United States
Department of
Agriculture

Office of
International
Cooperation and
Development

**Scientific and
Technical
Exchange
Division**

Washington, D.C.

GERMPLASM EXCHANGE BETWEEN THE UNITED STATES AND THE PEOPLE'S REPUBLIC OF CHINA

U.S. Germplasm Delegation
July 24 - August 21, 1980

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Prepared by:

Douglas R. Dewey
Donald W. Sunderman
Rex K. Thompson
Thomas J. Orton

This Study Tour/Exchange was jointly sponsored by the Office of International Cooperation and Development (OICD) at the U.S. Department of Agriculture (USDA) and the Ministry of Agriculture in the People's Republic of China. All comments, opinions, and recommendations, however, are those of the team members and not necessarily those of OICD, USDA, nor the Chinese hosts.

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I. INTRODUCTION

A. Previous Delegations

The present germplasm exchange is the most recent in a series of exchange delegations starting in 1974. The 1974 and 1976 delegations were sponsored by the National Academy of Science (CSCPRC). The Botanical Society of America organized the 1978 delegation, which received financial support from varied sources including the NSF, DOE, and Rockefeller Foundation. The 1979 delegation was sponsored by the U.S. Department of Agriculture (OICD). The composition of those delegations and their objectives are summarized below:

1974 American Plant Studies Delegation (August 27-September 23, 1974), a 12-member delegation representing varied plant science disciplines and crops. The delegation had three principal objectives:

> "(1) to establish contacts with Chinese authorities and scientific personnel for the purpose of initiating exchanges of information and biological materials which would be mutually beneficial to the two nations and which, hopefully, could continue and expand in the years ahead, (2) to obtain an understanding of the status and organization of Chinese scientific and technical work in the plant science field, and (3) to report its findings to the U.S. scientific community."

1976 American Wheat Studies Delegation (May 19-July 16, 1976), a 12-member delegation focusing on wheat breeding, physiology, pathology, and quality. Delegation objectives were:

> "(1) to study Chinese wheat research and its organization, (2) to examine wheat production and distribution methods, (3) to study processing of wheat and procedures employed to insure desired quality and nutritional standards, (4) to learn about management of soil, use of fertilizers, and irrigation practices, (5) to examine the economics of wheat production, processing, and distribution, and (6) to observe Chinese wheat germplasm and its management and explore opportunities for the exchange of wheat germplasm between the United States and China and Chinese participation in international wheat evaluation networks."

1978 Botanical Society of America Delegation (May 20-June 18, 1978), a 10-member delegation of botanists with varied specialties in botanical garden curating, molecular biology, insect-plant coevolution, nitrogen metabolism, systematics, evolution, physiology, cell culture, cytogenetics, and ecology. The purposes of this delegation were (1) to obtain an overview of botany in China, (2) to observe the organizational aspects of Chinese botany, (3) to determine major research foci, and (4) to observe botanical institutions.

1979 U.S. Germplasm Delegation (August 17-September 13, 1979), a 7-member delegation of six plant breeders and one pathologist specializing in soybeans, vegetables, sorghum, and millet. The delegation was given the following charge:

> "To study, select, and arrange for acquisition by the United States of germplasm of soybeans, sorghum, millets, and vegetables."

Each delegation has prepared a detailed report of their goals, achievements, and impressions. These reports are "must" reading for anyone who is interested in germplasm exchange between the U.S. and P.R.C.

B. The 1980 Delegation: Its Constitution, Itinerary, and Goals

Inasmuch as initial germplasm surveys have been made by relatively large delegations, the trend to smaller and more specialized delegations is both logical and advisable. It is impossible to construct an itinerary that satisfies the interests of all members of a large and diverse delegation. Although our delegation was small, the crop interests--forages, cereals, and vegetables--were varied and posed a problem in developing an acceptable itinerary. Because forages had not been the focus of previous delegations, our itinerary was constructed to favor the forage interests. Nevertheless, all areas visited were of significant interest to the other team members.

All delegation members were chosen from the western states, an area that has been poorly represented on previous delegations. A second reason for choosing scientists from the West was that our itinerary took us to areas in central and western China that are climatically similar to the western U.S. The 1980 Germplasm Delegation consisted of four scientists, two from the USDA-SEA-AR and two from State Experiment Stations:

Dr. Douglas R. Dewey (Delegation Leader)
USDA-SEA-AR
Crops Research Laboratory
Utah State University - UMC 63
Logan, Utah 84322 Phone: 801-750-3078

Dewey is a rangegrass cytogeneticist specializing in the perennial grasses of the Triticeae tribe (Agropyron, Elymus, Hordeum et al.). He has had a long-standing (25 years) interest in forage germplasm resources, having led plant-collecting expeditions to Iran (1972) and to the U.S.S.R. (1977). He is the current chairman of the W-6 Regional Technical Committee (Plant Introduction) and is a Curator in the National Germplasm System. Dewey hosted a Chinese Germplasm Delegation during their 4-day visit to Logan in July 1979.

Dr. Donald W. Sunderman
USDA-SEA-AR
Research and Extension Center
University of Idaho
P.O. Box AA
Aberdeen, Idaho 83210 Phone: 208-397-4181

Sunderman is a Research Leader who directs the USDA cereal breeding program at Aberdeen, Idaho. His entire professional career has been as a wheat breeder at St. Paul, Minnesota (1951-1960) and at Aberdeen, Idaho (1960-present). Sunderman's interest in germplasm has been largely as a "user." He has bred and released five hard red winter wheats, eight soft white spring wheats, and four hard red spring wheats.

Mr. Rex K. Thompson
Mesa Branch Experiment Station
University of Arizona
P.O. Box 1308
Mesa, Arizona 85201 Phone: 602-964-1725

Thompson is a Research Associate who has been involved in plant breeding, agronomic research, and crop production at the Mesa Experiment Station since 1953. He is more of a general agriculturist than the other delegation members, but barley improvement has always been a major part of his program. Thompson has been responsible for the maintenance and increase of the USDA's World Collection of barley, oats, and wheat at Mesa since 1957.

Dr. Thomas J. Orton
Dept. of Vegetable Crops
University of California
Davis, California 95616 Phone: 916-752-1734

Orton (the youngster of the delegation) teaches and does research on vegetable crops at the UC Davis campus, where he has been employed since 1978, following his graduate program at Michigan State University. His crop specialties are celery and cabbage-related groups, and he has been active in domestic exploration for celery brought to California by early explorers and settlers. Orton serves on the W-6 Regional Technical Committee (Plant Introduction).

Plans and negotiations for the 1980 Germplasm Delegation visit developed on rather short notice and proceeded rapidly, leaving little "lead time" for developing an itinerary. Proposals for 1980 and 1981 germplasm team exchanges were submitted in January 1980 to the Chinese Ministry of Agriculture (MA) by Quentin Jones (USDA-SEA-AR) and R. W. Hougas (Wisconsin AES) through the International Science and Education Committee (ISEC), a joint state/federal committee, with the USDA Office of International Cooperation and Development (OICD) serving as the Secretariat.

The delegation members were selected in early May 1980, and the following tentative itinerary was submitted to the Chinese MA toward the end of May.

Beijing - July 23 to 27

Hohhot, Inner Mongolia - July 28 to 30

Lanzhou, Gansu Province - July 31 to August 3

Urumqi, Xinjiang Autonomous Region - August 4 to 9

Chengdu, Sichuan Province - August 10 to 13

Xian, Shaanxi Province - August 14 to 16

Nanjing, Jiangsu Province - August 17 to 19

Shanghai - August 20

We invited the Chinese MA to modify the itinerary in any fashion as long as those changes did not jeopardize our expressed interest to visit rangelands in central and western China.

The Chinese MA did not respond to our tentative itinerary until we met with their officials in Beijing on July 25. At that time, Mr. Wang Xin-Hai (Deputy Chief, Division of Foreign Affairs, MA) presented us with an itinerary that was probably better than ours, so we readily accepted it. Some minor modifications of the itinerary were made during the course of the visit, and the following is our actual itinerary from the time we went to Washington D. C. for pre-trip briefings until we returned to the U.S.

Actual Itinerary of the 1980 Germplasm Delegation

Dates	Location	Institutions or Organizations Visited
July 21	Washington D. C.	Briefings by OICD, SEA-AR and State Department personnel
July 22	Travel Washington D.C. to Tokyo, Japan	
July 24	Travel Tokyo, Japan to Beijing, China	
July 25-28	Beijing Area	Ministry of Agriculture Crop Germplasm Resources Institute Genetics Institute Botanical Institute Institute for Application of Atomic Energy Evergreen People's Commune Great Wall, Ming Tombs, Imperial Palace

Itinerary cont'd

Dates	Location	Institutions and Organizations Visited
July 29	Travel (plane) Beijing to Xilinhot, Inner Mongolia	
July 30-31	Xilinhot Area	Vegetable Commune Grasslands Institute Jilin River Livestock Commune
July 31	Travel (plane) Xilinhot to Hohhot, Inner Mongolia	
July 31-Aug 1	Hohhot Area	Institute of Animal Husbandry College of Agriculture
August 2	Travel (train) Hohhot to Lanzhou, Gansu Province	
August 3-8	Lanzhou Area	Vegetable-Cereal Research Institute Wild Goose Vegetable Commune Biology Department, Lanzhou University Institute of Desert Research Yellow River Dam
August 8	Travel (plane) Lanzhou to Urumqi, Xinjiang Autonomous Region	
August 9-15	Urumqi Area	Stone River State Farm Turfan Grape Communes South Mountain Grassland Xinjiang Institute of Grasslands Xinjiang Academy of Agriculture August 1st College of Agriculture Tian Lake
August 15	Travel (plane) Urumqi to Shanghai	
August 16-18	Shanghai	Institute of Horticulture Institute of Plant Breeding Produce and Meat Market Long March Vegetable Commune
August 18	Travel (train) Shanghai to Nanjing, Jiangsu Province	
August 19-20	Nanjing	Nanjing Agricultural College Jiangsu Academy of Agriculture Nanjing Botanical Institute
August 20	Travel (train) Nanjing to Beijing	
August 21	Final meeting with Ministry of Agriculture officials and travel Beijing to Tokyo.	
August 22	Critique at Tokyo	
August 23	Travel Tokyo to U.S.	

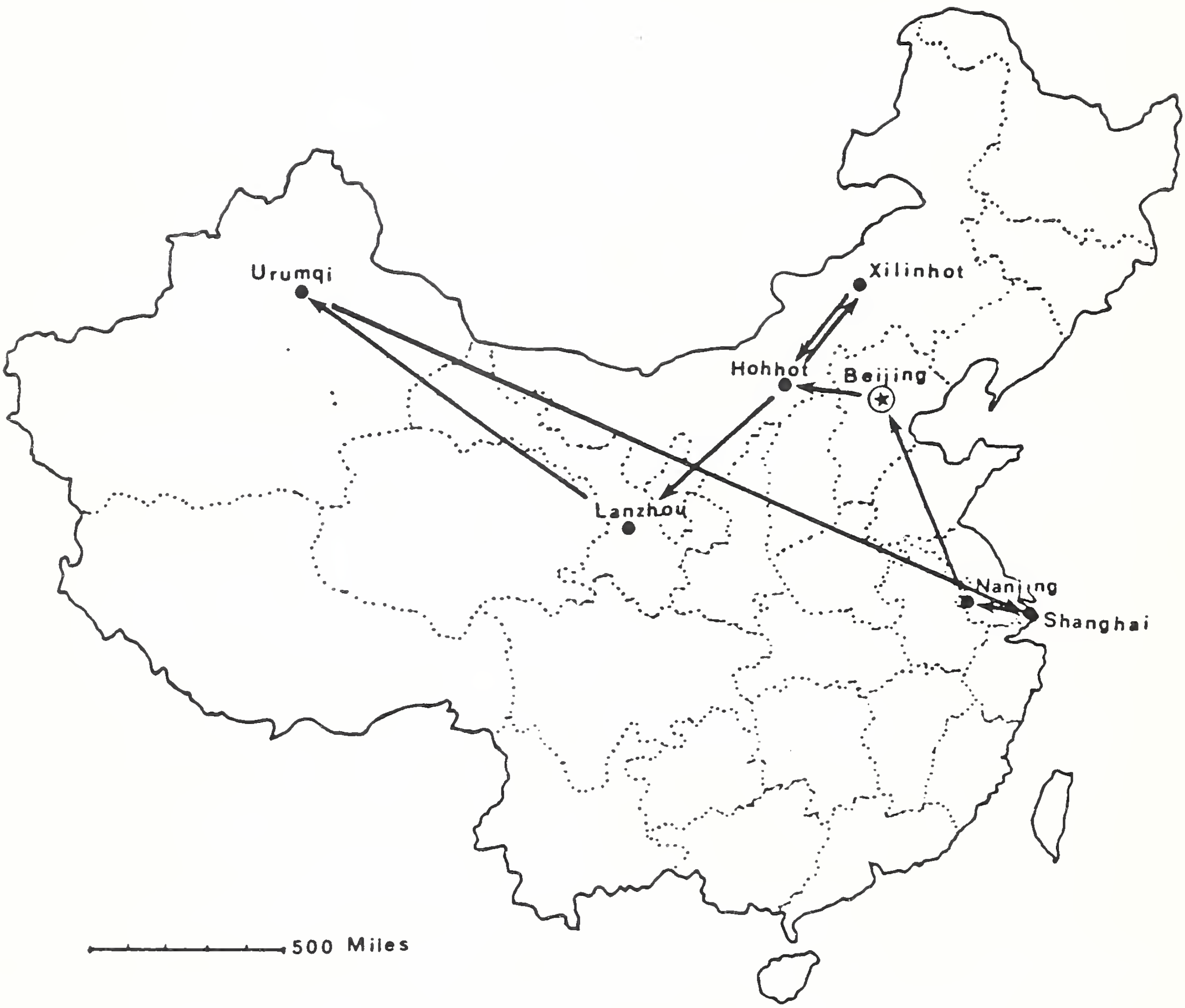

Figure 1. Route in China of the U.S. 1980 Germplasm Delegation.

