expenses by politicians, and their funding is the first to be cut in public budgets.

In the United States, one of the most comprehensive inventories of important genetic resources of plants is maintained by a consortium of botanical gardens through the American Horticultural Society. The AHS inventory of botanical garden holdings is computerized, and is generally available for interested persons to use.

Thus, botanical gardens and arboreta are central to all activities associated with the conservation of plant genetic resources. They possess a trained cadre of botanists, field and greenhouse facilities, libraries, laboratories, herbaria, and a philosophy which is critical to the needs of conservation. It is highly desirable, even critical, that any efforts on a national scale to conserve both plant and animal genetic resources place the botanical gardens and arboreta of the country in a central role.

Maintenance of Natural Diversity: Approach and Recommendations

Robert Jenkins
The Nature Conservancy
Arlington, Virginia

THE ECONOMICS OF VANISHING SPECIES

FRANK T. BACHMURA†

The disappearance of living species is a fact of the world's current natural history.¹ This fact has important consequences for both internal and external economic policy. Systematic analysis of this phenomenon is not conspicuous in economic literature. Economic analyses of what are called "fisheries" and of forestry resources have appeared,² as have systematic analyses of the depletion of mineral and other non-renewable resources.³ None of these approaches, however, specifically deals with the economic aspects of the disappearance of species.

The "fisheries" literature deals with relative numbers of individuals within a species rather than with species disappearance. The influence of fishing techniques upon catches of various species, the regulation of open seasons and fishing equipment, and the relative supply and demand of various species are among the topics analyzed.⁴ In the case of some fish and aquatic mammals included under the "fisheries" heading there has been peripheral mention of the possibility of extinction.⁵ Systematic study of the exploitation of "non-fisheries" animal populations is relatively new.⁶

The extensive economic literature of non-renewable resources does not concern itself with the "extinction" of a particular element or

†Associate Professor of Economics, Indiana University.

1. See Comm. on Rare and Endangered Wildlife Species, U.S. Dep't of Interior, Rare and Endangered Fish and Wildlife of the United States (Resource Pub. 34) (1968) [hereinafter cited as *The Red Book*]; G. Allen, *Extinct and Vanishing Mammals of the Western Hemisphere* (Special Pub. 11, 1942); S. Anderson & J. Jones, *Recent Mammals of the World: A Synopsis of Families* (1967); P. Darlington, *Zoogeography* (1957); J. Fisher, S. Noel, & J. Vincent, *Wildlife in Danger* (1969); J. Greenway, *Extinct and Vanishing Birds of the World* (1958); F. Harper, *Extinct and Vanishing Mammals of the Old World* (1945); 8 Int'l Cong. of Zoology Proceedings: The Protection of Vanishing Species (XVI Int'l Cong. of Zoology 1964); G. Munro, *Birds of Hawaii* (1960); E. Schuhmacher, *The Last Paradises* (1967); and V. Ziswiler, *Extinct and Vanishing Animals* (1967).

2. See F. Christy & A. Scott, *The Common Wealth in Ocean Fisheries* (1965); S. Ciriacy-Wantrup, *Resource Conservation: Economics and Policies* (1952); J. Crutchfield, *The Fisheries: Problems in Resource Management* (1965); Gordon, *The Economic Theory of a Common-Property Resource: The Fishery*, 42 J. Pol. Econ. 124 (1954); Scott, *The Fishery: The Objectives of Sole Ownership*, 43 J. Pol. Econ. 116 (1955); and Smith, *On Models of Commercial Fishing*, 77 J. Pol. Econ. 181 (1969).

3. See President's Materials Policy Commission, *Resources for Freedom* (1952) [hereinafter cited as *The Paley Report*]; H. Barnett & C. Morse, *Scarcity and Growth* (1963).

4. Smith, *supra* note 2.

5. Christy & Scott, *supra* note 2.

6. L. Talbot, *The Meat Production Potential of Wild Animals in Africa*, Technical Comm. 16, (Commw. Agr. Bur. 1965); Pearsall, *The Conservation of African Plains Game as a Form of Land Use*, in *Exploitation of Natural Animal Populations* 343 (E. Le Cren & M. Holdgate eds. 1962).

To all the members.

Enclosure A

ABSTRACT

The lack of native crop plants in the United States necessitated the creation of a national System for the introduction and maintenance of plant germplasm needed in agriculture. This paper discusses the development and present organization of the National Plant Germplasm System which forms a coordinated network of institutions, agencies, and research units (State, Federal and private) working cooperatively to introduce, maintain, evaluate, catalog, and distribute plant germplasm. This national System is designed to meet the highly variable research needs of plant scientists in the United States, including minimizing genetic vulnerability of our major crops. The National Plant Germplasm Committee, as a spokesman for the System, advises on policy and coordinates activities to meet the immediate and long term national goals of United States agriculture.

THE NATIONAL PLANT GERMPLASM SYSTEM

Most U. S. Farm Crops Are Not Native

Most of the plants from which the U.S. derives its food and fiber were introduced from other countries. Only a few of our crop plants are native to this country. Some of the more important native plants, in terms of economic worth to U.S. agriculture, are sunflowers, cranberries, blueberries, strawberries, pecans, hops, range and forage grasses, (but not cereals), conifers, and hardwoods. Early explorers and colonists settling on the U.S. Eastern shore soon recognized the almost total lack of food and fiber crops. Indians, of course, used many wild plants, but Indian corn (maize), beans, squash, and tobacco were the only crops found to be of much use. With the exception of tobacco, all of these crops were brought into the U.S. from Mexico hundreds of years ago via early Indian tribes, and corn was by far the most important food crop. Consequently, incoming colonists were cautioned to bring seeds of most crops with them. This form of plant introduction continued almost up to the present with one of the more notable late introductions being Grimm alfalfa brought in by a German immigrant of that name.

With such a dearth of native crop germplasm and a shallow base of primitive cultivars, our modern agriculture depends on a coordinated system to introduce, evaluate, and maintain the germplasm obtained elsewhere. Furthermore, the complexity of our research demands an efficiently organized effort to assure that Federal, State and local institutions, and commercial breeders get the germplasm they need. No single agency can be expected to provide the germplasm required by the array of breeders working with a given crop.

Plant Introduction Has a Long History

The American government early recognized the need for a continuing search for more adaptable crops. As early as 1819, American Consuls overseas were requested to send useful plants back to the United States. From 1836 to 1862 the U.S. Patent Commissioner conducted plant introduction as a routine government policy. With the establishment of the U.S. Department of Agriculture in 1862, plant exploration was accelerated and by 1898 this activity became important enough to establish a Section of Seed and Plant Introduction. The essential elements of our present plant germplasm system have developed since this time. The Research and Marketing Act of 1946 presented the opportunity for establishing Regional and Interregional Plant Introduction Stations with funds and staff provided by both the Federal government and the various states.

We Need to Collect and Save Desirable Genes

There are large gaps in our base of genetic diversity of some crops, particularly the wild species and primitive varieties that may contain genes for disease and insect resistance and other desirable traits. Though they exist in many areas of the world, these resources are rapidly being depleted, displaced, or abandoned. Once lost, these sources of diversity will never again be available to mankind. The very nature of collection and assembling genetic resources requires international collaboration. The preservation, evaluation, and distribution of this broad array of germplasm and the awareness of the needs of breeders for introduced germplasm rests with the System of coordinated, cooperative Federal/State research programs.

National Plant Germplasm System

The National Plant Germplasm System is a coordinated network of institutions, agencies, and research units in the United States which work cooperatively to

introduce, maintain, evaluate, catalog and distribute all types of plant germplasm. Primary financial and administrative support for the components of the System comes from the Agricultural Research Service (ARS) of the United States Department of Agriculture and from the State Agricultural Experiment Stations (SAES). Commercial breeding and seed trade interests also contribute to and support the System.

The elements of the Plant Germplasm System are: (1) the ARS Germplasm Resources Laboratory at Beltsville, MD; (2) three ARS Plant Introduction Stations at Glenn Dale, MD, Savannah, GA, and Miami, FL; (3) four State-Federal Regional Plant Introduction Stations located at Pullman, WA (W-6), Ames, IA (NC-7), Geneva, NY (NE-9), and Experiment, GA (S-9); (4) the State-Federal Potato Introduction Station at Sturgeon Bay, WI (IR-1); (5) the ARS National Seed Storage Laboratory at Ft. Collins, CO; and (6) a large group of Federal and State Plant Germplasm Curators located throughout the United States. The Mayaguez Institute for Tropical Agriculture at Mayaguez, PR also has responsibility for maintaining some tropical germplasm. In addition, limited germplasm resources are maintained and continuously evaluated by the Interregional Virus-Free Deciduous Tree Fruit Laboratory at Prosser, WA (IR-2), and by Regional Project cooperators in the 50 states, Puerto Rico, Guam and the Virgin Islands. The location of the major stations for the National Plant Germplasm System are shown in Chart 1 and discussed in greater detail in Table 1. The relationship of these cooperating agencies is shown in Table 2.

Coordination of the research and service functions of these elements is achieved on three sequential levels. Each Agricultural Experiment Station and participating federal agency is represented directly or indirectly on technical committees related to regional or interregional stations. Scientists who serve as technical committee members on these projects not only collaborate in the evaluation of plant introductions but also formally represent the National

Plant Germplasm System and provide liaison among other scientists at their respective locations. Some of the representatives of each technical committee are members of the ARS Plant Germplasm Coordinating Committee which is internally advisory to ARS. Several representatives of each technical committee are also members of the National Plant Germplasm Committee (NPGC). The NPGC also includes representation from the National Council of Commercial Plant Breeders and the Cooperative State Research Service.