The general goals of the 198 Germplasm Delegation were: (1) to assess the forage, wheat, barley, and vegetable germplasm resources and needs in China, (2) to survey the scope and quality of germplasm related research in China, (3) to establish personal contacts with Chinese agriculturists, and (4) to accomplish an immediate germplasm exchange and to facilitate future exchanges.

Inasmuch as our goals were similar to those of previous delegations, one might question the necessity of sending another team to cover the same ground as previous delegations. We were sensitive to that issue and informed the Chinese Ministry of Agriculture that we wanted to avoid seeing and doing the same things that other delegations had. That request was honored to a large degree and the 1980 Delegation was unique in the following respects:

- Our route took us to Inner Mongolia, to the Gansu Province in central China, and to the Xinjiang Autonomous Region in western China. Previous germplasm teams were restricted to eastern China and their routes frequently overlapped.

- The dates of our visit, July 24-August 21, covered a time frame that scarcely overlapped previous visits. This allowed our team to see crop production in a different season from that observed previously.

- The 1980 team focused on cool-season forage crops. This was the first delegation that included a plant breeder-geneticist (Dewey) that specialized in cool-season forages.

- Considerable collecting was permitted in the wild. This concession by the Chinese represents a significant departure from past policy. Virtually no restrictions were placed on field collecting of forages and wild relatives of certain vegetables. Less freedom was permitted in the field collection of wheat and barley.

C. Impact of the Cultural Revolution

Prior to our visit, we had no real appreciation of the devastating effects inflicted on Chinese science and education by the Cultural Revolution, a 10-year period between 1966 and 1976. During this time period, most higher education and scientific research ground to a halt. Most of the academic and research staffs were sent to the countryside to work as peasants, often at great distances from their traditional homes. The educational and research facilities were often occupied by Red Guard contingents that neglected or deliberately destroyed research and teaching equipment and library facilities. During the ensuing conflicts between opposing Red Guard units, many of the facilities were ransacked and left nonfunctional. Although the Cultural Revolution spanned a 10-year period, it set Chinese science and education back more than 10 years because it destroyed facilities (including libraries) and disrupted the educational system, which will require many years to restore.

Following the Cultural Revolution, the staffs of the research and educational institutions were returned to their former positions. However, their effectiveness was seriously impaired by the 10-year research and education hiatus and the substandard facilities to which they returned. One consequence of the Cultural Revolution is that most universities and colleges are grossly overstaffed, badly underequipped, and have relatively few students. Virtually all the staff of a university has returned to their jobs, but the 10-year educational "vacuum" has left few students prepared for a university education. It is not uncommon to have a staff:student ratio of 1:2. This means that many of the university staff have little to do, and it appears that some academic staff members never bother to come to work.

The colleges and universities are striving to increase their enrollments and improve their facilities, but this will be a slow process. They are looking to western countries, particularly the U.S., for help and direction in revitalizing their institutions of higher education.

D. Organization of Research and Higher Education in China

China is in a transitional stage with respect to the relationship between institutions of higher education and research institutions. Until recently, their research and higher education systems were organized along the lines of those in the Soviet Union where universities serve the teaching role and institutes conduct research. Graduate programs are usually administered jointly by a university and a research institute. Most middle aged (in their 40's and 50's) Chinese scientists and professors were educated and trained in the U.S.S.R., so it is quite natural that they have followed the Soviet system.

Now that China is looking more toward the U.S. for education and training of its scientists and professors, a noticeable shift is being made to the U.S. system incorporating both teaching and research functions in the universities. Nevertheless, most of the research is still being done in institutes. The more important research institutes will probably remain intact and separate from a university; however, one can anticipate that a much larger proportion of the research will be done at the universities in the future.

The influence of the U.S.-trained Chinese scientists and professors has increased substantially in recent years. For the most part, these people are more than 60 years old, having received their training in the U.S. before 1950. The U.S.-trained scientists appear to be in a favored position and often occupy key positions in science and education. An obvious competition exists between those people trained in the U.S. and those trained in the U.S.S.R. As more scientists and educators are trained in the U.S., one can expect an even greater shift toward the U.S. style of combining academic training and research in a university setting.

During our visit to any institution, we tried to gain an understanding of the administrative and organizational structure of the institution and to ascertain the number and types of scientists and support staff working on a given project. Rarely were we successful in obtaining the understanding that we desired. For instance, we could rarely separate the "professional" staff from the "support" staff. Apparently, the Chinese do not draw a very sharp line between scientists and technicians. Our inability to get clear answers on staffing patterns was due in part to the language barrier; however, we have no reason to think that the Chinese were being deliberately evasive in their answers. Basic differences in the American and Chinese philosophies in the organization and conduct of research, education, and politics may be at the root of our difficulty in getting a clear picture of the staff at the institutions.

When visiting an institution, we were usually met by a "Foreign Affairs" person who would then turn us over to the Deputy Director of the institution. Rarely did we get to meet the Director. The few Directors that we met were usually old men who appeared to have little to do with the day-to-day operation of the institution. In some instances, the director may have been a semi-political figure. On some occasions, we were unable to distinguish between the political leader and the professional-scientific leader. Also, we sometimes had difficulty in determining the correct titles of various individuals and in deciding who was the ranking person in an institution or laboratory. The Chinese do not seem to be conscious of titles, so we frequently did not know if we were speaking to a Professor, Doctor, or Mister. Consequently some of the descriptions of key personnel that we met may be inaccurate. As in the Soviet system, the rank of Professor was more prestigious than that of Doctor.

E. Preparation of The Report

In this report, we feel that it is not necessary to repeat many of the same observations made by previous delegations. Readers are referred to the four excellent previous reports. We will emphasize locations and institutions not visited previously. Nevertheless, we will touch on all locations and institutions visited because each individual sees things from a different perspective. Furthermore, changes are occurring rapidly in China, so conditions and attitudes at a given institution may differ significantly even in one year.

We are being somewhat selective in the listing of people whom we met. Rather than giving a complete list of all contacts, we are citing only people who seem to have significant responsibilities. Listing of many of the junior staff and technicians serves no useful purpose and only diverts attention from the key people.

Our report is organized with the first-order breakdown being by major agricultural area, e.g. II Beijing Area, III Xilinhot Area...VIII Nanjing Area. Under each Area, a description will be given of: A) Climate and Agriculture, B) Individuals and Institutions Visited, C) Description of germplasm resources in three categories, (1) Forages, (2) Cereals, and (3) Vegetables. In outline form, the format is as follows:

II. Beijing Area

A. Climate and Agriculture
B. Individuals and Institutions Visited
C. Germplasm Resources

1. Forages
2. Cereals
3. Vegetables

III. Xilinhot Area (same outline as II)

IV. Hohhot Area (same outline as II)

V. Lanzhou Area (same outline as II)

VI. Urumqi Area (same outline as II)

VII. Shanghai Area (same outline as II)

VIII. Nanjing Area·(same outline as II)

Each contributor to this report--Dewey, Orton, Sunderman, and Thompson--has prepared a somewhat more detailed account of their experience and impressions than appears in this consolidated report. Those interested in greater detail are encouraged to contact the individual delegation members.

I. BEIJING AREA (July 25-28)

A. Climate and Agriculture

Beijing (meaning northern capital) is one of three "municipalities" in China. It has a metropolitan population of about four million, with another four million people in the nine surrounding rural counties. The total land area in the municipality is about 17,600 square kilometers or an area almost 190 kilometers long and 95 kilometers wide. The Beijing metropolitan area is situated in a low-lying plain at about 50 meters elevation. However, the elevation increases to over 1,000 meters in the mountains near the Great Wall, about 65 kilometers north of the city.

At a North Latitude of near 40°, Beijing is comparable to Philadelphia. Annual precipitation is in the neighborhood of 750 mm, with most of it coming in the summer months. Summer temperatures occasionally reach 40°C. Winters are windy and dry, and temperatures sometimes drop below -15°C.

The Beijing area supports a varied agriculture, with vegetables and cereals playing prominent roles. The crop statistics provided by the People's Evergreen Commune give some indication of the crops grown near Beijing and their relative importance. The Evergreen Commune has 2,700 hectares of arable land, and about 1,700 hectares are devoted to vegetable farming. About 600 hectares are sown to wheat, corn, and rice. The remaining 400 hectares are used for fruit trees (pears, peaches, and apples) and grapes. The commune also raises cattle, pigs, and poultry. The livestock are fed crop residues, with little, if any, forage being grown exclusively for livestock feed.

B. Individuals and Institutions Visited

1. Ministry of Agriculture (MA). Ministry of Agriculture officials (and Mr. Ben Baer, USDA-OICD) met us on our arrival at the Beijing Airport (9:15 p.m., July 24) and transported us to the Friendship Hotel on the outskirts of the city. The next morning (July 25), we met in Dewey's hotel room with MA personnel to finalize our itinerary.

Mr. Wang Xing-Hai, the ranking MA official at this meeting, presented us with the itinerary outlined on page 4. We accepted the itinerary readily because it included stops in Inner Mongolia, Gansu Province, and the Xinjiang Autonomous Region, all of which were areas of our primary interest and had not been visited previously by U.S. germplasm delegations. The itinerary included the institutions that we had requested to visit plus several others that the MA had added. The cooperation given by the MA was very good, and they should be commended for their efforts.

Mr. Liu Chun-Meng of the MA in Beijing was apparently a direct assistant to Mr. Wang. He arranged our itinerary while we were in Beijing and appeared to have considerable influence.

Mr. Li Zheng, a MA agronomist, was designated as our official escort during our entire stay in China. Li had been a member of the 1979 P.R.C. Germplasm Delegation to the U.S. and was acquainted with Dewey because of their visit to Logan in July 1979. The functions of Mr. Li were to make our travel arrangements throughout China, to put us in contact with provincial agricultural officials, and to generally oversee the logistics of the trip. All official expenses (including food and lodging) were paid by the MA. We were authorized $9.00 per day by OICD to cover personal expenses that we might incur.

Miss Du Yue-Xin served as our interpreter throughout the entire trip. She is a young woman, in her late 20's, and had spent 2 years in New Zealand. Consequently, she had an excellent command of English. She was cooperative and hard working, and much of the success of our trip must be attributed to her.

During our 4-day stay in Beijing, we met with two high ranking officials of the MA.

Mr. Hao Zhong-Shi is one of the 20 Vice Ministers of Agriculture. He was the highest ranking official that we met in China. We met for about 1 hour on July 28 with Mr. Hao in the Beijing Hotel and discussed in general terms the needs and benefits to be deprived from free germplasm exchange between the U.S. and China. Dewey stressed the need for the Chinese to emphasize forage production on rangeland and erosion control along the Yellow River by seeding watersheds to crested wheatgrass. Mr. Hao showed considerable interest in the prospect of controlling erosion with grass seedings. It was a cordial meeting but had little substance.

Mr. Ma Ling (Deputy Director, Bureau of Foreign Affairs) served as the host during a banquet that the MA gave our delegation on the evening of July 25. We included him in our banquet given for the Chinese on July 28. Other than on these two occasions, we saw nothing more of Mr. Ma.

We are especially indebted to Dr. William, Tai, Prof. of Botany at Michigan State University, for his assistance while we were in Beijing. Dr. Tai (a former student of Dewey's) was in Beijing for 6 months (April-September) as a visiting Professor at the Institute of Genetics. Dr. Tai accompanied our delegation during our stay in Beijing and he "opened" many doors for us and gave us access to individuals that we could not have seen otherwise. He was instrumental in making the remainder of our itinerary successful. Dr. Tai has considerable influence with higher echelon agricultural officials in China and his advice should be sought by any future agricultural delegations traveling to China.