These cooperative units, which comprise the National Plant Germplasm System, have a general mission of providing plant scientists with the germplasm needed to carry out their research. The research programs that are supported in this way are widely varied and include breeding new cultivars--for resistance to diseases, insects, smog injury, temperature, moisture, salinity, and other environmental stresses; for increased yield and quality; for ease of harvesting, better processing, and longer storage; for beautification, noise abatement, erosion control, and resistance to fire; and as sources of anti-cancer medicinals, analgesics, and industrial chemicals. The well-coordinated operation of the System, under its funding constraints, is evidenced by the reasonably good status of our present plant genetic resources propagated by seed.

Introduction of plant materials is accomplished through planned foreign and domestic explorations, by exchange with foreign scientists and agencies, and by contributions from traveling scientists. To set up an exploration, breeders, scientists or commodity groups send proposals through the State-Federal regional project structure (see Table 2) for review and possible funding by ARS. The Germplasm Resources Laboratory provides a national focal point and clearing house for exchange of plant germplasm with foreign countries. This laboratory also catalogs all incoming accessions, assigns Plant Introduction (P.I.) numbers, makes taxonomic identification, and distributes P.I. material to maintenance centers or other curators according to established regional crop priorities.

Selected germplasm also enters the National Plant Germplasm System from domestic research programs. These include induced and natural mutations; cytological stocks such as monosomes, trisomes, translocations, etc; marker genes; species hybrids, breeding material with valuable combinations of characters; pest resistant stocks; and obsolete commercial varieties that may have genes useful in the future. Research personnel who develop such material have an obligation to call it to the attention of the appropriate Regional Coordinator or crop curator for inclusion in the maintenance System.

Maintenance is the responsibility of Regional and Interregional Plant Introduction Stations, curators of collections for specific crops, and the National Seed Storage Laboratory. Curators are individual research scientists with special long-term interests in particular kinds of plant germplasm who agree to maintain plant germplasm in cooperation with Regional and Interregional Stations. The National Seed Storage Laboratory is concerned with the long-term storage of seed. The Regional and Interregional Stations and the germplasm curators must continually replenish plant germplasm by regrowing accessions in the field and greenhouse and preserve viable seed stocks for distribution.

Evaluation of plant genetic resources is accomplished in several ways: (1) plant introductions are screened initially for a wide range of desirable characteristics, including their resistance to predominant diseases and insects affecting commercial crops to which they are related, and (2) are extensively evaluated in the field, greenhouse and laboratory by cooperating state, federal, and private plant scientists for the widely varying traits needed in their research. Results are reported back to the maintenance centers.

Distribution of plant germplasm is made to all responsible scientists, agencies, and institutions requesting it. All federal and state-federal stations which maintain working collections distribute, free of charge, sufficient quantities of plant material to start their research. The National Seed Storage Laboratory distributes stocks only when material is not available from working collections. Persons who receive plant materials are responsible for acknowledging in publications the source of any material used in their research and for reporting to the supplying agency, the performance of all materials tested.

Table 3 shows the approximate number of accessions of introduced plants held by the various stations or laboratories and the samples distributed during the last three years (1973 through 1975).

The National Plant Germplasm System (NPGC) is well established and coordinated, and is functioning to fulfill the germplasm needs for minimizing the genetic vulnerability of our major crops. The unmet needs and goals of the System, which have been the subjects of continuing NPGC recommendations for funding, also relate directly to national goals that have been recommended recently by national advisory bodies.

The National Plant Germplasm Committee, advises the Systems, coordinates activities, and continually reviews needs. It is advisory to the administrators of the U.S. Department of Agriculture and State Agricultural Experiment Stations. The following high priority items have been identified:

A. Establishing repositories for clonally propagated plants; such as pome fruits, stone fruits, small fruits, grapes, citrus, nut crops, and subtropical fruits.

B. 1) Providing for capital improvements, additional staff, and support funds for National, Regional and Interregional Stations and laboratories for the continuing introduction, quarantine, maintenance, distribution, and evaluation of plant genetic resources. 2) Establishing and funding a tropical facility

with primary responsibility for increase and maintenance of plant genetic resources.

C. Funding selected plant germplasm curators throughout the United States.

D. Identifying the gaps which exist in our major collections and greatly increasing funds for plant explorations designed to fill these gaps.

E. Computerizing, in uniform terms, all plant genetic resource holdings in the United States.

F. Consolidating our plant genetic resource holdings for safer maintenance at least cost and enhance wider availability to users.

G. Expanding preliminary evaluation of plant germplasm.

MAJOR STATIONS FOR THE NATIONAL PLANT GERMPLASM MAINTENANCE SYSTEM

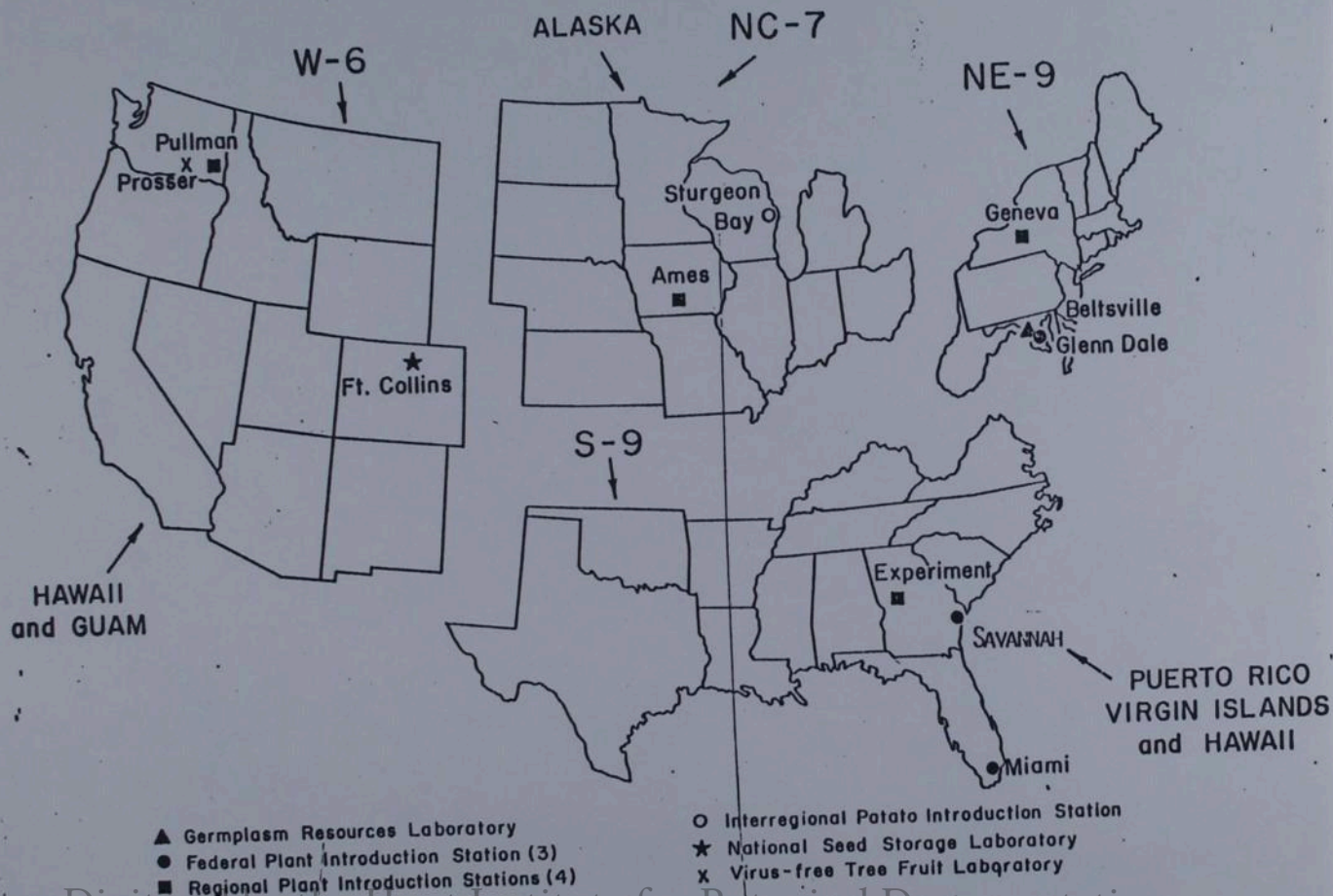


TABLE 1

NATIONAL PLANT GERMPLASM SYSTEM
PRINCIPAL STATIONS OR LABORATORIES RESPONSIBLE FOR
INTRODUCTION, MAINTENANCE, AND DISTRIBUTION OF PLANT GERMPLASM

Station or Laboratory	Name and Address	Examples of major collections of regional responsibilities	Remarks
National Seed Storage Laboratory	: Dr. Louis N. Bass : National Seed Storage Lab. : Fort Collins, CO 80521	: Gene bank collections of seed: : crops and their wild : relatives	: Long-term storage
Germplasm Resources Laboratory	: Dr. George A. White : Plant Genetics & Germplasm : Institute : ARS-West : Beltsville, MD 20705	: World Collections of wheat, : oat, barley, & rye (Dr. J.C. : Craddock) and rice (Dr. A. J. : Oakes)	: National focal point for int : duction, documentation, : initial distribution, and : exchange of plant germplasm. : Quarantine & detention : nursery; coordination of : cereal rust program.
Northeastern Regional Plant Introduction Station	: Dr. Desmond D. Dolan : N.Y. State Agric. Expt. Sta. : Regional Plant Intro. Station: : Geneva, NY 14456	: Perennial clover, onion, pea, : spinach, broccoli, timothy	: Operating through Regional : Research Project, NE-9, 12 : States, ARS, FS, & SCS : participating.
Southern Regional Plant Introduction Station	: Dr. W. R. Langford : Regional Plant Intro. Sta. : Experiment, GA 30212	: Cantaloupe, cowpea, millet, : peanut, sorghum, pepper	: Operating through Regional : Research Project S-9, 14 : States, ARS & SCS : participating.
North Central Regional Plant Introduction Station	: Dr. Willis H. Skrdla : Regional Plant Intro. Sta. : Iowa State University : Ames, IA 50010	: Alfalfa, corn, sweet clover, : beets, tomato, cucumber	: Operating through Regional : Research Project NC-7, 13 : States, ARS & SCS : participating.
Western Regional Plant Introduction Station, Pullman & Central Ferry, Washington	: Dr. S. M. Dietz : Regional Plant Intro. Sta. : Room 59 Johnson Hall : Washington State University : Pullman, WA 99163	: Bean, cabbage, fescue, wheat : grasses, lentils, lettuce, : safflower	: Operating through Regional : Research Project W-6, 12 : States, ARS, SCS, FS, & BLM : participating.

NATIONAL PLANT GERMPLASM SYSTEM TABLE 1 (CONT'D)

Station or Laboratory	Name and Address	Examples of major collections of regional responsibilities	Remarks
Interregional Potato Introduction Laboratory	: Robert E. Hanneman, Jr. : Inter-regional Potato : Introduction Station : Sturgeon Bay, WI 54235	: <u>Solanum tuberosum</u> and <u>Solanum</u> : spp.	: Operating through Inter- : regional Project 1, SAES & ARS : in four regions participating.
ARS Plant Introduction Station	: Dr. Howard E. Waterworth : Plant Quarantine Facility : P.O. Box 88 : Glenn Dale, MD 20769	: Pome and stone fruits and : woody ornamentals	: Distributes certified pest- : free introductions consisting : of prohibited and post-entry : quarantine categories of : fruits, woody ornamentals, and : certain vegetables.
ARS Plant Introduction Station	: Dr. W. C. Adamson : U.S. Plant Introduction Sta. : Route 4, Box 433 : Savannah, GA 31405	: Cold hardy bamboo species	: Research on kenaf and : Chinese waterchestnuts.
ARS Plant Introduction Station	: Subtropical Horticultural : Research Station : 13601 Old Cutler Road : Miami, FL 33158	: Tropical and subtropical : species including 287 : accessions of coffee, 152 : mangoes, 160 cacao	
Interregional Virus-Free Deciduous Tree Fruit Lab.	: Dr. Paul R. Fridlund : Irrigated Agriculture Res. : and Extension Center : Prosser, WA 99350	: Virus-free cultivars of pome : and stone fruits	: Operating through Inter- : regional Project 2, SAES & : ARS in four regions : participating.

TABLE 2 -- COOPERATIVE INPUT INTO THE NATIONAL PLANT GERMPLASM SYSTEM

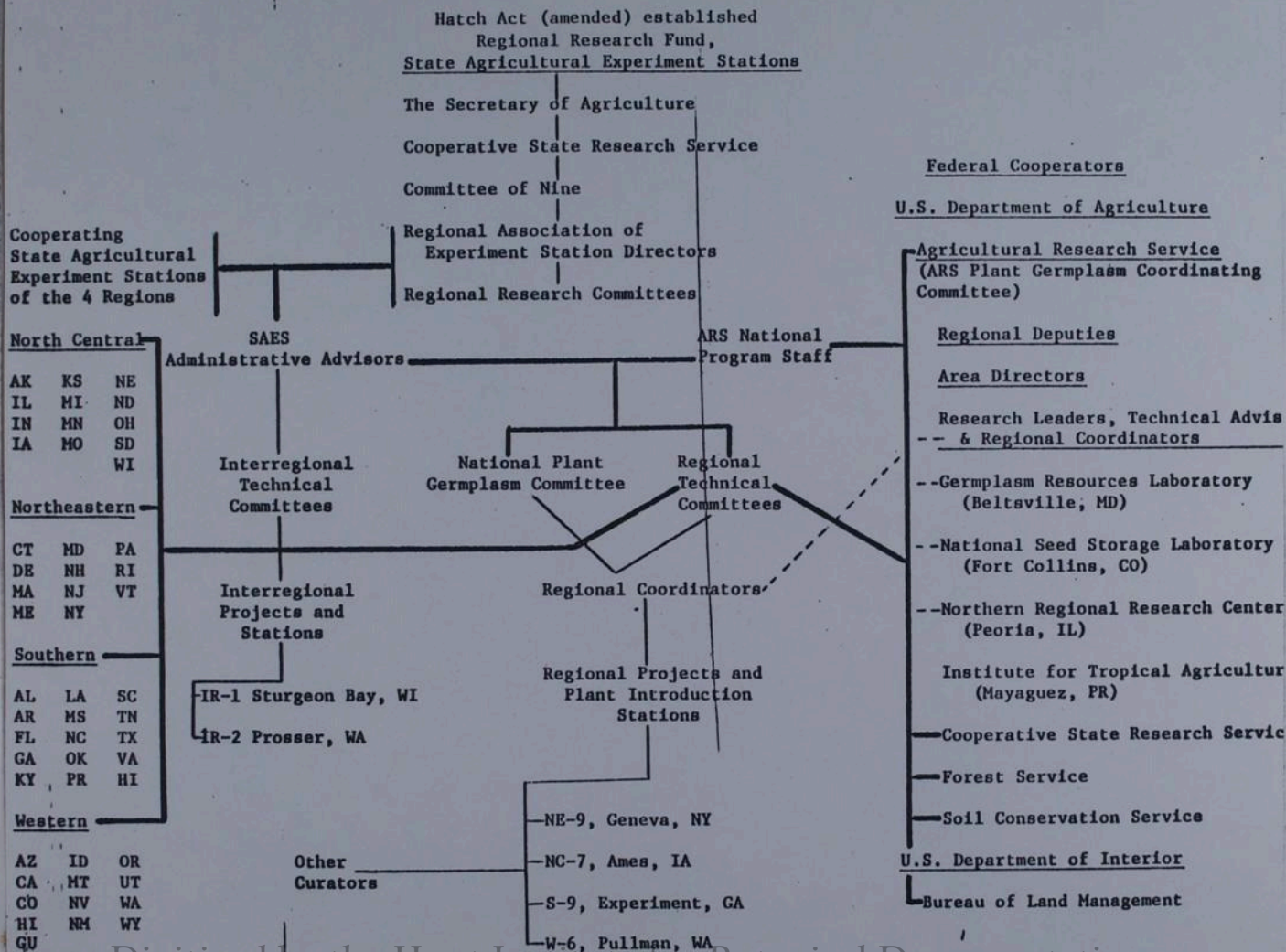


Table 3—Number of Plant Introductions Held and Samples Distributed (1973) by the Various Units Within the National Plant Germplasm System

<u>Station or Laboratory</u>	<u>Total Plant Introductions Held</u>	<u>Samples Distributed in:</u>		
		<u>FY 1973</u>	<u>FY 1974</u>	<u>FY 1975</u>
National Seed Storage Laboratory	90,233 (1975)	730	792	730
Germplasm Resources Laboratory (Small grains collections)	71,870	143,300	128,896	117,495
Northeastern Regional Plant Introduction Station	20,000	10,500	4,052	8,998
Southern Regional Plant Introduction Station	28,000	9,000	8,532	11,981
~~North Central Regional Plant Introduction Station~~	~~20,000~~	~~10,000~~	~~6,855~~	~~11,500~~
Western Regional Plant Introduction Station	28,000	17,000	12,000	28,448
Interregional Potato Introduction Station	4,000	2,570	2,908	3,400
ARS Plant Introduction Station (Glenn Dale, MD)	9,000	2,250	2,500	2,775
ARS Plant Introduction Station (Savannah, GA)	397	50	40	50
ARS Plant Introduction Station (Miami, FL)	4,164	601	1,711	1,366
Interregional Virus-Free Tree Fruit Laboratory	460	buds 14,125 cultivars 476	22,520 878	— —

COMMITTEE ON GERMPLASM RESOURCES

Final Report

Proposed List of Contents

N.B. Please use both the generic and specific name for each organism referred to. Each unit should be in International System of Units (SI). (National Bureau of Standards Publication No. 330)

A. INTRODUCTION (To be completed by Russell with help from Pye)

This section will map out the report as as such will include:

- i. Definition of "germplasm resources," preservation in vitro and preservation in situ.
- ii. Details of the scope of the problem, urgency, economic benefits of action, etc., bonus of preservation of natural ecosystems in maintaining species of which we had no prior knowledge.
- iii. Details of the approach used in writing the report and an explanation of the three categories used in Section B.
- iv. General statements will be made about cooperation between agencies and institutions, with more specific analysis given in the relevant portion of the text.
- v. History of regulations and laws.
- vi. The problem of endangered species and how to deal with it most effectively (natural habitats), including brief definitions.
- vii. Identification of audience and reasoning behind the detail of the report. Specific institutional responsibilities could be indicated here.

B. DESCRIPTION OF THE STATUS OF GERMPLASM RESOURCES FOR EACH OF THE FOLLOWING:

1. Natural Ecosystems

To include discussion of methods of determining which

environments will be most needed for future resources; improved economic analyses of the benefit derived from such systems; the esthetics of non-resources; the preservation of adequate genetic diversity; their resistance to perturbations (both man-made and evolutionary); life-zone classification and reserve systems.

- i. Land-based Goodwin, Briggs
(To include some mention of drug plants)
- ii. Marine Grassle
- iii. Freshwater Goodwin
- iv. Special section for endangered species and the role of ecosystem preservation in both the restoration of such species and in the prevention of future avoidable cases of endangerment.

Benirschke, Grassle, anyone who wishes to make a contribution.

2. Economically Important Organisms

- i. Crop plants currently used in the U.S. and the developed world, both for food and fiber, range plants. Lewis
- ii. Livestock, including poultry and bees - Someone from ARS to be identified by Lewis.
- iii. Fish - marine Grassle
- freshwater. Benirschke will ask Hubbs for help in this area.
- iv. Forests. Krugman will be asked to contribute.
- v. Pests - pathogens. Bachmann, Judd
- biological control. Lewis will ask Bryan
- vi. Organisms used in industrial production of all kinds.