<u>Names and Addresses</u>:

Mr. Hao Zhong-Shi (Age: ca 70) 郝中士
Vice Minister
Ministry of Agriculture
Beijing
People's Republic of China

Mr. Ma Ling (Age: ca 60) 馬凌
Deputy Director, Bureau of Foreign Affairs
(Same address as above)

Mr. Wang Xing-Hai (Age: ca 60) 王兴海
Deputy Chief, Division of Foreign Affairs
(Same address as above)

Mr. Lǐ Zheng (Age: 56) 李铮
Agronomist, Division of Foreign Affairs
(Same address as above)

Mr. Li was a member of a germplasm delegation to the U.S. in 1979.

Miss Du Yue-Xin (Age: ca 25)
Interpreter, Division of Foreign Affairs
(Same address as above)

2. <u>Crop Germplasm Resources Institute</u> (July 25). The CGRI is the primary organization in the Chinese germplasm system, and is part of the Chinese Academy of Agricultural Sciences (CAAS). It serves the combined roles of the USDA's Germplasm Resources Laboratory, Beltsville, MD, and the National Seed Storage Laboratory, Ft. Collins, CO. In addition, the CGRI is involved in a number of research and breeding projects.

We were welcomed on Friday July 25 to the CGRI by a Deputy Director, Mrs. Dong Yu-Shen. Mrs. Dong was the co-leader of the Chinese Germplasm Delegation to the U.S. in 1979. She first became acquainted with Dewey during their visit to Logan. Another Deputy Director, of the CGRI, Xu Yun-Tian, was not at the Institute when we arrived, but he joined us that evening at the banquet sponsored for us by the MA. Dr. Xu was the leader of the Chinese Germplasm Delegation to the U.S. in 1979.

Mrs. Dong (who is the wife of Dr. Hu Han, Director of the Institute of Genetics) presented the following summary written in Chinese. This translation and others throughout our report were made by Mrs. C. T. Hsiao, Botanist, USDA-SEA-AR, Logan, Utah. We are indebted to Mrs. Hsiao for the translations as well as for printing of the Chinese characters of names of scientists visited.

"The Crops Germplasm Resources Institute is a national research center on germplasm. It has a national goal to unify and coordinate all efforts on field crop germplasm research.

There are eight research laboratories in the Institute:

Plant Introduction Laboratory: It is responsible for international germplasm exchange. It is also in charge of plant introduction (quarantine) regulations.

Rice Research Laboratory: It is responsible for the national rice germplasm collection, storage, research, evaluation, and release. It maintains germination potential of seed stocks by renewed planting. It also provides seeds to various provincial and educational research units.

Wheat Research Laboratory: It is responsible for national germplasm collections of wheat, barley, and oats, as well as their storage, research, evaluation, and release. General functions are the same as those of the Rice Research Laboratory.

Corn and Bean Research Laboratory: It is responsible for germplasm collections of corn and edible beans (excluding soybeans). General functions are the same as those of the Rice Research Laboratory.

Sorghum and Miscellaneous Grain Research Laboratory: General functions are the same as those of the Rice Research Laboratory.

Physiology, Biochemistry, and Genetics Research Laboratory: This laboratory studies hybridization between wheat and rye. It also studies cold and salinity resistance of wheat-rye hybrids and determines their protein and amino acid content.

Disease and Insect Resistance Laboratory: It studies the resistance to blight of rice, rust of wheat, brown spot of corn, and aphids of wheat, etc.

Germplasm Storage Laboratory: After the germplasm bank is finished, it will house the national field-crop germplasm collection. The laboratory will also conduct research on seed physiology during storage.

Germplasm resources of cotton, oil seeds, fiber crops, mulberry, tea, sugar, vegetables, tobacco, fruits, and rangegrasses will be under the care of separate research institutes in CAAS."

Organization of the Crop Germplasm Resources Institute

Director

Deputy Director(s)

- Office for Management of Experimental Plots
- Scientific Research Division
- Revolutionary (political) Committee

Research Laboratories

- Plant Introduction
- Rice
- Wheat
- Corn Beans
- Sorghum and Grains
- Physiology Biochemistry and Genetics
- Disease and Insect Resistance
- Germplasm Storage

Mrs. Dong Yu-Shen gave the following report on "The Present Status of China's Germplasm Research:"

> "It is well known that China possesses a great wealth in germplasm of field crops. However, in the past, China had very few researchers working on germplasm. There were only a handful of plant breeders, geneticists, and botanists who collected a small amount of germplasm on sporadic expeditions. Most of the field crop varieties were preserved by the local farmers.
>
> During the early 1950's when the People's Republic was established, China encouraged its people to select good crop varieties for general use. This procedure resulted in increased yields of farm crops. At the same time, a large number of less-productive varieties were eliminated. To preserve those varieties from extinction, China's Ministry of Agriculture in 1955 and again in 1956 informed each province to collect local varieties from each county. In early 1958, at the national meeting of field-crop research, it was reported that more than 40 species of field crops and about 200,000 varieties (including some duplicates) had been collected. Among them, rice had 30,000 collections, wheat 20,000 collections, other grains 20,000 collections, and soybeans 10,000 collections. In 1965, at the national meeting of vegetable research, 17,000 varieties were reported (including some duplicates). Basically, we had collected most of the local varieties in our country. Germplasm collections were deposited at various provincial agricultural institutes and the CAAS in Beijing.
>
> From the late 1950's to early 1960's, various agricultural research units had started to classify and record the morphological and biological characteristics of those varieties. Thus a national record and standard were established.

During the Cultural Revolution, the national germplasm record was destroyed and part of the seed lost its viability. For example, most of the rice resources were lost compared to that of 20 years earlier.

After the fall of the Gang of Four, China's agricultural sciences have gradually recovered. In 1978, the Crop Germplasm Resources Institute was established in the CAAS. I (Mrs. Dong) am responsible for the organization of national crop germplasm research and am in charge of the international germplasm exchange program. In the near future, when the germplasm storage facilities are finished, we will do further collection and research on the field crops such as rice, wheat, barley, corn, sorghum, beans, etc. In recent years, we have continued to collect local crop varieties and to conduct more expeditions for wild relatives of the important crops."

All international seed exchanges should be channeled through the CGRI at Beijing in much the same fashion that we should send seed overseas via the Plant Germplasm Resources Laboratory at Beltsville. Consequently, we left all of the seed that we took to China at the CGRI. We presented Mrs. Dong with 96 collections of forages, 71 collections of cereals, and 96 collections of vegetables (see Appendix I for a complete listing).

We later regretted leaving all of our seed at the CGRI. As we visited other institutions in China, we asked them for various seedstocks; in turn, they asked us for seed. We explained that we left our seed at Beijing and that they could get the seed from the CGRI. That explanation did not set well because most of the breeders expressed doubts that they could get the seed from Beijing. We could have undoubtedly obtained more seed from other institutions if we would have had seed to give to them. Future germplasm teams should learn from this experience and not leave all of their seed at Beijing.

Following our orientation by Mrs. Dong, we were taken on a tour of the following laboratories and facilities:

Analytical Laboratory Complex. This is a service complex consisting of a series of laboratories for measuring biochemical and quality characteristics of crops. The laboratories are equipped with rather sophisticated instruments--gas chromatographs with recording computers, spectrophotometers, amino acid analyzers, and refrigerated centrifuges. Most of the equipment is Japanese or U.S. made. These labs seem to be "showcases" for equipment, some of which is still in the shipping crates. There appeared to be little connection between the analytical laboratories and the plant breeders. We failed to ascertain the role of these laboratories, which seem to be receiving the highest priority for funding.

Genetics Research Laboratory. This laboratory is devoted largely to the breeding of triticale, under the direction of Mrs. Ma Yuan-Sheng. This work on wide hybridization was started in the 1950's, probably because of the influence of Soviet breeders, who are strong proponents of wide-hybridization breeding. Mrs. Ma recently reinstated the project and has developed both hexaploid and octoploid triticales. She seems to favor the octoploids, which are being backcrossed to wheat to develop cold-tolerant strains of wheat. The research facilities are rather poor and the breeding effort is simply a standard triticale program in its early stages.

Seed Storage Laboratory. A new facility is in the process of construction and is scheduled for completion in 1981. Its construction is being supported in part by funds from the Rockefeller Foundation. Mr. Jiang Chao-Yu is the Director of the storage facility. He visited the National Seed Storage Laboratory at Ft. Collins, CO in 1979, so he has a good example to work from. The storage rooms are supposed to operate at 0° to -4°C and at a relative humidity of 30%. There was considerable skepticism among the Institute staff that they can actually achieve these temperature and humidity goals.

We were taken through the existing storage facilities by Mrs. Qian Fu-Mao, the curator of the wheat collection, a job that she has held for 20 years. These facilities have no temperature or humidity controls. Seed is stored in metal cans that fit inside metal drawers. It gets hot and humid in Beijing in the summer, but the seed retains adequate viability for 5 or 6 years, after which it is regrown. The new refrigerated storage facilities will replace this storage.

Vegetable Crop Breeding Plots. This was the only field work that we had time to see. We were escorted through the field plots by two women plant breeders, Mrs. Wang Su and Miss Zhang Su-Fen. They have large plantings of eggplants, tomatoes, and green beans. The plots were well kept and the breeders appeared to be competent.

Names and Addresses:

Dr. Xu Yun-Tian (Age: 57) 许运天
Deputy Director
Crop Germplasm Resources Institute
Chinese Academy of Agricultural Science
Beijing
PEOPLE'S REPUBLIC OF CHINA

Dr. Xu is a Soviet-trained wheat breeder and has been in the U.S. on two occasions, most recently in 1979.

Dr. (Mrs.) Dong Yu-Shen (Age: 54) 董玉琛
Deputy Director
(same address as above)

Mrs. Dong is a Soviet-trained wheat breeder who has been in the U.S. in 1979.

Mr. Jiang Chao-Yu (Age: 47) 江朝余
Head, Germplasm Storage
(same address as above)

Mr. Jiang was a member of germplasm delegation to U.S. in 1979.

Mr. Ying Cun-Shan (Age: 44) 应存山
Head, Plant Introduction
(same address as above)

Mr. Ying was a member of germplasm delegation to the U.S. in 1979.

Mrs. Ma Yuan-Sheng (Age: ca 40) 馬缘生
Head, Laboratory of Physiology, Biochemistry, and Genetics
(same address as above)

Mrs. Ma is a triticale breeder

Mrs. Qian Fu-Mao (Age: ca 60) 錢复楙
Associate Wheat breeder
(same address as above)

Mrs. Qian curates the wheat collection

Mrs. Wang Su (Age: ca 40) 王素
Vegetable Breeder
Vegetable Institute
Chinese Academy of Agricultural Science
Beijing
PEOPLE'S REPUBLIC OF CHINA

Miss Zheng Su-Fen (Age: ca 35) 張淑芬
Vegetable Breeder
(same address as above)

Mrs. Chen Hang 陈航
Director
Beijing Municipal Institute of Agriculture
Beijing
PEOPLE'S REPUBLIC OF CHINA

Mrs. Chen is a vegetable breeder.

3. Institute of Genetics (July 26). The Institute of Genetics is part of the Chinese Academy of Science (CAS = Academia Sinica) and not the Academy of Agricultural Science. It appears the Academia Sinica is a more prestigious academy than the Agricultural Academy, a pattern that parallels the Soviet system.

We were welcomed by the Institute Director, Prof. Hu Han (husband of Mrs. Dong Yu-Shen), and by Deputy Director, Dr. Shao Shi-Quan. Dewey had previously exchanged correspondence with Prof. Hu, so the meeting was unusually cordial.

Prof. Hu gave a short overview of the history and work of the Institute, and the following summary is extracted from notes taken from Dr. Hu's comments via an interpreter. The Institute of Genetics was established in 1959. At present, the Institute is staffed with 20 scientists and a support staff of 180. The Institute consists of seven laboratories:

- Molecular Genetics (prokaryotic and eukaryotic organisms)
- Human, Medical, and Animal Genetics
- Somatic Hybridization and Tissue Culture
- Cytoplasmic Effects (mitochondria and chloroplasts)
- Distant Hybridization (interspecific, intergeneric, and wider)
- Applied Plant Breeding (corn, sweet potatoes, wheat, etc.)
- Technology (isotopes, lasers, etc.)

The Institute of Genetics is housed in a large old-looking building (but probably quite new) with three other institutes. Although the Institute is concentrating on basic research, they are obligated to conduct applied plant breeding. They have 10 hectares of experimental field plots, but we did not see them. We gathered that the Institute staff would rather not do plant breeding, but they were being pressured into some applied work.

The Institute of Genetics is probably China's foremost center for tissue culture (particularly anther culture). Prof. Hu has achieved international recognition in tissue culture, and the Institute hosted an International Symposium on Plant Tissue Culture in 1978. The proceedings are published in a 531-page volume (Prof. Hu presented Dewey with a copy).

The Chinese have excelled in anther culturing and it seems that "everyone is doing it." Anther culture is being used by virtually all plant breeders in China, even at the commune level. We recognize that a few research centers should be working on tissue culture, but it is certainly a mistake for most breeders to be using anther culture. They should restrict themselves to proven and traditional plant breeding practices.

Wide hybridization is a second area of emphasis at the Genetics Institute. Dr. Shao, the Deputy Director, is stressing this work as well as work on the wild relatives of barley. Chinese scientists, including some from the Institute of Genetics, have claimed to have made exceptionally wide crosses. The validity of some of these "wide hybrids" remains in doubt.

Some of Dr. Shao's more important work involves newly discovered wild relatives of cultivated barley and wheat from Tibet. Shao has developed a new theory on the origin of cultivated barley. He has discovered and named a new subspecies of semiwild wheat, _Triticum aestivum_ ssp. _tibetanum_ Shao.

Prof. Hu presented the U.S. delegation with the 1979 Annual Report of the Institute and many recent reprints. The scope of the work being conducted at the Institute is reflected in the following selected titles from their 1979 Annual Report:

"Synthesis and Characterization of RNA during Antigen Recognition in Macrophages"

"The Extraction Separation and Characterization of RNA Polymerases A, B and C from Nuclei of 615 Mouse Livers"

"Giemsa Banding of Maize (*Zea mays*) Chromosomes"

"Induction and Utilization of Parthenogenesis in Wheat (*Triticum aestivum*) Breeding I. Induction of Parthenogenesis in *Triticum aestivum* by Delayed Pollination With Alien Pollen"

"Peroxidase Isozymic Analysis of Hybrids in Tomato"

"Isozymic Studies on the Origin of Cultivated Corn"

"Inheritance of the Properties of Photosynthesis in Millet"

"The Viability of Rabbit Embryo After Storage in Liquid Nitrogen"

"Evolutionary System of Cultivated Barley"

"A Large Family With the Hereditary Proximal Spinal Muscular Atrophy"

"A Successful Test-Tube Fertilization of Maize Ovules"

"Genetic Investigation of Pollen-Derived Plants in Wheat (*Triticum aestivum*)"

"Preliminary Experiment in Applying Ruby Laser Microbeam Irradiation in Cell Biology"

"Enhancing Effect of Laser-Irradiation on Interferon Induction"

"The NMF Parameter Listing Dump Program and the NMR Peak Value Listing Dump Program on the Line Printer"

The Institute of Genetics exercises considerable influence on all genetic work in China because Prof. Hu and Dr. Shao are editors of the major Chinese genetics journals:

Acta Genetica Sinica - edited by Hu Han

Hereditas (Beijing) - edited by Shao Shi-Quan

International Genetics and Breeding - edited by Shao Shi-Quan

Most of the staff of the Institute of Genetics were trained in the Soviet Union during the time that "Lysenko genetics" was prevalent. We saw some evidence at the Institute of Genetics and in other institutions in China that Lysenko genetics is not completely dead.

<u>Names and Addresses</u>:

Prof. Hu Han (Age: 55) 胡 含
Director
Institute of Genetics
Academia Sinica
Beijing
PEOPLE'S REPUBLIC OF CHINA

Prof. Hu specializes in tissue (anther) culture and is Soviet trained

Dr. Shao Qi-Quan (Age: 48) 邵 启 全
Deputy Director
(same address as above)

Dr. Shao is specializing in wide hybridization and evolution of *Triticum* and *Hordeum*. He was trained in Leningrad U.S.S.R. from 1951 to 1960.

Dr. Shao will be working and studying in the cytogenetics laboratory of Dr. William Tai at Michigan State University from November 1980 until May 1981. He will then spend 2 weeks with Orton (Davis, California), and one month (June) with Dewey at Logan, Utah.

Mr. Hu Qi-De 胡启德
Associate Researcher
(same address as above)

Mr. Hu is a wheat breeder who is developing haploids from crosses of wheat X *Hordeum bulbosum*.

Mr. Zhang Xiao 张 笑
Assistant Researcher
(same address as above)

Mr. Zhang is working on *Triticum* X *Aegilops* hybrids.

While at the Institute of Genetics, we met the following individual who was visiting the Institute from another location:

Dr. Li Zhen-Shang 李 真 生
Director, Remote Hybridization Department
Northern Western Institute of Botany
Wu Kung
Shaanxi Province
PEOPLE'S REPUBLIC OF CHINA

Dr. Li leads a group involved in hybridization between *Triticum* and *Agropyron*. He presented us with a reprint of a paper entitled "The Cross Breeding and Its Genetic Analysis Between *Triticum aestivum* and *Agropyron elongatum*." The purpose of this research is to transfer disease resistance from *Agropyron* to wheat.

4. Institute of Botany (Saturday, July 26). Our visit to the Institute of Botany, which belongs to Academia Sinica, was hastily arranged, and we spent only 2 hours at the Institute. The 1978 Botanical Society Delegation spent much more time at the Institute of Botany, and the reader is referred to their report for a more thorough perspective of the functions of China's most prestigious botanical institution.

We were welcomed to the Institute by its Director, Dr. Tang Pei-Sung, who is also the president of the Botanical Society of China. We visited only two of the seven laboratories (1 - Systematic Botany and Herbarium and 2 - Plant Morphology and Cytology) of the Institute and those visits were very cursory.

Considerable work is being conducted on tissue culture (anther culture) in the Plant Morphology and Cytology Laboratory. Some feel that the highest quality anther culture program in China is being conducted by Drs. Zhu Zi-Qing and Wang Jing at the Institute of Botany. These scientists developed the N6 anther culture medium still in wide use internationally. They are studying the application of anther culture as a tool for haploid breeding of rice, wheat, triticale, and for rapid isolation of addition/substitution lines of *Agropyron intermedium* into wheat. In 1975, this group released a rice variety developed from a somatically doubled haploid derived from haploid plantlets recovered from anther cultures of 40 F_1's. This variety is now grown on 7,000 hectares in Manchuria. Presently they are conducting research into the mechanisms of somatic embryogenesis from pollen. They are also conducting extensive research into the phenomenon of albinism in plantlets derived from anther culture. They have also isolated protoplasts of Gramineae species and have successfully recovered callus from the protoplasts. They have successfully regenerated roots, but not whole plants as yet. Finally, they are applying somatic selection techniques to select for sugarcane lines exhibiting high sucrose, but apparently have not intercalated an *in vitro* selection step.

The Institute of Botany houses China's largest herbarium (1,000,000 specimens). We were not taken into the herbarium itself, but the chief curator (Mr. Tang Yen-Chen) had specimens brought to us of any species that we were interested in. From these specimens, we learned that the perennial grasses of the Triticeae tribe are widespread in China. Although the Institute of Botany at Beijing is probably the leading center of botany in China, the Nanjing Institute of Botany is taking the lead in the preparing of 5 grass volumes in the new 80-volume Flora of China.

The Institute of Botany is located in the same compound as the Beijing Zoo. After our visit to the Institute of Botany, we toured the zoo, which was quite impressive.

Names and Addresses

Dr. Tang Pei-Sung (Age: ca 70) 汤佩松
Director
Institute of Botany
Academia Sinica
141 Hsi Chih Men Wai Ta Chie
Beijing
PEOPLE'S REPUBLIC OF CHINA

Dr. Tang is U.S. trained (Minnesota, John Hopkins, Harvard). He is a plant physiologist but is no longer active in research.

Mr. Tang Yen-Chen (Age: ca 60) 汤延成
Head, Laboratory of Phytotaxonomy
(same address as above)

Dr. Zhu Zi-Qing (Age: ca 35) 朱自清
Assistant Researcher of Cytology
(same address as above)

Dr. Wang Jing (Age: ca 35) 王 · 敬
Assistant Researcher of Cytology
(same address as above)

Mr. Liu Liang 刘亮
Assistant Researcher, Taxonomy
(same address as above)

Mr. Jiang Shu 姜恕
Associate Researcher, Ecology
(same address as above)

Mr. Hu Zhi-Ang 胡志昂
Assistant Researcher, Ecology
(same address as above)

Mr. Li Chao-Luan 李朝銮
Assistant Researcher, Nitrogen Fixation
(same address as above)

Mr. Ma Cheng 馬誠
Director, Genetics Laboratory
(same address as above)

5. <u>The Institute for Application of Atomic Energy in Agriculture (July 28).</u> This Institute was visited by the 1975 Plant Studies Delegation, the 1976 Wheat Delegation and the 1978 Botanical Delegation. However, our delegation had the advantage of two of our members being personally acquainted with the Director of the Institute, Prof. Xu Guan-Ren (=Hsu Kuan-Jen = Harry Hsu). Sunderman had worked directly with Prof. Xu for several years in the 1950's at the University of Minnesota where both worked as wheat breeders. Dewey had a more casual acquaintance with Dr. Xu while Dewey was a graduate student at the University of Minnesota from 1954 to 1956. Prof. Xu was very delighted to see his former acquaintances, and he gave us a personal tour of the Institute.

Prof. Xu returned to China in 1956 and was the driving force behind the establishment of the Institute of which he is now the Director. Previous delegations did not identify Dr. Xu as the Director of the Institute, instead they referred to a Mr. Chao Wen-Pu as the Director or Responsible Person. Mr. Chao may be the political leader, but Dr. Xu is certainly the Director.

Prof. Xu provided us with a published paper (1979 or 1980) entitled "Application of Atomic Energy in Agriculture in China," which outlines the history of the Institute and some of the accomplishments. The following is extracted from that paper.

> "BRIEF HISTORY: In 1958, China made her first 12-year plan on the development of science and technology. Peaceful use of atomic energy was one of the first principal programs. According to the schedule of this plan the first research laboratory for the application of atomic energy in agriculture was established in 1957. It was one of the constituent units of the Chinese Academy of Agricultural Sciences. In this laboratory five short-term classes were opened successfully for training technical personnel who were interested in the use of radioisotopes and ionizing radiation for agricultural research. Within 3 years more than 300 trainees, mostly college graduates, completed their study of fundamental courses and acquired the skill of using radioisotope techniques. Four years later, the research laboratory was developed into an institute.
>
> As soon as well-trained personnel were ready, a variety of research work got started. Among these activities were studies on mutation breeding, growth stimulation, food preservation, sterile insect techniques, and many other subjects. Irradiation facilities, such as X-ray machines, electron accelerators, Cobalt-60 sources, thermal column of the reactors, were used in these studies. At the same time, radioisotopes and stable nucleids were used as tracers in the studies of fertilizers and plant nutrition, pesticides and environmental protection, photosynthesis and metabolism, as well as many other subjects related to agricultural science and production.

Unfortunately, there came the disastrous interference from Linpiao and the Gang of Four, which lasted for almost 10 years. Many laboratories were closed, while the personnel were forced to leave their posts.

Since the downfall of Linpiao and the Gang of Four, most of the laboratories have resumed their research activities. Now more than 500 specialists are engaged in agricultural research with nuclear techniques throughout the country.

In order to meet the ever increasing needs of exchanges of experiences and ideas, a nationwide scientific organization by the name of Chinese Society of Nuclear-agricultural Science was inaugurated this year. More than 150 from 27 provinces and autonomous regions attended the inauguration meeting which was held last March in Hangzhou. An editorial board was formed to take charge of the publication of a new journal which is named the Journal of Application of Atomic Energy in Agriculture. All these activities constitute a landmark indicating that application of atomic energy in agriculture in China has proceeded into a new stage of development.

SOME ACHIEVEMENTS: The scope of using radioisotope and ionizing radiation is manifold. Cited as follows are some achievements made by Chinese research workers.

Crop improvement by means of inducing mutation has been practiced in China since 1956. Various physical agencies, such as X-ray, gamma ray, beta ray, fast neutron, and thermal neutron, have been used either singly or in connection with chemical agencies. Radiation breeding is aimed not only at inducing mutation but also at promoting genetic recombination. A large number of small study teams in communes also took part in mutation breeding. It has been reported that more than 100 improved varieties and strains have been obtained through radiation breeding.

Yuanfeng Early is an improved rice variety which matures 40 days earlier than the original variety.

Emai No. 6 is an improved wheat variety which yields 20% higher than the original variety Nanda 2419.
Lumian No. 1 is a high yielding cotton variety which yields 48% higher than the original variety.

Tiefeng No. 18 is an improved soybean variety which yields 15% higher than the local variety. Yueyou No. 22 is an improved peanut variety that yields 12% higher than the check variety and shows better resistance to pests and better tolerance against environmental stress.