Bachmann, Nanney

vii. Drug plants

viii. Food crops important in the lesser developed countries

- diet (e.g. cassava)
- economy (e.g. coffee)

Ethnobotanically and ethnozoologically important crops.

Rogers

3. Specialized collections.

- i. The general principles of the importance of maintaining specialized collections. Mention two-organism systems where each might need different methods for maintenance (plant and nodules). Cite models. Judd
- ii. Genetically defined stocks. Briggs, Judd, Roderick
- iii. Medical and associated uses. Briggs, Russell
- iv. Pollutant monitors. Grassle
- v. Cell lines. Mazur, Nanney, Coriell (Russell will ask)
- vi. Others, e.g. zoos, aquaria, botanical gardens, etc.

Benirschke

N.B. In addition to those persons indicated above, it was decided that each committee member should contribute to this section in their particular areas of specialty and interest.

C. PROBLEMS AND SOLUTIONS

1. Maintenance of reproducing colonies either in wildlife preserves or laboratory stock centers. This should include discussion of the following.
 - i. Technical
 - ii. Administrative
 - iii. Legislative and quarantine
 - iv. Genetic drift - initial sampling (Cite T.T. Chang Rice Manual)

- Change on regrowth

2. Preservation in the dormant state.

- i. Administrative and organizational. Mazur, Lewis
- ii. Technical. Mazur

The areas outlined in C will be addressed with regard to the 3 categories used in B. The assignments would therefore be the same as for B, with the exception of Mazur's contribution on the technical problems.

D. INFORMATION MANAGEMENT

- i. Data management, including storage, retrieval and dissemination. Rogers.
- ii. The role of agencies, publications, etc. Rogers.
- iii. Rationale in deciding what is an endangered species, flaws and good points. This would include discussion of the definitions used by F&WS and IUCN. Goodwin.

E. CHALLENGES TO THE NATION

Russell will coordinate this but all committee members will contribute. Discussion of what should be conserved and what should be let go, both now and for the future, who makes such decisions, how efforts should be organized and coordinated and how much money should be allocated for this purpose will be appropriate. Discussion of improving economic analysis to include non-resources, should also be included.

F. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This will necessarily be compiled after the first draft has been circulated to the committee members. Written suggestions should be available from each person prior to or at the beginning of the June meeting.

G. LITERATURE CITED

In the text the reference should appear in parentheses with the author's/authors' surname and the year of publication. Citation forms are enclosed for your use to ensure that all the information required for listing in an NAS report is provided from the start. Please ask for more forms if you need them.

If a suggested reading list is contemplated, incorporating references not cited in the text, please indicate that such information is for the Bibliography.

Feb. 10, 1977

Dr. Veronica Pye
National Research Council
Washington, D.C.

Dear Dr. Pye:

I enclose herewith one of the two "assignments" we had before the next meeting of the committee on genetic resource conservation. I trust that this is useful.

Will you be sending out notices for the next meeting? If you could ask your secretary just to send me tickets for the same airline, same schedule as I had last time, and arrange a room at the Park Central again, that would be fine with me.

Sincerely,

David J. Rogers
Professor of Biology

Suggested headings for study and/or report from
Genetic Resources Conservation Committee
by
D.J. Rogers

Introductory comments

- Definitions, concepts, included in this study
- Charges to the committee, by whom
- Exclusions (if these can be determined)
- Historical development (experts consulted; involvement of members; sources of funds; who is this committee meeting now; previous reports by NRC, NAS).
- Short summary of results, recommendations

Information management resources needed for genetic resources conservation

- Sources of data
 - Compilation of tapes, catalogues, lists, descriptive information, not only for the biological materials themselves, but for interested people and organizations.
- Methods of data storage, retrieval, other data processing systems needed.
- Cooperative methods for data exchange.

Requirements for a central responsibility in US

- A clearing house agency
- A data center
- Funding agency

Problems of global activities

- Political aspects between countries with differing requirements
- The US already conserves some material that is shared around the world --
What are the continuing implications?

Means, mechanisms, for long term conservation

- Single cells, multicellular plants & animals,
- Cold requirements
- Cultivation requirements for plants & animals not yet capable of storage at cold temperatures either as seeds, or semen, or other small body.
- Dormancy problems

Differentiation between needs for:

- Experimental organisms
- Cultivated or domesticated organisms
- Wild organisms that require maintenance in place in an ecosystem.

Requirements for:

- Research in conservation, both plants and animals, i.e. genetic, systematic, physiological, ecologic, etc.
- Facilities for each type of (or group) listed above.
- Personnel required and training needed.

Standards for:

- Sampling the environments where organisms grow--diversity indices.
- Determination of Completion of projects to conserve various groups
- Communications of results

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

DIVISION OF BIOLOGICAL SCIENCES

February 14, 1977

Dr. David J. Rogers
Department of E.P.O. Biology
University of Colorado
Boulder, CO 80309

Dear Dr. Rogers:

I have arranged for a prepaid ticket to be available in your name at the United Airlines desk at Denver Airport. This saves mailing it. We will send payment on March 3 and the airline will call you after that to tell you it has arrived. You will fly out at noon March 11 and return at 5:20 p.m. March 13--same flights and times as the last meeting. If anything goes awry with this arrangement let me know as soon as possible.

In addition reservations have been made for you at the Park Central Hotel for March 11 and 12. Should there be a change in your schedule please let them know directly as the Academy has guaranteed payment.

Many thanks for getting the "List of Contents" to me so quickly. See you in March.

Sincerely,



Veronica I. Pye
Staff Officer

VIP/ejh



BIOSCIENCES INFORMATION SERVICE
OF BIOLOGICAL ABSTRACTS

H. E. KENNEDY
Executive Director

50th Anniversary

BIOLOGICAL UNITY THROUGH COMMUNICATIONS

May 26, 1977

Dr. David J. Rogers, Professor of Biology
Department of Environmental,
Population and Organismic Biology
University of Colorado
Boulder, Colorado 80309

Dear David:

I apologize for this delayed response to your letter of March 15. By way of excuses, while the staff searched the file for the information you requested, I was out of the country, and my absence from the office was then extended to 5 weeks with a bout of old-fashioned flu. The response waited on my desk. I hope it is not too late to be of help.

The following paragraphs are quoted from Louise Schultz's report to me on the search.

"As we learned in the preliminary investigation conducted earlier, the Food and Agriculture Organization of the United Nations, in collaboration with the International Biological Program of ICSU and other international groups, was engaged in acquiring information about organizations maintaining germplasm resources. As Dr. Rogers notes in his letter, association with FAO provides him with a source for the information they are developing.

Having participated in the 1976 CODATA program, Dr. Rogers is undoubtedly familiar with the recommendations by Professor F.D. Rossini, first president of CODATA, concerning the establishment of a general index to data collections and a "CODATA Order Clearing Office" through which referrals and/or orders for copies of data collections could be processed. The CODATA Newsletter of February 1977 further indicates that the CODATA Secretariat (Betrand Dreyfus) is responsible for the establishment and operation of a World Data Referral Centre. CODATA members "in several countries" are preparing a master list with emphasis on numerical data resources. The referral center is to be operated by CODATA with sponsorship by Unesco-UNISIST, BNIST (Bureau National de l'Information Scientifique et Technique), and the EEC.

2100 Arch Street
Philadelphia, Pennsylvania 19103 • U.S.A.
Telephone: (215) 566-4016

TRUSTEES: A. Geoffrey Norman, President, University of Michigan • Orr E. Keynolds, Vice President, American Physiological Society • H. Boyd Woodruff, Treasurer, Merck Sharp & Dohme • Robert G. Lindberg, Secretary, University of California at Los Angeles • William Bevan, Duke University • David E. Davis, Santa Barbara, California • Robert E. Gordon, University of Maryland • Thomas L. Hunt, Federal American Tobacco Co. (Environmental Biology) • Fred W. Howarth, University of British Columbia • H. E. Kennedy, Biosciences Information Service, University of Colorado at Boulder

Digitized by the Hunt Institute for Botanical Documentation

BIOSCIENCES INFORMATION SERVICE
OF BIOLOGICAL ABSTRACTS

Dr. David J. Rogers,

Page 2

May 26, 1977

As we might have expected from the preliminary study, principal emphasis in the subject matter of germplasm resources has centered around crops. Therefore, Dr. Rogers' sense of incompleteness with regard to maintenance of other organisms for purposes of germplasm resources conservation apparently accurately reflects the picture of the present situation.

Despite the wealth of references in BIOSIS files containing information of use to the matter of germplasm resource conservation, examination of the literature of the last two years reveals a paucity of information about major organization efforts for germplasm resource data bank maintenance. Attached is a list developed through use of conventional library tools, which exhibits also the preponderance of interest in crop resources. Data base on other entities are indicated parenthetically when the information could be obtained."

We conclude that serious investigation of the identity of organizations conducting research directed toward germplasm resource conservation--especially outside the area of crops--needs to be done. The literature we process does not reveal the extent to which numerical data are being maintained about particular collections. Nevertheless, it may be feasible for BIOSIS, given its resources in identification of the authors of literature hinting at an interest in germplasm resources conservation, to develop the liaison links necessary for the accumulation of information about the existence of such data banks and, therefore, subsequently the opportunity for development of the classification scheme for the data you mentioned. That is, given the necessary support, we could establish a project for examining search output regularly to begin creation of a list of names and professional addresses for principal authors of papers potentially pertinent and to begin the accumulation, through correspondence with those authors, of a directory on this subject. Analysis of the data classes or classification systems in use by these researchers and in existing files could contribute to the design consideration in which you are interested.

I hope we have been of some help to you although I'm sure this response is less specific that you had wished. And, again I hope it's not too late to be of use.