A bud mutation of pear has been obtained in Heilongjiang province, which could stand a low temperature 33 degrees below zero Centigrade. An improved fall-growing Chinese cabbage variety Baicai No. 9 is cold tolerant.

Studies on preservation of farm products by irradiation was started in 1958. A study group was organized by research workers specialized in entomology, microbiology, agronomy, toxicology, animal nutrition, and medical science. The research work was undertaken along four lines, namely: (1) entomological studies, (2) microbiological studies, (3) studies on nutrition and wholesomeness, and (4) studies on irradiation facilities and methodology. Satisfactory results have been obtained in such cases as inhibiting the sprouting of onions and potatoes, killing granary insects, and preventing small grains from molding in storage. The shelf-life of fresh pork-cuts, which were wrapped in double layer plastic film bags and irradiated under low temperature, could be prolonged for more than 2 months under ambient temperature.

More intensive studies are required before preservation of food by irradiation could be industrialized and commercialized in China.

Shortly after the United States of America announced the successful control of screw worm by male-sterile technique, the same sort of research work on corn borer was started in China.

In addition to corn borer, other insects such as oil-tea tree looper, yellow sugarcane borer and diamond back moth have also been studied.

Production of higher effective vaccine with little toxicity is demanded by animal immunization. Irradiation of mycoplasma which causes enzootic pneumonia of swine has been resulted in the production of a new vaccine.

Radioactive phosphorus-32 has been used as tracers in many experiments, such as in the study of uptake of phosphorus from soils and from fertilizers by various crop plants. On the basis of these studies, recommendations have been made to guide the farmers to use the fertilizers more effectively and economically. Radioactive phosphorus has also been used in the studies of translocation of metabolities within plants and secretion of metabolities from root systems.

Stable nucleid Nitrogen-15 has been used as tracers to evaluate the availability of nitrogenous fertilizers when they are applied to different crop plants. Experiments of this kind have offered useful guides for proper use of fertilizers in the sense of efficiency and economy.

Since residues of pesticides and pollutants in smoke and waste water could be serious contamination against public health, tracer technique and activation analysis have been used more and more in the study of environmental protection. The labelled compounds have been applied to various kinds of field crops, vegetables, fruit trees, tea trees, mulberry trees, and many other plants, and their fâte as residues and degradants in soils and in plants have been traced by radioassay technique.

Carbon-14 has been used as tracers to study the efficiency of photosynthesis of crop plants and translocation of photosynthesates within the plants under different growing conditions. Carbon-14 has also been used as tracers to study the distribution of growth regulating substance within the plants and their effects on growth and development.

In the study of nitrogen fixation, Nitrogen-15 has been used, among other things, to study the association between rice plants and the microorganisms capable of fixing nitrogen.

FUTURE OUTLOOK: It is the earnest intention of the Chinese research workers that more efforts should be made to extend the application of nuclear techniques to much broader fields in macro-agriculture. In order to achieve this far-reaching object, it is necessary to set up a number of well-equipped research laboratories. The first step which has been taken is to reconstruct those laboratories which were built in the past. Now, some new laboratories have been set up, while others are under construction. It has been planned that a research center will be established in Beijing on the basis of the present Institute for Application of Atomic Energy. It is expected to be comparable with those modern establishments of high reputation in the world. It is hoped that a well-organized network for application of nuclear techniques in macro-agriculture could be formed in the near future.

The common objects of using nuclear techniques in macro-agriculture in China are: (1) to increase the yield, (2) to stabilize the yield, (3) to improve the quality of the products, (4) to preserve the products from damage, (5) to offer better technology for research work (6) to supply better instruments for research work, (7) to promote mechanization and automation of agricultural production, (8) to provide nuclear energy for agricultural use, and (9) to develop the nuclear-agricultural science as a new branch of applied science.

What is urgently wanted is better instruments and technology. More efforts will be made on the improvement and device of nuclear instruments, such as semiconductor radiation vectors. More attention will be paid to the development of new technology, such as double-label counting and triple-isotope counting in liquid scintilation counting, multichannel gamma ray spectrometry, double-label micro-autography, and autoionography, structural analysis of isotope label in molecules, nondestructive activation analysis, and so forth.

With regard to basic research, particularly in such field of studies as gene mutation, photosynthesis, nitrogen fixation, plant metabolism, animal physiology, disease resistance, micro-dosimetry, and mathematical simulation of ecosystems, there is a lot of things for Chinese researchers to learn from experienced scientists abroad. Therefore, international exchanges of scientific learnings and international cooperation on research work are most sincerely expected."

It is probable that Prof. Xu's assessment of the accomplishments of "irradiation breeding" somewhat overstates the case (a common tendency for anyone who is describing the importance of his own specialty). Attributing yield increases of 12 to 48% in various crops as the consequence of irradiation per se is questionable, as is the claim that more than 100 improved crop varieties have been produced by irradiation breeding. The strong effort given by the Chinese to irradiation breeding reflects their great interest in unique or novel plant breeding approaches at the expense of proven and traditional methods. This tendency for "bandwagon" research is promoted by the higher funding given to "glamour" projects, a condition not uncommon in U.S. science.

The Institute has a staff of 140 research workers and 100 support staff. When queried as to how many of the research workers are capable of independent research, Prof. Xu answered "about 50." The Institute is obviously well funded for equipment, having three electron microscopes and irradiation capabilities via x-rays, Cobalt-60, and fast neutrons. It is one of the few research facilities in China that has air conditioning, an indication of its special status.

Names and Addresses:

Prof. Xu Guan-Ren (Age: ca 70) 徐冠仁
Director
Institute for Application of Atomic Energy
Chinese Academy of Agricultural Sciences
P.O. Box 1509
Beijing, PEOPLE'S REPUBLIC OF CHINA

Prof. Xu is also President of the Chinese Society of Nuclear-Agricultural Science. He is U. S. trained (Minnesota).

Mrs. Yang Yu-Siu 杨玉秀
(same address as above)

Mrs. Yang is using radioactive isotopes to study plant nutrition and fertilizer and herbicide movement.

Mr. Li Jing-Wei 里景伟
(same address as above)

Mr. Li is studying nitrogen fixation in Alcaligenes faecalis and Enterobacter cloaceae

Mr. Zhang He-Qin 张和琴
(same address as above)

Mr. Zhang is rearing male-sterile corn borer populations.

6. People's Evergreen Commune (July 28). This commune is a model production commune on the outskirts of metropolitan Beijing. It is one of the 262 communes in the Beijing municipality and one of 30 communes whose chief product is vegetables. This commune is a showplace for foreign visitors, and we were ushered along to make way for other visitors to the commune.

   The following statistical information was provided on a fact sheet given to us by the commune leadership.

   > "In August, 1958, the People's Evergreen Commune was organized by combining six good grade agricultural production brigades. Its total area is about 72 square kilometers. Total cultivated area is about 2,616 hectares. There are 11,000 families who live on the commune. Total population is 43,000 and 23,000 of those are laborers.
   >
   > Since the establishment of the commune, increased agricultural production has been a major objective. Following a continuous effort by the people, there was very little difference in production levels among units. In 1978, it was changed into first grade commune and divided into specialized production units. There are eight vegetable units, nine management stations (crop farms, orchards, animal ranges, experimentation, industry, farm machinery, water and electricity, main office, and health service).

Major crop production of the commune is vegetables, which occupy 60% (1,667 hectares) of the total cultivated area. The rest are grain fields (600 hectares) and orchards (400 hectares). In 1979, average vegetable production per hectare was 82,500 kg which is two-fold increase in production than that before the establishment of the commune. Total varieties also increased from 50 to 130. In winter months, vegetables are grown in the greenhouses. Grain production was 7,960 kg per hectare, which was two-fold increase. Fruit production was 6,500,000 kg, which is a 120% increase.

Pigs are the major animals reared on the commune. Others include ducks and chickens. In 1979, 1,450,000 kg of pork, 47,000 ducks, and 30,000 chickens were sold to the government. The secondary production of the commune was about 68% of the total income.

Since the establishment of the commune, the irrigation system and farm machinery were greatly improved. Now we have 480 electric-powered wells, and 98% of the land is under irrigation (15% before liberation). Before the commune was established, animal power and hand work were the major labor resources. Now we have 180 trucks, more than 70 tractors, 300 hand-operated tillers, 8 harvesters, and more than 800 various agricultural machines, such as sprayers and shredders. At this time, We are trying to mechanize our farming techniques.

Distribution of commune benefits to its members is based on their work contribution, which is judged by selected members. Men and women share equal opportunity for benefit and responsibilities. In 1979, average annual income for workers was 738 yuan (1 yuan = 0.62 U.S. dollars). Highest income for workers was 1,000 yuan and lowest was 500. For the whole population, average annual income per person was 368 yuan. Besides the collective income, commune members also have additional income produced on their private plots.

For public service, the commune provides free education, nursery (day care for children), health service, and 56 days paid maternal leave. Old people may retire at age of 55 for women and 60 for men. Average monthly compensation for the retiree is about 24 yuan."

It was enlightening to visit an agricultural commune, but little stands to be gained by way of germplasm exchange with communes. Consequently, we are not giving the names and addresses of the commune staff, most of whom were public relations people. While at this commune, we met Mrs. Chen Hang, Director of the Beijing Municpal Vegetable Institute. She may be a useful contact, and her name and address are given under the previous section of this report devoted to the Crop Germplasm Resources Institute.

C. Germplasm Resources of the Beijing Area

1. Forage Crops (Dewey)

a. Resources

Virtually no forage crops are grown in the Beijing area. Livestock are fed crop residues and not the crops themselves. I saw no alfalfa growing in or around Beijing. Although few, if any, forages are cultivated in or around Beijing, the mountainous regions to the north of the city contain an excellent forage grass resource. About 40 km north of Beijing toward the Great Wall, there are low hills (ca 300-400 m). At these elevations most of the grass vegetation along the roadside was warm-season species. By the time we had gone 50 km and had reached elevations of about 500 m, we began to encounter cool-season grasses (Agropyron and Elymus). Grass vegetation at the Great Wall (70 km N of Beijing and about 800 m elevation) was predominantly Agropyron and Elymus.

The vegetation in the mountains around the Great Wall is dominated by deciduous woody shrubs and small trees with an understory of grass. The Agropyron and Elymus species are all caespitose species, and all are probably self-fertilizing (as evidenced by very high seed set). These species, such as Agropyron yezoense and Elymus dahuricus are typical of Far-Eastern Triticeae grasses and are placed by Chinese taxonomists in the genus Roegneria, following the treatment of the Soviet botanist, Nevski.

The Great Wall presents a remarkable plant-collecting opportunity for the future. The Wall extends some 1,500 miles and gives access to terrain not accessible by roads. A properly planned expedition could traverse several hundred miles of the Wall on foot during the course of a summer. Vegetation could be catalogued on both sides of the wall, and seed would be collected of many species. Although the wall has become badly deteriorated in many places, it still provides a route that could be covered on foot. Food and other supplies could be replenished at various villages along the wall. Seed and herbarium species could be sent out at designated villages. Such a project is worthy of negotiation with the Chinese Ministry of Agriculture.

b. Collections and Exchanges

I obtained no forage seeds from any of the institutions in the Beijing Area because they are doing no work on forages. An Agropyron was growing near the Friendship Hotel and I collected it. I was permitted to make three Agropyron-Elymus collections along the roadside enroute to the Great Wall and another three collections at exits along the Wall. Considerable curiousity was expressed by onlookers on the Wall at a foreigner collecting seeds. Dr. William Tai, who accompanied us to the Wall, explained to the crowd that the seeds were being collected for scientific purposes that would benefit both countries. This satisfied their curiousity. Indsicriminant collecting in the wild without a proper escort would very likely generate some resentment.

The 96 collections of Agropyron, Elymus, Hordeum, and interspecific hybrids that I left at the CGRI were small lots of about 5 grams each. I intended to give them enough seed to get a start from which to make their own seed increases. Inasmuch as no one in Beijing is working with grasses, it is doubtful that these collections will be used by the Chinese.

2. Wheat and Barley (Sunderman and Thompson)

a. Resources

Considerable wheat is grown in the Beijing municipality, but no barley was seen. The CGRI is the prime source of wheat and barley germplasm in Beijing and the entire country. Mrs. Qian who is in charge of the CGRI wheat collection, indicated about 4,000 foreign introductions (2,000 of which were catalogued) and 3,900 north China winter wheats (2,900 of which were catalogued) were stored at Beijing.

The wild wheats and barleys collected by the Institute of Genetics staff in Tibet are especially intriguing. The following information is extracted from two mimeographed publications provided by Dr. Shao Qi-Quan. A field expedition sponsored by Academia Sinica went in 1974 to the Qing-Zang Plateau of the Qinghai Province and the Xizang (Tibet) Autonomous Region in search of wild 2-row and 6-row barleys.