It was a pleasure seeing you briefly in early March. We would be pleased to have you visit us if you get to Philadelphia this summer. Please give me a call when your plans are complete so that I can be sure to be here.

Sincerely,



H. E. Kennedy

HEK/jam
Enclosure

2101 Constitution Avenue Washington, D. C. 20418

June 8, 1977

TO: Committee on Germplasm Resources

FROM: Veronica Pye *Veronica*

SUBJECT: Minutes, Report, Tasks and Deadlines

Would you please have your contributions of rewritten, rearranged or totally new material to me by June 27th and no later than June 30th.

I have assumed, perhaps wrongly, that each of you is aware of the tasks assigned to you. If there is any difficulty about this, please call me. I look forward to hearing from you in the near future.

You will recall that I reported that during my visit to the Fort Collins Seed Storage Lab, I was told by a member of their staff that they had dispensed with their backup generator system. Dr. Lewis has contacted Dr. Bass, director of the facility, who has assured him this is not so, and that they were in fact considering "beefing up" their backup system. I'm sure you will be as relieved to hear this as I was. It will be made clear to the staff at Fort Collins that this is the case.

The National Research Council is the principal operating agency for the National Academy of Sciences and the National Academy of Engineering to serve government and other organizations

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

DIVISION OF BIOLOGICAL SCIENCES

Committee on Germplasm Resources
Meeting June 4-5, 1977, NAS 180

MINUTES

Attendance

All the Committee members were present.

Staff: Veronica I. Pye
Russell B. Stevens*
Nancy Muckenhirn*

*For part of the meeting only.

The meeting opened at 9:00 am. Comments on the first draft of the Committee's report were discussed. Dr. Russell suggested that the Committee consider what main recommendations were emerging from each section. The rewriting or rearrangement of the material could then be geared to these recommendations. The Committee proceeded to examine the section on Natural Ecosystems. The following statements or modifications thereof, were suggested for inclusion:

- The health of domestic ecosystems is part of the health of world ecosystems.
- Nature cannot evolve rapidly enough to deal with the damage inflicted by man.
- Since the effects of the loss of species and habitats are not known, the best course of action would be
 - 1) to conserve large enough areas to ensure the survival of the component parts of the system
 - 2) to conduct further studies of interactions of individuals and populations to facilitate predictions

- The purpose of ecological preserves be well defined so that suitable management plans may be worked out.
- The argument for preserving diversity is our ignorance of what would happen if we did not do so.
- It is not possible to preserve every living organism.
- The species by species approach versus preserving the whole ecosystem needs to be discussed.
- Trained personnel in the fields of genetics and ecology are urgently needed.
- The Committee's attitude about the ramifications and implications of the Endangered Species Act needs to be clarified.

For the Recommendations section it was suggested that a system of evaluation to decide what ecosystems and species should be preserved should be urged. This is more realistic than recommending that everything be preserved no matter what the cost.

Decisions should be made by a qualified group of scientists on an individual case basis. The uniqueness and "preservation priority" should be determined for each case.

The possibility of recommending an oversight committee for germplasm resources be set up, either in the NRC or elsewhere, was explored. Such a committee would be charged with organizing and integrating knowledge of organisms, their interactions and diversity within the U.S. The desirability/necessity of having an operating arm for such a committee was pointed out.

Dr. Mazur made detailed comments on the section dealing with collections of economically important organisms. Dr. Lewis stated his intention to strengthen the section on crop plants. The Committee discussed the problem of knowing what associated microorganisms are essential to preserve along with organisms considered for long-term dormant storage. The letter from Dr. Sprague was discussed.

The Committee agreed that research collections, by and large, are better maintained in the laboratory than in the wild. The recommendations for this section should include:

- Evaluation of personal collections
- Scientists considering support/termination of collections should represent a broad spectrum of users/interested parties, rather than just the immediate specialty.
- There should be a clearly identified central "organization" with responsibility for research collections re crises, information.
- Cooperation and coordination between the agencies currently involved with research collections.
- A set of criteria for the maintenance of research collections is needed, emphasizing quality and reliability.

The Committee then broke up into three groups to examine the content of the three sections in (B).

Natural Ecosystems: Goodwin, Briggs, Grassle, Rogers.

Economically important organisms: Bachmann, Judd,
Lewis, Mazur

Research Collections: Benirschke, Nanney, Roderick,
Russell

June 5th

Dr. Russell opened the second day of the meeting by outlining her plan to reorganize the section on specialized research collections.

It was decided that the specific recommendations should appear in two places in the final report, namely in the body of the text, and in the summary. Each recommendation should consist of a brief summary of the problem and an outline of the specific solution(s).

The list of suggested general policies put together by Dr. Nanney was circulated, discussed and endorsed.

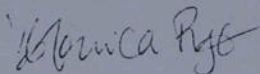
Tasks for rewriting or rearranging the material for the report were allocated. The group then split into three subgroups and continued its discussion of the specific recommendations for each section. The sections were rearranged as follows:

1. Natural Ecosystems
2. Organisms of Commercial Importance
3. Organisms maintained in zoos, aquaria, botanical gardens and arboreta
4. Organisms for Research
 - a) "Genetic"
 - b) Other research organisms

It was recognized that there will undoubtedly be some overlap between these sections.

The meeting adjourned at 4:00 pm.

Respectfully submitted,



Veronica Pye, Ph.D.
Staff Officer

Yale University *New Haven, Connecticut 06510*

SCHOOL OF MEDICINE

333 Cedar Street

Department of Human Genetics

June 10, 1977

Dr. David J. Rogers
Department of E.P.O. Biology
University of Colorado
Boulder, CO 80309

Ans 6/15/77

Dear Dave:

In the little group dealing with economic organisms at the last meeting of the germplasm resources committee, I was assigned the task of rewriting pages B39 and B40. I have now done this but, since I don't know much about the subject matter, I think that you had better check it carefully for distortions or inaccuracies. The idea was, as in other sections, to condense the material and emphasize basic problems being illustrated.

Please send this to Veronica Pye after you have looked it over, noting any objections which you may have to either style or content.

I am enclosing a reprint which describes briefly our computer program. I think that the first paragraph is most important. Manufacturers and wholesalers who have to keep up inventories may have better experience at this sort of thing than computer programmers who are accustomed to designing programs for scientists who want to do computations.

I tried to buy a copy of Tomlinson's book for you today, but none of the bookshops had it. Maybe it is out-of-print. However, I came across a dog-eared, marked-up, rainsoaked paperback copy in a used book stall. A book is a book. I hope you enjoy it.

With best regards.

Sincerely,

Barbara

Barbara J. Bachmann

June 11 - I have now re-done pp. 41-43.

Also someone tells me that I was mistaken in thinking that you are going to the Amazon so I shall hold the book until I hear from you.

UNIVERSITY OF COLORADO

BOULDER COLORADO ~~XXXX~~ 80309

June 15, 1977

Department of Environmental,
Population and Organismic Biology

Dr. Veronica Fye
Assembly of Life Sciences
National Academy of Sciences
Washington, D.C. 20418

Dear Veronica:

Enclosed are:

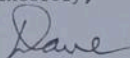
--Barbara Bachman's rewrite of pages B39-B43, with my inserted
comments and recommendations;

--my own effort for the new segment on botanical gardens and
arboreta. I have not had time to get any feedback from my
friends in such institutions in such a short time, but I think
I covered the assignment wanted. I am not able, obviously, to
state anywhere near what you might call a catalog of plants
conserved in these institutions.

I shall probably be unavailable until the 1st week of July, when
I will be back here for just a week, and then take off on another trip
to the east. I may give you a call sometime in July (towards the end)
to see if there's anything else you need.

Good luck!

Sincerely,



David J. Rogers
Professor of Biology

The following examples may serve to emphasize the ^{necessity} need for maintaining a broad germplasm base to meet changing needs. One deals with a crisis which was successfully met in the past, the other with a problem which we are now facing.

The grape is the largest economic fruit crop in the world. In the latter half of the nineteenth century the wine industry of France (and other European countries) was nearly destroyed by the ravages of an insect, Phylloxera, which attacked the roots of the vines. In Europe and Asia there was only one species of vine, Vitis vinifera, and so all plantings on the continent were equally susceptible to attack. There were eighteen species of vines recognized in

America and it was known that the roots of some or all of these were resistant to ~~the attacks of~~ Phylloxera. However, they did not produce ~~the same~~ wine. ^{of the same quality as that from the European species.} The numerous varieties of European grapes had been produced by centuries of cultivation and selective breeding from the gene pool of the one wide-spread species. This process could not be repeated in a hurry with the American vines. The problem was solved, and what apparently would have been the demise of the industry was avoided, by grafting the French vines onto American root stocks, on which they still grow today. ^{Similarly the wine grape in California is most frequently grafted onto native American species stocks.}

The native wild vines of North America are now being seriously reduced in extent by the inroads of man. Probably two approaches are needed for the conservation of the American species of Vitis: one is the collection of representatives of the wild species and maintenance in viticultural collections, and ^{their} the other, the conservation of regions in which the species are found in the wild.

An example of a problem facing us today which calls for diverse germplasm resources is the reclamation of lands in the western US which have been subject to strip mining. In these semi-arid regions the reclamation of strip-mine tailings is a horribly difficult problem. Most of the native species that are best adapted

to the natural conditions of these regions are not good colonizers of disturbed habitats. Some of the best possibilities for introduction come from other regions and include weeds from other parts of the world. Conservation with plants of this type is a very risky business, because the chance of introducing plants that cause more troubles than they solve is very high. The solutions to this complex environmental problem which man has created for himself will require more intensive research than has so far been available. It will require the testing of many species from a wide variety of localities in order to deal with the various localities in the US which will be mined with more intensity as supplies of fossil fuel decline.

Suggested heading: Export crops of the less-developed countries

A wide variety of crops are produced on a large scale in the developing countries for export. These include such commodities as tea, rubber, teak, other forest products and numerous others. The current practices of large-scale exploitation of some of these resources are having drastic and deplorable effects from the standpoint of worldwide germplasm resources.

The germplasm base of the crops so exploited is being reduced through the planting of vast areas with single types.

The enormous native genetic diversity formerly present in these areas is being destroyed on a grand scale in the process.

Much of this large-scale devastation is being conducted by international business concerns in areas where the local governments are not equipped to enforce sound practices upon these firms. The developed countries are benefitting from these crops in the short-run, but their long-range interests are endangered by current practices. The only likely present source of pressures that could curb these inroads upon the world's long-range resources lies within the developed countries.

Rubber is an important export crop in many parts of the world, but cannot be planted on a large scale in the Western Hemisphere because the Latin American plants (*Hevea brasiliensis*) are ^{Eastern tropical areas are now at about their peak production capacity.} subject to a serious disease of the leaves. ^{As sudden introduction of the South American leaf disease could easily destroy their productivity.} Because petroleum products are the starting material for the production of synthetic rubber, it is probable that we shall become increasingly dependant upon this crop. It is therefore of particular importance that a pool of diverse germplasm for this species be maintained as a resource for use in responding to future needs.

BOTANICAL GARDENS, ARBORETA AND GENETIC RESOURCES CONSERVATION

The role of botanical gardens and arboreta as institutions of fundamental importance in genetic resources conservation is frequently overlooked by those in agriculture, but these institutions have long played a central role in these functions. The distinction between botanical gardens and arboreta is that (theoretically) the arboreta grow only woody shrubs and trees and botanical gardens are not confined to one type of plant or other. In practice, however, the differences are very small. Commonly, these institutions are thought to be only for the purpose of display of beautiful plants. While this is one important role (and through it, conservation of important germplasm) most of these types of institutions are much broader in objective and function. The living collections at botanical gardens range from the very rare plants (such as endemic or threatened species confined to small geographic areas) to those of some other type of importance, either scientifically or commercially. Frequently botanical gardens or arboreta are the owners of acreage in nearby countryside where conservation of natural areas is practiced. The planting objectives of each garden are different, and because this is true, a wide range of plant materials is maintained across the country. Usually a botanical garden will attempt to reproduce several different types of habitat in their greenhouses or outdoors, such as deserts, marshes and bogs, aquatic, forest, prairie, both tropical and temperate zones. Because of this diversity, a large sample of genetic resources of native and cultivated plants are maintained.

Most botanical gardens and arboreta have several types of research programs. Not only are they concerned with the classification of the diversity of plants on the earth, but they do research in such areas as conservation, physiology, genetics, horticulture, and others. Moreover, their library and

museum (herbarium) functions are the best documentary institutions in the world. By combining systematic research with the library and herbarium activities, we are today aware of the destruction of our environment. Botanical gardens and arboreta are also engaged in a function that is highly important in conservation, and that is seed exchange. Most of these institutions have certain types of plants they are willing to share with other institutions, and sometimes, these seed exchanges are the only place in the world to find some particularly valuable or interesting plant. Usually, the institutions publish "index semina" which is a catalogue of the viable seeds available for exchange.

A vital role of many botanical gardens is public education. Normally, the educational efforts are directed to the lay public, rather than to specialists. This very important activity is one of the means by which the public's awareness of the problems of destruction of genetic resources has been heightened, and by which more influence can be generated to support programs in conservation.

Financial arrangements to support botanical gardens is varied, from public federal funds (in a very small number of cases in the United States) through state, county and city funds. Many are associated with large universities. Almost all such institutions have additional private endowments, and in some outstanding cases, the only funding is from private resources. Needless to say, almost all such institutions today are in dire financial straits. They are usually considered as "luxury" or "expendable" expenses by politicians, and their funding is the first to be cut in public budgets.

In the United States, one of the most comprehensive inventories of important genetic resources of plants is maintained by a consortium of botanical gardens through the American Horticultural Society. The AHS inventory of botanical garden holdings is computerized, and is generally available for interested persons to use.

Thus, botanical gardens and arboreta are central to all activities associated with the conservation of plant genetic resources. They possess a trained cadre of botanists, field and greenhouse facilities, libraries, laboratories, herbaria, and a philosophy which is critical to the needs of conservation. It is highly desirable, even critical, that any efforts on a national scale to conserve both plant and animal genetic resources place the botanical gardens and arboreta of the country in a central role.

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

DIVISION OF BIOLOGICAL SCIENCES

June 15, 1977

MEMORANDUM

TO: Elizabeth Russell Burke Judd
Barbara Bachmann Peter Mazur
Charles Lewis David Rogers ✓

FROM: Veronica Pye WP

I enclose two "rewrites".

1. Forest Germplasm. The shortened version has been checked out with Stanley Krugman who supplied the original text. He made two specific suggestions for recommendations which appear at the end of the text.
2. Indigenous subsistence agriculture. This has been shortened considerably.

Please let me have your comments on clarity and sense as soon as possible.

Enclosures

NORTH CAROLINA STATE UNIVERSITY AT RALEIGH

SCHOOL OF PHYSICAL AND MATHEMATICAL SCIENCES

DEPARTMENT OF STATISTICS
Box 5457 Zip 27607

June 14, 1977

Dr. Charles F. Lewis
U.S.D.A.
Plant Industry Station
Beltsville, Maryland 20705

Dear Dr. Lewis:

I understand that you are in the course of writing the plant portion of the latest National Academy of Sciences report on germplasm resources. Relatively little has been published on the details of the status of the corn collections, and I believe the general consensus has been that they are in good shape.

While I tend to agree with this consensus, at the moment, I would like to emphasize that their current equilibrium status is unstable. I enclose a copy of an unpublished paper, a portion of which (the section specifically on maize) I presented at the Agronomy meetings in Knoxville in 1975. To the best of my knowledge, it is the most detailed summary available for the Latin American races of maize.

At present the various collections of maize are housed in essentially 7 locations: PCIM in Peru, ICA in Colombia, CIMMYT and INIA in Mexico, and Fort Collins, Ames, and Raleigh. That is an impressive array. However, the duplicates of the collections appear to exist only at Fort Collins in general and at Raleigh for the so-called typical collections. In fact, Fort Collins has only a small fraction (I would guess about 1/6 or less) of the total number of available collections, and no funds to adequately handle or maintain that set.

PCIM is doing an adequate job for the Peruvian collections. ICA seems to have handled the Venezuelan and Colombian collections well and the low altitude Ecuadorian and Bolivian collections reasonably well. Many of the higher altitude Bolivian and Ecuadorian collections have not been adequately maintained, and a number of the high altitude Peruvian collections were lost previously. The remaining Chilean collections (a number have been lost) seem to be maintained only by me from seeds obtained from Brown and Fort Collins. No germplasm bank even recognizes the responsibility for them.

INIA has the only adequate set of Caribbean, Guatemalan, and Mexican individual collections. However, the organization lacks the funds, personnel, interest, and the cooperative attitude needed to adequately maintain, inventory, and insure the viability of these collections. Their general lack of cooperation is legendary, but I am not sure that it is not without reason.

CIMMYT has an excellent set of collections from eastern South America and an odd assortment of collections from Mexico, Guatemala, the Caribbean, and elsewhere. These complement somewhat those collections at INIA and were salvaged largely by the efforts of Dr. Mario Gutierrez, whose efforts seem to have stimulated similar work at ICA and PCIM. Gutierrez put the CIMMYT bank in order, increased about 3/4 of their collections, and then left. He has not been adequately replaced, and I do not detect much current interest at CIMMYT in maize germplasm preservation. There appears to be no plan at present to complete the work started by Gutierrez; a complete catalog of CIMMYT's past and present collections assembled by Robert Bird last year has yet to be adequately proofed and published; and a non-Spanish speaking female postdoctoral (Dr. Jean Hanson) had temporarily replaced the temporary replacement (Dr. N. L. Dhawan) for Gutierrez as of last report. With CIMMYT designated by FAO as the center to coordinate maize germplasm maintenance, the prospect for much future activity in this area appears bleak.

The collections maintained at the Ames center (North Central Plant Introduction Station) seem to be in adequate shape, although that center handles only materials adapted to that region, not most tropical materials.

Here in Raleigh, I maintain a set of all the available typical Latin American collections plus a few others. This collection is currently in good shape, but it is financed exclusively with soft monies and is housed in off-campus leased facilities. There is no guarantee at all that it will continue. Current plans are to deposit the materials with Brown, who has salvaged some of them previously, if and when local funding is exhausted.

While no one of these situations is an immediate emergency, the general outlook seems to be that no problems exist. In the case of maize, there appears to me to be no lack of planning for germplasm preservation, but a real lack of current action being taken to guarantee the preservation of what we now have.

With best regards

Major M. Goodman
Major M. Goodman

/lr

Enclosure

Carbon copies to:

Dr. Hermilio Angeles Arrieta
Dr. J. Lawrence Apple
Dr. Louis N. Bass
Dr. Robert M. Bird
Dr. William L. Brown
Dr. Climaco Cassalet D.
Dr. D. N. Duvick
Dr. Keith W. Finlay
Dr. W. C. Galinat
Dr. Mario Gutierrez G.
Dr. E. Hernández X.
Dr. R. F. Holland
Dr. Veronica Pye
Dr. L. M. Roberts
Dr. David Rogers
Dr. Elizabeth Russell
Dr. Ricardo Sevilla
Dr. William E. Sievers
Dr. E. W. Sprague
Dr. S. G. Stephens
Dr. David H. Timothy
Dr. Manuel Torregroza
Mr. Louis E. Vincent
Dr. H. Garrison Wilkes
Dr. J. T. Williams

Copies of manuscript to:

Dr. J. Lawrence Apple
Dr. William L. Brown
Dr. Keith W. Finlay
Dr. Charles F. Lewis
Dr. Veronica Pye
Dr. L. M. Roberts
Dr. David Rogers
Dr. Elizabeth Russell
Dr. Ricardo Sevilla
Dr. J. T. Williams

Rogers

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20418

DIVISION OF BIOLOGICAL SCIENCES

January 9, 1978

MEMORANDUM

TO: Committee on Germplasm Resources
FROM: Russell B. Stevens *RBS*
SUBJECT: Final Draft of Report

We have long since run completely out of time and money, and very nearly out of steam. Let me bring you up to date.