"The expedition verified that two-rowed wild barley not only occurred in the southwestern part of China, but is widespread from the east Dacfu County, Ganze Autonomous Prefecture, Shichuan Province to the west Xigaze County, Xigaze Prefecture; from the south Cona County, Shan-nan Prefecture to the north Dologdequen County, Lhasa, lengthwise and crosswise about 1500 km, from 2,800-4,050 m above sea level, involving the agricultural areas of Yalong River Valley, Jinsha River Valley, Lancang River Valley, Nu River Valley, Yarlong Zonbo River, Nianchu River, and Lhunze River. It is assumed that the real distribution area will be even wider.

The distribution of the 6-rowed wild barley is similar to or even surpasses that of the 2-rowed wild forms. Two-rowed wild forms could not be found in some places, while there were a lot of 6-rowed wild types. The 6-rowed wild barley is not easily distinguished from the cultivated species. Natural populations of wild barley will be eliminated rapidly by increased cultivation. The 6-rowed wild barley is the immediate ancestor of the cultivated 6-rowed type. A Tibetan Commune member said that barley with a brittle rachis was grown in ancient times. The wild barley was provided for milling flour and making wine in Yangda Commune, Dueilong-deqing County, and Jiula District, Cuona County. The native farmer knew it well, and gave it a special Tibetan name as "Tzeda," the English equivalent of which is the "wild thing." These facts further indicate that 6-rowed wild barley is native to the southwestern part of China, and it is closely related to the cultivated type.

Semi-wild wheat was discovered during a scientific expedition to the Qing-Zang Plateau in 1974, and a large number of seed and plant samples were collected. Semi-wild wheat usually grew as a weed in barley and wheat fields. It was first discovered in the Jitan District, Chaja County, Changdu Perfecture, and samples were collected later in Jiacha and Gunga counties. The majority of the lines had a brittle rachis although segregation in this trait was found in individual lines. Significant differences occurred between semi-wild wheat in Xizang and Spelta wheat. Semi-wild wheat is 2n=42, a hexaploid. It can be very easily crossed with common wheat, but sterile lines segregated in the offspring. Because of significant differences of semi-wild wheat from Triticum spelta and ssp. yunnanensis, it should be divided into a new subspecies of Triticum aestivum, i.e. ssp. tibetanum."

b. Collection and Exchanges

We requested scab resistant and yellow dwarf tolerant varieties of wheat from the CGRI, but were told that they were stored elsewhere. However, as we left China at the end of the trip we were presented with 15 wheat varieties and a book describing wheat varieties grown in China.

Attempts to obtain seed of the wild wheats and barley from Dr. Shao of the Institute of Genetics were unsuccessful. The Chinese are quite protective of this germplasm. Maybe an exchange can be arranged now that Dr. Shao is in the U.S. Dr. Shao has since sent Dewey two collections of Aegilops squarrosa, one collection of Hordeum bulbosum, and one collection of Secale vavilovii, and two collections of Secale cereale. None of these collections appear to be especially valuable, although we are glad to get them.

The CGRI requested "leaf spot" resistant varieties from us, but they could not specify the causal organism of the leaf spot. Thompson presented them with five barleys, three wheats, and one collection of oats. Sunderman delivered 32 collections of cereals during our visit to the CGRI.

3. Vegetables (Orton)

a. Resources

Thirty vegetable communes service the Beijing Area. Approximately 150 different kinds of vegetables are grown, the top 10 of which account for over 90% of the total production. It was estimated that the total annual production of vegetables for Beijing is about 945,000,000 kg, or about 135 kg per person. Leafy-type vegetables such as Chinese cabbage, celery, and radishes are densely planted on 1.0-1.5 m x 10 m beds. Fruited vegetables are planted on similar beds in rows and spaced to allow for staking. Planting density tends toward excessively high.

Tomatoes: Tomatoes are transplanted during March into beds protected from frost by plastic covers and harvested during June-July (multiple harvests). They are almost entirely standard pole fresh market types, which are supported by individual bamboo pyramids. Most of the varieties grown in the area are pure lines and mixtures of pure lines introduced from the U.S. and Japan. Presently, germplasm is being screened for adaptivity, disease resistance, and as suitable sources for the extraction of inbreds for hybrid production. Little or no pedigree or backcross breeding was observed. A program in anther culture of tomatoes has begun with some success.

Eggplants: The Institute of Vegetables has an active eggplant breeding program with a number of excellent looking lines that exhibited excellent resistance to virus.

Peppers: Sweet/hot green bell types are being amassed and evaluated. Almost all of the lines appear seriously diseased with what was identified as cucumber mosiac virus (CMV).

Celery: They have acquired and are testing a number of introduced varieties from the U.S. and Southern China. Florida 683 has become quite popular and is grown on a large area south of Beijing.

Hybrid varieties are being explored for a number of other crops including head cabbage (via self-incompatibility), Chinese cabbage (via male sterility), radish (via self-incompatibility), and cucumbers (via gynoecious lines). Other prevalent vegetables in the Beijing area were cowpeas. carrots, watermelons, pole beans, water lilies, potatoes, onions, leek, snake squash, and white gourds.

Over 17,000 vegetables lines were collected in 1965 from diverse localities throughout China. This collection was nearly 75% destroyed in the course of the Cultural Revolution, and the Institute of Vegetables has been assigned the task of re-collecting local "landrace" vegetable varieties by 1982. The Institute still maintains the largest collection of landrace vegetables on a national scope. Any requests for seed will draw expectations of reciprocal exchange. Some thought should be given to lines of interest to the Chinese in exchange.

Any locally bred germplasm, particularly landraces in the Beijing area for over 100 years, have been subjected to very hot, humid conditions during the midsummer accompanied by severe, even unchecked, pressure from pathogens and parasites. These lines may have evolved genes for adaptivity to these conditions and tolerance to biotic pathogens and parasites. A tremendous range of variability was observed in some of the crops, particularly in tomatoes, peppers, and cucumbers.

b. Collections and Exchanges

The Institute of Vegetables presented the U.S. Delegation with two collections of celery and one eggplant. Two sugarbeet lines were obtained from the CGRI to be given to Dr. John McFarlane, Salinas, California. A celery collection was made on uncultivated land. A wild carrot and a wild unidentified crucifer were also collected.

Orton presented the following collections to the CGRI: 19 *Brassica compestris*, 15 *B. carinata*, 43 *B. juncea*, 13 *B. napus*, 2 broccoli, 1 brussel sprouts, and 1 cauliflower.

The Chinese vegetable breeders would like the following: (1) several eggplant lines, (2) virus tolerant pepper lines, (3) virus resistant tomato lines, (4) bush-type processing tomatoes, (5) tomato lines tolerant to heat and cold extremes, and (6) wild tomato species.

III. XILINHOT AREA - INNER MONGOLIA (July 29-31)

A. Climate and Agriculture

Flying the 400 km from Beijing to Hohhot (Capital of Inner Mongolia) took us over a plateau region with low mountains and few trees. The plateau region appeared to be very dry and erosion was severe. Terraces were everywhere on the hillsides. Valleys of various sizes were interspersed among the mountains, and those valleys being farmed contained relatively large fields adaptable to mechanized farming. Most of the river beds were dry and much of the area was sparsely populated. As we approached Hohhot, the terrain became greener and the river beds had some water. The flight from Beijing to Hohhot took about one hour.

After a short layover at the Hohhot Airport, we boarded a small plane for Xilinhot, about 500 km NE of Hohhot. On leaving Hohhot, we passed over low mountains with terrific erosion and wide, dry river beds. The mountains were smooth with shrubby vegetation and a few deciduous trees. Beyond the low mountains, the terrain opened into rolling hills that were cropped with spring wheat and oats. About midway between Hohhot and Xilinhot, the terrain flattened out and became very dry, with a few scattered reservoirs. We next crossed a large sand desert that appeared to be uninhabited. As we approached Xilinhot, the vegetation increased and we entered a vast flat grassland. The flight from Hohhot to Xilinhot took about 1 hour 15 minutes.

The Xilinhot region resembles the Northern Great Plains in topography and vegetation. Xilinhot is at about 44° N latitude (equivalent to Rapid City, South Dakota) and at an elevation of about 900 m. Annual precipitation is in the vicinity of 300 mm, with the rainy season coming in the summer months. In spite of modest precipitation, underground water appears to be rather plentiful and easily accessible. Shallow wells (3 to 10 meters) can be used for stock watering and deep wells (100 meters) could be used for irrigation.

The Xilinhot region is a large unfenced grassland and the dominant agriculture is livestock grazing (sheep, goats, cattle, horses, and camels). The grassland is unimproved and the native vegetation consists largely of perennial cold-season grasses (*Agropyron*, *Elymus*, *Stipa*, and *Festuca*), shrubs (*Artemesia*) and legumes (*Medicago* and *Astragalus*). Improved seeded pastures and alfalfa fields are virtually non-existent. A diversified agriculture (vegetables, corn, small grains, pigs, and chickens) is found in the immediate vicinity of population centers such as Xilinhot. Pigs run loose in the streets of Xilinhot. We asked who owned the pigs and how they were cared for. We were told that the pigs were let out of their pens each morning to roam unattended about the city looking for food. At night, the pigs returned home, just like a dog, to be fed and locked up for the night. Smart pigs!!

B. Individuals and Institutions Visited

1. Government Officials

We were welcomed to Xilinhot by Mr. Su Ri Cheng La Tu (a Mongolian), the Deputy Director of the Xilinhot office of Foreign Affairs. Mr. Su arranged all of our activities during our stay in the Xilinhot area, and he was an effective and cooperative host. Mr. Su is an influential political figure who seemed to know everyone in Xilinhot (a city of about 100,000). He accompanied us throughout our visit to the Xilinhot area.

We were also accompanied in the Xilinhot area by Mr. Lo Song-Shan, the Deputy Director of the Bureau of Grassland and Manager of the Grassland Committee. Mr. Lo's function was not very clear to us. He is neither a political figure per se nor a scientist. He is probably a mid-level bureaucrat with some training in grassland management. He might be compared to a BLM state or district official. He was very accommodating and he presented Dewey with a book, "Handbook of Grasslands in Inner Mongolia." The book describes the primary forages in Inner Mongolia and how they should be managed.

Names and Addresses

Mr. Su Ri Cheng La Tu (Age: ca 40) 苏日成拉图
Deputy Director, Bureau of Foreign Affairs
Xilinhot, Inner Mongolia
People's Republic of China

Mr. Lo Song Shang (Age: ca 50) 罗嵩山
Deputy Director, Bureau of Grassland
Xilinhot, Inner Mongolia
People's Republic of China

2. Institute of Grassland (July 29)

This Institute, an affiliate of the Chinese Academy of Agricultural Sciences, is located on the outskirts of Xilinhot. We were welcomed to the Institute by Mr. Wang Lian-Kuei, Deputy Director, who gave us a briefing about the Institute. The Institute was established in 1964. Today it has a staff of 205, with 104 researchers (57 of whom are "senior scientists"). It is impossible to say how many of the researchers are bonafide scientists. The Institute is comprised of seven laboratories: (1) Grass Planting, (2) Grass Breeding, (3) Grass Utilization, (4) Grass Protection Against Diseases and Insects, (5) Forage Feeding, (6) Forage Development and Enlargement? and (7) Germplasm Resources. Our translation of the names of the laboratories obviously leaves something to be desired. None of these laboratories make mention of cereal crops; however, yield trials of wheat, barley, and triticale were conducted on the Institute grounds.

The "breeding" work being conducted by the Grassland Institute is more in the class of strain testing. They have a fairly extensive testing program of native and introduced forages and cereals.

We were shown a small herbarium and cereals display room. The remainder of the time was spent in the field plots. Apart from the strain testing program, we learned very little of what kind of work was being done at the Institute of Grassland. This Institute is moving to Hohhot in 1981, which is unfortunate because Xilinhot is the center of the Mongolia grasslands and Hohhot is not. However, a branch station will remain in Xilinhot.

Names and Addresses

Mr. Wang Lian-Kuei 王连奎
Deputy Director
Institute of Grassland, CAAS
Xilinhot, Inner Mongolia
People's Republic of China

Mr. Ma Zhi-Quang (Age: ca 35) 马志广
Head, Forage Resources Laboratory
(same address as above)

Mr. Ma is scheduled to go to Canada in 1981 for training in grassland ecology. He is our best forage contact at the Institute. Mr. Ma is a friend of Mr. Liu Chi-Wu, who worked in Dewey's laboratory from March to September, 1980.

Mr. Ning Bu (Age: ca 30) 宁 佈
Assistant Researcher for Germplasm
(same address as above)

Mr. Ning is a Mongolian. He seems to be Mr. Ma's chief assistant.

3. Local Vegetable Commune (July 29)

Our delegation was taken to examine vegetable production plots at a local commune maintained by Jiao Le Shao Bu, Farm Leader, whose plots supply the bulk of vegetables to the Xilinhot markets. Extensive use of advanced irrigation, fertilization, and plant protection techniques was observed. Ranges of plastic houses have been built for extending the growing season and accelerating growth of warm-season vegetables.

4. Jilin River Livestock Commune (July 30)

A full day was spent at this Commune, which is about 100 km NE of Xilinhot. The unimproved road to the Commune passed through native rolling prairie, which was in reasonably good condition. The dominant vegetation was *Elymus chinensis* and *Elymus dasystachys*, both strongly rhizomatous species. These grasses play the same role in Inner Mongolia that *Agropyron smithii* plays in our Northern Great Plains. The prairie is grazed by a combination of sheep, goats, cattle, and horses.

No hay is stored in the prairie lands. Livestock numbers are more or less controlled by the number of animals that can be overwintered on the native prairie. Consequently, much of the prairie is underused in the summer and overused in the winter. Livestock production could be increased substantially by raising alfalfa hay for winter feed; however, the Mongolians do not seem to be disposed to this type of agriculture.

We had an interesting and unusual dinner in a Mongolian tent with the Commune leader. This Commune has a herd of about 100 camels, which are used to move the nomad camp during the winter. Camels can apparently move in snow better than horses.

C. Germplasm Resources of the Xilinhot Area

1. Forages (Dewey)

a. Resources

The Xilinhot grassland is a prime collecting area for cool-season forage species, many of which should be immediately adapted to the Northern Great Plains. Fifteen forage collections were made on the prairie enroute to the Jilin River Commune. The *Elymus chinensis-dasystachys* species complex is the prevalent grass in these prairies. They have much in common with *Agropyron smithii*, being strongly rhizomatous and having rough, stiff, bluish leaves and culms to about 100 cm tall. These grasses have been introduced only rarely into the U.S. and they have never been adequately evaluated. They appear to hold great potential.

The crested wheatgrasses (*Agropyron cristatum* et al.) is another important group of grasses native to the Xilinhot prairies. These species have already demonstrated their value for revegetating U.S. rangeland. Crested wheatgrass germplasm from China has been previously unavailable to U.S. grass breeders, so the Mongolian germplasm represents an entirely new source of breeding material.

Legumes are rather scarce in the Xilinhot native grasslands. They have probably disappeared because they are grazed preferentially. Nevertheless, some *Medicago* and *Astragalus* species can be found if they are searched for carefully.

b. Collections and Exchanges

I was able to make 21 forage collections, mostly from the native prairie on the road to the Jilin River Commune. Almost half of the collections were rhizomatous *Elymus* species (more correctly identified as *Leymus*). Four collections were made of the species of the crested wheatgrass complex (Agropyron cristatum et al.). We, of course, scarcely scratched the forage germplasm resource of Inner Mongolia. A major plant-collecting expedition for forages is justified in Inner Mongolia.

The Institute of Grassland has a modest collection of forage germplasm. Their grass researchers seem to be more interested in caespitose species like Elymus sibiricus and E. dahuricus than in the rhizomatous species, E. chinensis and E. dasystachys. They are doing no work with legumes. We were presented with seven grass collections from the strain trials being conducted at the Institute. The Institute asked that we provide them with the following forages: (1) Lespedeza sp., (2) Bromus tectorum, (3) Eragrostis chloromelas, (4) Eragrostis superba, (5) Eragrostis curvula, (6) Lolium rigidum, (7) Poa pratensis, (8) Festuca ovina, (9) Panicum antidotale, and (10) Oryzopsis miliacea. Most of these species are obviously not appropriate for the Xilinhot area and it would be futile to even try these species. After returning to the U.S., Dewey sent the Institute 10 collections of Agropyron and Elymus, consisting largely of improved varieties. Five Agropyron and Elymus varieties were also sent to Mr. Lo at the Bureau of Grasslands.

2. Wheat and Barley (Sunderman and Thompson)

a. Resources

Wheat is not a major crop in the Xilinhot area, as only 4,000 hectares were grown. The only disease seen was barley yellow dwarf. The growing season is very similar to that at Aberdeen, Idaho. They plant in April and harvest about the middle of September. Yield nursery plots were planted under irrigation and were 6-row plots 5 meters in length with a row spacing of about 25 cm. The nursery was irrigated about every 14 days with approximately 5 cm of water. The soil was a sandy loam and plants were showing moisture stress. Although there were complaints about the difficulty of getting seed from Crop Germplasm Resources Institute at Beijing, we observed Steptoe and Unitan barley in the yield trials and upon asking, found they were sent out by the CGRI. Steptoe appeared to be one of the high yielders in the trial.

b. Collections and Exchanges

We were given 3 collections of wheat, 2 of barley, and 23 of oats. They provided a "wants" list of 60 oat varieties. They must have access to an oat variety list from the U.S. and Canada and asked for everything on it.

3. Vegetables (Orton)

a. Resources

Head cabbage exhibited a great deal of morphological variability with respect to heading characteristics and leaf color and texture. Heavy looper damage was evident, but there were no overt signs of disease. Solanaceous crops such as eggplant, pepper, and tomato were extensively grown and exhibited mild to severe symptoms of TMV and other viruses. Other vegetables grown to a lesser extent were pole beans, french beans, celery, and spinach. A type of melon roughly translated as "mangua" was cultured in an interesting manner. After one or two fruits were set, the entire apical meristem was buried with soil. This prevented the setting of additional fruit and stimulated the development of adventitious roots on the buried stem thus enhancing the development of set fruits. Mr. Jiao practiced conscious and unconscious selection among vegetable populations, but no organized vegetable breeding effort was otherwise observed in Xilinhot.

Most of the vegetable lines obtained originally in 1955 for adaptation to Xilinhot were introduced from Eastern Inner Mongolia where they were originally local types. Since then, a number of lines have been acquired from the vegetable collection in Beijing and variously worked into the germplasm pools. Judging by the extent of variability in many of the vegetable lines, particularly head cabbage, peppers, and cucumbers, the general degree of genetic variability is extremely high.

b. Collections and Exchanges

Mr. Jiao (farm leader of the Vegetable Commune) provided 10 collections of Allium, Brassica, Apium, Capsicum, Cucumis, Lycopersicon, and Raphanus. Orton collected two accessions of cultivated oilseed Brassica, six accessions of Angelica, one wild Daucus, and one wild unidentified crucifer.

Orton will send Mr. Jiao the best lines of the following vegetables adapted to mild, arid conditions under irrigation, preferably with tolerance to virus: pepper, eggplant, cucumber, tomato, celery, and pole beans.

More exchanges of germplasm with Mr. Jiao and establishment of connections with vegetable specialists in Eastern Inner Mongolia are urged.

IV. HOHHOT AREA - INNER MONGOLIA (July 31-August 2)

A. Climate and Agriculture

Hohhot, a city of about 600,000 people, is situated in an irrigated valley among low-lying mountains about 400 km WNW of Beijing at the North Latitude of about 41°. Precipitation was reported to be about 300 mm annually, with most of it coming in the summer. Winters are open and windy, with temperatures falling to -20°C. It is a spring wheat area, with oats being a major crop. Vegetable farming is important near population centers. The valley areas are almost completely cultivated and irrigation is commonly practiced. The irrigation water comes from wells dug to a depth of 50 to 100 meters. The hilly regions, which account for about 70% of the land, are grazed with livestock or planted to wheat and oats. The latitude and climate of Hohhot is roughly equivalent to that of North Platte, Nebraska.

B. Individuals and Institutions Visited

1. Government Officials (July 31)

We were escorted in Inner Mongolia (both Xilinhot and Hohhot) by Mr. Fan Cheng-Liang and Mr. Bao Wen-Zhang. Mr. Fan appeared to be a government bureauacrat with no specialized training in agriculture, whereas Mr. Bao had an obvious background in range and pasture management.

Names and Addresses

Mr. Fan Cheng-Liang (Age: ca 45) 范成良
Chief, Division of Science and Education
Bureau of Agriculture
Hohhot, Inner Mongolia
People's Republic of China

Mr. Man De-Hu 曼德胡
Deputy Director
Bureau of Animal Husbandry
Hohhot, Inner Mongolia
People's Republic of China

Mr. Bao Wen-Zhang (Age: ca 35) 包文志
(Title and address uncertain)

2. Institute of Animal Husbandry and Veterinary Science (July 31)

We were welcomed by the Director of the Institute, Mr. Gu Ba Zha Bu and his deputy, Mr. Ha Si. Mr. Gu gave us the following statistics relating to the agriculture of Inner Mongolia. Of the 1,170,000 sq km in Inner Mongolia, 800,000 sq km are devoted to livestock grazing, 120,000 sq km are suitable for crop production, and 250,000 sq km are used for mixed livestock and crop production.

The Animal Husbandry Institute is a Provincial Institute that was established in 1954. It consists of three departments with a total staff of 90 people. By Chinese staffing standards, this is a rather small institute. We could not determine whether the 90 staff members were all scientists or a mix of scientists and technicians. The Department of Animal Husbandry, with a staff of 35, has the task of breeding better livestock. The Department of Veterinary Science, also with a staff of 35, is concerned primarily with disease prevention. The Grassland Department, with a staff of 10, has the assignment of improving the grasslands. The Grassland Department is a separate organization from the Institute of Grassland, CAAS, which will be moving to Hohhot from Xilinhot in 1981.

After a brief tour of the veterinary labs, which were poorly equipped, we visited the forage plots. We saw the first alfalfa of the trip and were assured that alfalfa was grown commonly around Hohhot. We were escorted through the forage plots by Mr. Li Yan-Qin and Mr. E Mu-He, two forage breeders. Mrs. Li is the wife of Mr. Na Sen, who is the chief forage breeder at the Institute. Mr. Na Sen was in Beijing at the time of our visit. After our return to the U.S., Mr. Na Sen called Dewey on the phone from Colorado, where he was visiting. The forage breeding work at Hohhot hardly qualifies as breeding, rather it is a modest species evaluation program. These people are very cooperative and are willing to share seed.

<u>Names and Addresses</u>

Mr. Gu Ba Zha Bu (Age: ca 70) 古仈札布
Director
Institute of Animal Husbandry and Veterinary Science
Hohhot, Inner Mongolia
People's Republic of China

Mr. Ha Si 佮斯
Deputy Director
(same address as above)

Mr. Na Sheng (Age: ca 40) 纳森
Grass Researcher
(same address as above)

Mr. E Mu-He (Age: ca 35) 额木合
Grass Researcher
(same address as above)

Mrs. Li Yan-Qin (Age: ca 30-35) (wife of Mr. Na Sen) 李艳芹
Grass Researcher
(same address as above)

3. College of Agriculture and Animal Husbandry (August 1)

The College was first established in 1952, but it was disbanded during the Cultural Revolution and reinstated in 1978. It consists of five departments: (1) Animal Husbandry, (2) Veterinary Science, (3) Crop Science, (4) Water Resources, and (5) Mechanical Arts. Departments of Economics and Rangeland Management will be added soon. The College has 964 students and a staff of 855, which includes 420 teachers, 248 lecturers, 35 Associate Profesors and 5 Professors. The College has an impressive display of animal skeletons, some with the dried muscles intact, for use in teaching animal anatomy. We were given a demonstration of acupuncture on a horse.

The College is primarily a teaching institution; however, they are conducting (for 2 years) sizeable breeding programs with corn, sorghum, cereals, vegetables, and forages. We split into three groups (forages, cereals, and vegetables) at the College and each of us visited the field plots of our interest.

The forage program is under the direction of two men (lecturers), Mr. Wang Be-De and Mr. Wu Qu-Lai. The forage effort consists largely of demonstration plots to acquaint students with various forage crops. The demonstration plots contain 49 different species of grasses, legumes, and miscellaneous forbs. Some of the species are native to China, but many others are introduced. These forage workers are not coordinating their program with that of the Animal Husbandry and Veterinary Institute, although the two institutions are located very close to each other.

The Department of Vegetables had eight research faculty members, but that was reduced to four during the Cultural Revolution. Their faculty includes Professor Lin Wei-Shen, who is a nationally known expert on greenhouse production, and Mr. Zhao Qing-Yan, a tomato and pepper breeder. The Hohhot Municipal Institute of Agriculture apparently also performs vegetable research, but we didn't have the opportunity to visit there.

Wheat breeding is being conducted by Mrs. Xu Ji-Feng. Sunderman and Thompson visited the breeding plots of wheat and oats. Although stem rust is the major disease problem, yellow dwarf and leaf rust were found in the plots. The program was small and populations being tested were limited in size.