After Veronica left, Tibby Russell and I undertook to incorporate as much as we possibly could of the comments from committee members and from the four reviewers (Harry Beevers, Jack Harlan, Howard Schneiderman, and Garrison Wilkes). What with illness here and there, and some rather slow responses from committee members--and the fact that some comments tended to be cancelled out or contradicted by others--it has taken a good bit of time. The end product is as you see it in the attached copy, minus the literature citations, for the time being.

We sent out one emergency request for help with literature citations, but two still remain unsolved. They are as follows:

Page 57 -- Mason, 1974 (Complete reference needed)

Page 109 -- Meers, 1970 (Complete reference needed)

There were a lot of suggestions that required considerable modification of the manuscript. I've done the best I could under the circumstances. Perhaps the most difficult were the reactions to what is now chapter 7. Several liked the chapter but felt it was excessively long

and detailed compared to everything else. Others felt it didn't do justice to dormant preservation other than strictly cryobiological, etc. My tentative solution to this dilemma was to retitl the chapter so that it clearly talked about cryobiological matters only. As to shortening, which several seemed to think necessary, I felt that the last ten pages of the chapter were decidedly less effective than the earlier sections and have deleted them. I hope you will agree that the result is acceptable.

If Tibby approves this version when I see her on January 17 I propose to turn the manuscript over to the Printing and Publishing Office for publication. We could continue to make changes, but I think we should do so only if there are outright mistakes or horrendous issues that cannot be accepted. Do call Tibby directly (207/288-3373, ext. 290) or me (202/389-6200), if you find something that must have attention.

Enclosure

17 111 6800

Jan. 26, 1978

Dr. Russell B. Stevens
National Research Council
2101 Constitution Avenue
Washington, D.C. 20418

Dear Russ:

I enclose extracted pages with a few corrections in the excellent report of the Committee on Germplasm Resources. You are to be congratulated on such a fine job with such minimal support. I talked to Tibby about these changes and she agrees with them.

Other than these few minor corrections, I think things are in very good order. I look forward to the final result.

Thank you for your efforts.

Sincerely,

David J. Rogers
Professor of Biology

Enclosures.

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES

2101 Constitution Avenue Washington, D. C. 20018

DIVISION OF BIOLOGICAL SCIENCES

July 6, 1977

Dr. Howard S. Irwin, President
The New York Botanical Garden
Bronx, NY 10458

Dear Doctor Irwin:

I would like to thank you for preparing the informative and useful paper on the conservation of genetic resources by botanical gardens and arboreta. I have sent a copy to the Chairman of the Committee on Germplasm Resources, Dr. Elizabeth S. Russell. There is much in your contribution that the Committee will doubtless wish to use, both in the section dealing specifically with arboreta and botanical gardens, and also perhaps in the introductory statement on the necessity of genetic conservation.

We expect the Committee's report to be available some time this autumn, and I will arrange for a copy to be sent to you then.

Yours sincerely,

Veronica I. Pye
Staff Officer

cc: Dr. David Rogers ✓
Dr. Elizabeth S. Russell

Dr. Rogers

24 June '77

THE NEW YORK BOTANICAL GARDEN

Howard S. Irwin
President

Days:

Here is a copy of what I submitted on botanical gardens and genetic resources -- essentially an outgrowth of my introduction to *Extinction is Forever* (Iain will let you know how to get a copy) and a couple of talks I have given on the subject. It may not be focussed exactly as you had hoped, but it is long enough to be edited around to the right tack, if that is needed. You will see that I am not as high on botanical gardens and arboreta in this arena as you because I think most have not yet heard the clarion call. Certainly the brethren in AARGA seem little stirred by the threat to genetic resources (botanical) at this time, save for a few local parochial issues here and there. As a result, my piece is as much an exhortation and forecast of what can be done by these institutions as a document of past and present accomplishment.

Anyway, I hope this helps. My best to you, Connie, at al.

Howard



The New York Botanical Garden

Bronx, New York 10458

(212) 220 8700

June 28, 1977

Dr. Veronica Pye
Assembly of Life Sciences
National Research Council
2101 Constitution Avenue
Washington, D.C. 20418

Dear Dr. Pye:

At the invitation of Dr. David J. Rogers, I have prepared a paper in which I have summarized my views about the ongoing impoverishment of botanical diversity and the past, present, and future roles of botanical gardens in preserving that diversity. As you can see, I do not believe botanical gardens and arboreta are doing nearly enough in this regard, and so place considerable emphasis on what can be done, recognizing at the same time that the very limited financial resources available to gardens seriously militate against their making marked programmatic changes, however sound these might be in rationale and relevant to newly perceived needs.

Please let me know if you have any questions or if additional information is required.

Sincerely yours,

Howard S. Irwin
President

HSI:aaa
Enclosure

cc: Dr. David J. Rogers

THE CONSERVATION OF GENETIC RESOURCES

BY BOTANICAL GARDENS AND ARBORETA*

BY

HOWARD S. IRWIN

There are three stages in man's awareness of his relationship to the biosphere. The first may be characterized as resource extraction, which is a function of conquest, expressed in the location of pioneering settlements and eventually in foreign colonization. The second is the unevenly perceived necessity for conservation, as is now beginning to be appreciated in some countries, but remains confounded by conflicting professional solutions. The third is the inevitable worldwide recognition that concerted remediation in man's relationship to the natural world is the key to his survival. The last is still a wild idea to most, looms politically unfeasible, and may never be attainable because it implies stopping "progress."

Today's conservation conflicts are seen in extreme political learnings: the far left pushes for radical and immediate change, no matter what the consequences; the far right allows only cosmetic, easily accommodated adjustments. Through all the turmoil and confusion some progress has been made, symbolized by the establishment of 1200 national parks in the last decade.

The purpose of biological conservation is not to stop everything going on in the world but rather to preserve biological diversity as a way of keeping future options open. Only in the last decade has serious attention been given the problem of the

*Although reference is made only to botanical gardens in this article, all remarks apply equally to arboreta.

accelerating biotic impoverishment of planet Earth.

Recent convocations of botanists in all countries have focussed upon the responsibilities of botanical gardens to help preserve botanical diversity. Few of these meetings, however, have been satisfactory in process or impact. In many cases, the audience has been of the same disciplinary persuasion as the discussants -- a case of the converted talking to the converted. In others, the rationale for concern has been more emotional than scientific, with participants anguishing more over the loss of patrimonial heritage than over the long-term evolutionary consequences of the extinction of gene sets. In still others, representation has been too narrow for the scope of the problem, as when scientists and conservationists in Europe and North America self-righteously rail about the destruction of tropical ecosystems, too often forgetting that their comfortable vantage has resulted from the historical exploitation of the very resources in their own countries that they would now have held inviolate elsewhere.

In many parts of the world, lists of endangered species have been or are being prepared and various laws and enforcement measures initiated to protect such species. Yet we all know that the problem before us is basically one of conscience. If only a small percentage of our citizens remain indifferent or conscienceless, attempts at species preservation will be seriously, even hopelessly, frustrated. In societies where the individual's conscience is the only restraint against the unlimited exploitation of a limited resource, it is obvious that

the conscienceless person has a selective advantage because he gets more than his share and suffers no significant penalty. Unfortunately, in the consideration of species preservation, this verity is usually ignored.

There are real difficulties in establishing a basis for species preservation because so many basic questions remain unanswered. What is the effect of a given endangered species on others? What are the adverse ecological effects to be expected if a given endangered species becomes extinct? What is its impact upon the functioning of the earth's life support system now and in the future? How do we weigh the aesthetic or emotional satisfaction we derive from preserving endangered species? To reduce these concerns to the language of the street: What does it matter? Who cares? So what?

The fact is we know pathetically little about most of the species on this planet. Precise environmental interactions are not known nor can we predict with any precision the environmental response to the loss of even well-represented species. Although our lack of information about individual species is appalling, our knowledge and understanding of how aggregations of species behave is even sparser. We do know that there are multiple interlocking cause-and-effect pathways tending to magnify the sudden loss of a truly critical species, but even here there is enough functional redundancy to minimize if not compensate for the loss of such a species. Few data of general application exist about species replacement or invasion rates. Ecosystems evolve and change in speciation, but much of this change is idiosyncratic and as yet little studied. Functionally, critical

species are not necessarily identifiable by their size or abundance.

For these reasons -- basically that we do not know enough about community dynamics -- it appears best to give our attention to the preservation of critical habits and ecosystems, separating manageable units as examples to be retained in perpetuity for future study. It must be recognized that virtually all major ecosystems transcend existing political boundaries, and thus any effort to preserve them requires international cooperation.

The symptoms of ecosystem mismanagement are the disappearance of many species and the intensifying endangerment of others. The ideal solution, however, is not an isolated piecemeal attempt to save each species that faces extinction but to develop procedures for ecosystem preservation and management that will enable us to deal with the basic causes of the problems.

Yet we can take scant comfort in this recognition, for the drama at hand seems likely to be played out over a very short time scale. As human populations and affluence grow, we demand more of the resources of the planet and we lean more on the life that shares it with us, thereby inducing changes measurable in perhaps only a few human generations that could prejudice our own survival.

The living kingdoms balance each other biochemically, with the synthetic abilities of green plants matching the degradative powers of animals and of non-photosynthetic microorganisms. This is the basic framework of life on earth and no matter what our technical ability and capacity to understand and reason, we are inescapably locked into this system. It is the tremendous

and appalling failure of our educational process that leaves so many people unaware of this basic fact and its implications for their future and for mankind as a whole. In some unbelievably arrogant visions of Utopia the entire output of the world's vegetation would be devoted to human sustenance. In such a world all other than anthropogenic ecosystems would be gone, all ecological cycles would be man-governed and all organisms would exist at people's sufferance for their use or entertainment.

From the vantage of sheer logic, such a global economy is feasible and its desirability is more a matter of value judgment and aesthetics than of science and economics. It would represent the ultimate in anthropocentrism and thus would hardly offend the religious and political bases for so much human behavior in the western world. But even with this goal, mankind is doing a poor job of setting up the global farm, what with immense areas under pavement, human effluents poisoning air and water, land being cleared without regulation, rapacious uncontrolled extraction forestry in progress, and dust-bowl agricultural practices degrading fragile environments even to the extent of threatening the primary producers. The results are alarming, even within the framework of simple economics, in which the best use is made of standing crops and the way prepared for a world-wide sustained-yield agricultural system.

The principal loss in such a system, even if it is well pursued, is biological diversity, with the only survivors crops and stock animals, along with weeds and vermin. Does it matter? Obviously, there are some who will think little

of the loss of blue bells and columbine, of orchids and tigers; man is such a product of conditioning that future generations may not mourn the loss anymore than we do the dodo and dinosaurs.

The hazards, however, are real, and they are hazards which even those who advocate maximized human populations and the global farm cannot fail to perceive.

In the first place, to extirpate so much of the world's vegetation before we know what it has to contribute to us is myopic indeed, whatever one's ethics. Our knowledge of the economic potential of endangered species is no more than fragmentary; our acquaintance with their chemistry and pharmacology trivial.

We know already that there is a serious risk of loss of genetic potential for future breeding programs from the plant species we do use in agriculture. The successes of modern agriculture have been bought at high cost, not just in dependence upon mechanization and chemicalization and profligate use of energy, but, perhaps most important of all, by reducing the genetic basis upon which production rests. Genetically heterogeneous primitive stocks have been replaced by the uniform, high-yield variety, and with such aggressiveness that wild races and primitive relatives are being eliminated from marginal lands. Thus the gene pool for future breeding is drained away, as has been well documented by the F.A.O. for most major food crops.

And so what of the role of botanical gardens to preserve the diversity still at hand? What are the 1,000 or more botanical gardens around the world doing?

Anyone who has had the opportunity to compare several of the more important botanical gardens cannot fail to be struck by their uniformity in tradition and function. In the Americas and Europe, if not everywhere, they are largely nineteenth-century institutions in genesis, created and shaped to meet the demand for popular education at a period when world travel was restricted to the few but knowledge was available to the masses. Thus they are the parallels of the Victorian museum; in many respects the museum and garden evolved together. Botanical gardens became citadels of certain kinds of important research, that which involved studies of diversity and the cultivation and propagation of living plants. They were not thought of as instruments of plant conservation, mainly because in the height of their expansion, the widespread Victorian optimism extended over the whole field of world resources, all of which seemed inexhaustible.

Although rare plants were often cultivated, the botanist seldom viewed his action as preservation of the stock for posterity, and the garden in which such plants were grown hardly ever maintained records. Regrettably, most botanical gardens continue to operate on this level. In contrast to their potential, any true conservation role they fill is small, secondary, and seldom well documented. Increasingly, botanists are challenged by this deplorable state of affairs, and their swelling ranks now include some who direct botanical gardens and determine their program priorities.

What can botanical gardens do to promote a better understanding of the endangered species problem and to actually conserve genetic resources?

In the first place, consider what botanical gardens are: by their very nature they are treasuries of botanical diversity, growing everything from algae to redwoods and displaying a wide array of native and exotic species and cultivars, outside and under glass. It is not uncommon for a garden to maintain several thousand kinds of plants in a score of natural or simulated habitats. Regardless of the quality and extent of documentation, the mere fact that such an aggregation of genotypes is consistently maintained has pertinent conservation value, and augurs well for a more direct role in botanical conservation. Several gardens also own or have custody of significant tracts of natural vegetation which are not only interpreted for public understanding but also as conserved natural areas are refuges for the genetic resources comprising them as well as for research on these resources.

Associated with the living collections of many botanical gardens are libraries devoted to botany and horticulture. Several gardens also maintain plant specimen museums or herbaria, which are collections of superbly documented specimens representing the full range of extant diversity of the 250,000 species of plants on earth. The two together are essential instruments for the pursuit of research in plant systematics, evolution, geography, and ecology. Such research is fundamental not only for an understanding of the forces at work in the accelerating impoverishment of genetic resources but also for the establishment of sound conservation practices.

Botanical gardens usually offer educational programs to

an increasingly interested lay public, again to bridge the gap between the prevailing public ignorance about plants and selected subsets and degrees of botanical and horticultural knowledge. Several gardens, either as components of or in association with universities, also provide professional and post graduate training in botanical science and in various aspects of horticulture.

With this array of current program emphases as a backdrop, there is a sound basis upon which to develop a stronger conservation focus in botanical gardens. The following seem attainable and germane:

First, gardens can develop public exhibits dramatizing the need for botanical conservation. In comparison with the intensely emotional publicity generated in response to the depletion of zoological diversity, the custodians of the plant world have much to do, witness the public's almost total lack of awareness of the fact that one in twenty native plant species in North America is threatened with extinction by human act or agency. Displaying and interpreting rare plants could be of enormous value in giving publicity to local, national, and international conservation organizations. By trying to answer such questions as why some plants are rare, what factors threaten their continued existence, and why botanical diversity is important, gardens could do much to help organizations directly involved with the preservation of natural resources as well as to establish themselves as advocates for a cause no other human agency is better able to espouse.

Second, botanical gardens can broaden or shift their research programs to include studies on plant ontogeny, longevity, and reproductive effectiveness, focussing these investigations on rare plants. Such autecological information is essential to success in any attempts made to salvage by cultivation plant species threatened with extinction. At the moment so little data of this nature is available that salvage of most endangered species by transplanting or cultivation is commonly fraught with failure. Simple, well-documented cultivation experiments in a botanical garden, preferably in conjunction with a nature preserve, would do much to answer questions about species of narrow ecological amplitude whose survival is dependent upon cultivation in alien habitats.

Third, a better job can be done by botanical gardens to actually safeguard stocks of endangered plant species. Critical to this function is a satisfactory system of documentation for living collections. Wild species in cultivation should be of known and recorded provenance, as should be all seeds and other propagules of such materials sent out on exchange to other gardens. Rare and endangered species should be attempted and experimented with in cultivation, not by transplantation (unless this be the only remaining survival option) but by judicious seed or cutting collection. American botanical gardens are the most logical agency to take on the responsibility of protecting the thousand-odd threatened and endangered plant species of this continent north of Mexico, rather than leaving the exercise to chance. Special attention is needed by species actually facing extinction, by narrowly endemic species confined to a particular limited area, and by wild relatives of cultivars.

Some species may lend themselves to seed-bank conservation; others will require the maintenance of successive generations, all in the hope that eventual reintroduction to the wild will be a possibility.

Because of the traditional involvement of some larger gardens with programs in the tropics, where both speciation generally and problems associated with the protection of rare and endangered species are greater (in part because so little is known about them), such institutions might well become engaged in the preservation of certain tropical groups. International coordination is obviously essential to success in such a complex endeavor, and several conferences addressing this topic have been held in recent years.

To summarize, botanical gardens, the only human institution created to display and interpret plants for people, are central to all activities associated with the conservation of plant genetic resources. They embrace a philosophy of conservation, have access to real estate on which to grow and exhibit living plants, and are equipped with trained professionals, research facilities, and museological and bibliographic collections. In any national effort to conserve this continent's biotic resources, botanical gardens will surely play a pivotal part. With proper documentation and adequate source data, living collections can serve as genetic resources. The questions before botanical gardens with respect to threatened and endangered species include:

- (1) How can gardens serve as salvage centers for species otherwise certain to become extinct?
- (2) How can the already slender and diminishing financial resources available to gardens be

directed to such a purpose? (3) Is the salvaging of threatened and endangered species to serve only an archival function? (4) How can gardens help other agencies concerned with land use prepare for the reintroduction of salvaged species into the wild? (5) How can gardens function in broadening the catalog of economic plants?

Each of these questions relates to grave problems confronting mankind. Few professionals, let alone the public, understand the moral obligation gardens have to address these problems and the potential gardens have to find solutions. The options before gardens include: (1) encouraging the establishment of biological preserves; (2) actually salvaging species doomed to extinction; (3) educating the public to mankind's dependence on the world flora; (4) pursuit of research related to botanical diversity and ecological stability.

The present times offer botanical gardens new challenges and problems which cannot be met in the old way. The new spirit requires collaborative, integrated, coordinated efforts by the world community of botanical gardens and arboreta. The impetus for that approach is fostered by the increasingly prominent role of the U.N., as in the Man and the Biosphere Program, as well as by the International Union for the Conservation of Nature and Natural Resources, the World Wildlife Fund, the Nature Conservancy, the Audubon Society, the International Association of Botanic Gardens and others.

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
NATIONAL PROGRAM STAFF
Plant and Entomological Sciences
Beltsville, Maryland 20705

June 22, 1977

Dr. Veronica Pye
Biological Sciences, NRC
2101 Constitution Ave., NW
Washington, DC 20413

Dear Veronica:

Enclosed is a revision of the section "B2, i, Economically important organisms - crop plants." I hope it satisfies, in part, the suggestions made at the last meeting of the committee.

Sincerely,



Charles F. Lewis
Staff Scientist
Plant Genetics and Breeding

Enclosure

cc:
E. S. Russell
B. Bachmann
B. H. Judd
P. Mazur
D. J. Rogers