Names and Addresses

Dr. Lu Chun-Xiang 陸纯詳
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People's Republic of China

Dr. Lin Wei-Shen
Professor of Vegetable Crops
(same address as above)

Mr. Zhao Qing-Yan 赵清岩
Lecturer of Vegetables
(same address as above)

Mr. Wang Be-De 王比德
Lecturer of Forages
(same address as above)

Mr. Wu Qu-Lai 吴祖赖
Lecturer of Forages
(same address as above)

Mrs. Xu Ji-Feng 徐季凤
Lecturer of Wheat
(same address as above)

C. Germplasm Resources

1. Forages (Dewey)

a. Resources

Inasmuch as I was unable to visit any natural grasslands in the Hohhot area, I have no first-hand information on the native forage resources. The rangeland around Hohhot appeared from the air to be badly abused, so forage collecting may be less productive here than around Xilinhot. There was no indication that forage workers in Hohhot or Xilinhot are collecting their native germplasm. Instead, they are accumulating forage strains from other parts of China and around the world via the Crop Germplasm Resource Institute at Beijing.

Based on conversations with forage researchers and on the list of plants in the Grassland Handbook for Inner Mongolia, it appears that significant forage germplasm resources occur in Inner Mongolia in the following genera: *Medicago* (primarily *falcata*), *Hedysarum*, *Oxytropis*, *Astragalus*, *Bromus*, *Poa*, *Festuca* (primarily *ovina*), *Hordeum*, *Elymus* s. lat., *Agropyron* s. lat. *Stipa*, *Eurotia*, *Atriplex*, *Kochia*, *Artemisia*, *Sanguisorba*, *Potentilla*, *Carex*.

b. Collections and Exchanges

I obtained 11 forage collections from the forage plots of the Animal Husbandry and Veterinary Institute. Collections were made of species in the following genera: *Bromus*, *Elymus*, *Agropyron*, and *Medicago*. They had a very large *Astragalus* sp. (over 1.2 meters tall), but it had not flowered and no seed was available.

From the forage plots of the College of Agriculture, I collected 12 seed lots of species in the following genera: Agropyron, Elymus, Hordeum, Bromus, Trifolium, and Medicago. One of the most interesting species was Trifolium lupinaster, a red-flowered clover native to Inner Mongolia. It overwinters well at Hohhot and produces about the same as T. pratense. Collections were made from segregating populations of Medicago sativa X M. falcata. The grass breeders at the College are emphasizing Elymus sibiricus. This species produces well on irrigated land but cannot compete with A. cristatum on rangeland. I think that they should forego work on forages for irrigated land and concentrate on species for rangeland.

A set of 10 varieties and hybrid lines of Agropyron and Elymus have been sent to both the Institute of Animal Husbandry and to the College of Agriculture. Hopefully, this will open the way for further exchanges. The College has since contacted Dewey concerning placing one of their forage breeders, Mrs. Yun Jin-Feng, in his laboratory for a year. This arrangement would facilitate germplasm exchange.

2. Wheat and Barley (Sunderman and Thompson)

a. Resources

The total wheat acreage in Inner Mongolia is about 664,000 hectares, of which about 40% is irrigated. Wheat yields in Inner Mongolia vary from 1,500 to 6,000 kg/hectare.

Several selections in the barley screening nursery were heavily infested with stem rust. Yellow dwarf and leaf and stem rust were present. The most serious disease was stem rust, of which they have four races that had been used for a number of years and a new race which first became prevalent in 1979. Mrs. Xu had some winter x spring crosses, one of which was Cajeme x Bezostaja. She has used Orofen in many of her crosses. The F_2 populations observed were segregating for rust resistance, and she had some desirable semi-dwarf F_4 lines that had good resistance to rust. Most F_2 populations had about 500 plants, but she had many crosses. The oat and barley breeders had similar programs. All of the varieties looked at were foreign varieties or selections derived from crosses of local varieties with foreign varieties. The major shortcomings of the wheat program, if there were any, were the use of only the current rust race as the tester for rust resistance and the limited population of each cross.

b. Collections and Exchanges

Three collections of oats, two of barley, and one of wheat were given to us by the College of Agriculture.

3. Vegetables (Orton)

a. Resources

Local materials represented a valuable store of germplasm adapted to dry, mild conditions. The disease pressure, particularly virus, was not nearly so great as in other localities, even in similar climates. The reasons for this are not clear since cultural practices were not drastically different. Research into the comparative epidemiology of viral disease of vegetables is needed.

The vegetable breeding program at the College of Agriculture and Animal Husbandry was determined to be quite progressive and well-run. It was judged that perhaps one of the most comprehensive collections of peppers, tomato, and cucumber germplasm is maintained here. Local lines of other vegetables have been thoroughly collected, maintained, and evaluated.

Eggplant: Mostly "local" varieties are grown. Breeding is done from a germplasm base which has been in Hohhot for at least 30 years. The best variety observed was translated as "Precious Stone." Plants and fruits were quite pale at maturity. Fruits were large and oblong. The population observed was highly uniform with respect to type, and no disease or insect damage was evident.

Peppers: Of all the pepper breeding efforts observed, the program at Hohhot headed by Mr. Zhao was the largest and most progressive. Approximately 60 to 100 different lines, both local and introduced foreign, were being tested for adaptivity and disease resistance. It was surmised that a comprehensive collection of local and introduced lines is maintained here, perhaps one of the largest in China.

Tomatoes: Two main types of tomatoes were observed: medium to late maturing indeterminant staked types and "early-maturing" semi-determinant types. The germplasm base is a mixture of "local" and introduced Chinese lines. The local consumers prefer pink fruit and much emphasis is placed on breeding lines exhibiting slow ripening characteristics in addition to uniformity and earliness. TMV and other viral diseases were observed, but symptoms were not as severe as in other parts of China.

Cucumbers: Both open-pollinated and hybrid varieties have been developed and are being grown. The germplasm base for current varieties is made up of "local" and introduced lines. Hybrids are primarily F_1 between "local" inbreds and those developed from material introduced from Tientsin. Gynoecious lines selected from materials introduced from Manchuria are used as female parents. Preferred fruit is a thick, less spiny type as compared to standard Chinese cucumbers; more similar to the varieties grown in the U.S. The most serious disease is a leaf spot caused by Pseudoperonospora cubensis. Some varieties were completely devastated by the disease.

Others: Green beans; mostly introduced germplasm - a garden bush type was being tested from Great Britain. Radish; favorite local type, has green skin and purple flesh. Spinach; both Amaranthus tricolor and Spinacea oleracea are grown (minor crop). Onions; long-day bulbing type, Tomatillo; introduced from the U.S.S.R. and used to make sour sauce. Turnips; early spring crop. Chinese cabbage has replaced heading cabbage as the most popular leafy vegetable.

b. Collections and Exchanges

Nine collections of vegetables--eggplants, tomatoes, celery, cucumber, pepper, radish, spinach, and beans--were presented by the Department of Vegetables. Two collections, Angelica archangelica and a radish, were made in the vegetable plots. In return they would like to have: (1) disease resistant tomatoes and peppers, (2) our best O.P. lines of eggplant, (3) RIN and NOR mutants of tomato, and (4) leaf-spot resistant cucumbers.

V. LANZHOU AREA - GANSU PROVINCE (August 2-7)

A. Climate and Agriculture

A 22-hour (11:00 p.m. August 1 - 9:00 p.m. August 2) train ride (about 1,100 km) from Hohhot to Lanzhou gave us a broad perspective of the agriculture in North Central China. The railroad follows the Huang Ho (Yellow) River most of the way. Much of the area is sparsely populated, with cultivated agriculture being concentrated adjacent to the river. The elevation along much of the route is near 1,000 m. In many places the Yellow River is shallow and wide (up to 1 km). A short distance from the river, the cultivated land turns into a sand desert with a few low-growing shrubs. Crops grown along the river include corn, sorghum, wheat, and millet.

At the iron mining city of Wuhai (about half way between Hohhot and Lanzhou) we entered a mountain valley with surrounding mountains up to 2,200 mm elevation. The mountains are badly eroded, leaving all of the top soil near or in the Yellow River. A great effort is being made to stabilize the sand dunes adjacent to the railroad by extensive tree (mostly poplar) plantings. The wider valleys support the productive agriculture, consisting of corn, sorghum, sunflowers, wheat, and some rice to the South. Considerable Elymus grows along railroad right-of-way.

Between Yinchuan and Zhongwei in Ningxia Province were vast areas of denuded hilly rangeland and desert. Near Zhongwei we entered prime agricultural land with corn, wheat, hemp, peppers, potatoes, flax, tomatoes, and poplars. After leaving Zhongwei, the railroad leaves the Yellow River and crosses a plateau region with elevations in the vicinity of 1,500-1,800 meters. The plateau region is dry and desolate, but it is still being grazed heavily by sheep and camels. The rangeland is badly abused and living conditions are primitive with mud houses that resemble the Navajo hogans in our Southwest desert.

As we got nearer to Lanzhou, which straddles the Yellow River, cultivated agriculture increased, with wheat being the major crop. The elevation dropped from 1,800 meters on the plateau to about 1,500 meters at Lanzhou, where we arrived at 9:00 p.m., much after dark.

Lanzhou (the capitol of Gansu Province) is an industrial city of 1,200,000 situated in a valley of the Yellow River at about 1,500 m and surrounded by mountains rising to about 2,000 m. Precipitation is 300-400 mm annually. The surrounding mountains have a moderating effect on the climate and the growing season is about 200 days, from early April to mid October. The mountains also trap smog and Lanzhou is often blanketed with a heavy layer of pollution coming from the factories in the area and from nearby mining operations.

Lanzhou is well known in China as a center for melons (especially the honey dew) and fruit trees (apples and pears). A wide variety of vegetables are grown near Lanzhou under irrigation. In the non-irrigated areas around Lanzhou, wheat is the most prevalent crop. At a North Latitutde of 36°, Lanzhou is somewhat comparable in its general climate to that of Santa Fe, New Mexico.

B. Individuals and Institutions Visited

1. Government Offices

We were met at the train station by Mr. Huang Pei-Rong, Deputy Director of the Gansu Bureau of Agriculture and Mr. Liu Fu, Chief of the Science and Education Division of the Gansu Bureau of Agriculture. Mr. Liu was our permanent escort during our 6 days at Lanzhou. He was probably the most helpful government official that we encountered at the Province level. He was flexible in developing an itinerary and in varying from the itinerary when necessary. Mr. Liu took a personal interest in making field collections and actually helped with the collecting on several occasions.

Names and Addresses

Mr. Huang Pei-Rong (Age: ca 60) 黄培荣
Deputy Director
Gansu Bureau of Agriculture
Lanzhou, Gansu
People's Republic of China

Mr. Liu Fu (Age: ca 40) 刘 福
Chief, Division of Science and Education
(same address as above)

2. Cereal-Vegetable Research Institute (August 4)

This Institute, which is a Provincial Institute of Agriculture, is located inside Lanzhou and is separated into two major departments, cereals and vegetables. The cereals work is under the direction of Mr. Hu Yu-Guo, who also serves as the Director. The vegetable program is led by Mr. Fan Hung-Xui, the Deputy Director of the Institute. We tried, but without success, to get staffing information and other facts about the Institute. Communications were very difficult here for some reason.

We separated into three groups with Sunderman and Thompson going with Mr. Hua to see the cereals work; Orton going with Mr. Fan to look at vegetables, and Dewey wandering loose on the premises looking for grasses on ditch banks, etc.

The wheat had been harvested but not threshed so we were able to look at the types they grew. Most were awned with large heads and were slightly taller than American semidwarfs. The leading irrigated variety, Kan Ming No. 8, was an awnletted stiff-strawed variety from the cross of a Sichwan selection with Abbendonza from Italy. In visiting with Mr. Hu Yu-Guo, the wheat breeder, we learned that stripe rust is one of the major diseases in the province and that they have identified four races. He reported that the segregating generations were tested as seedlings and at the boot stage with the four races. Another important disease problem in the southern winter wheat zone is yellow dwarf.

Mr. Hu uses mainly cross breeding to develop the segregating populations. However, he has some material irradiated with neutrons and has developed some strains by a method he calls single female production. He takes the F_1 from a cross, emasculates it and pollinates the female with barley pollen or uses chemical irradiation and gets a small percentage of seed (we think they are probably selfs) which leads to fertile segregating populations with wheat and barley characteristics. All of this smacks of "Lynsenko genetics," which is not entirely dead in China and Russia. He also tried anther culture but discontinued it after 100,000 anthers were cultured and no useful varieties were obtained. No forage work is being done at this Institute. However, a modest program of wide hybridization between Triticum and Agropyron is being carried out. This illustrates once more the fascination that the Chinese have with nontraditional breeding procedures. They would be well advised to stick with the "basics" and leave the "fancy stuff" to others.

Names and Addresses

Mr. Hu Yu-Guo, Director (Age: ca 65) 胡育国
Cereal Crop Branch
Gansu Provincial Institute of Agriculture
Lanzhou, Gansu
People's Republic of China

Mr. Fan Hung-Xui, Deputy Director (Age: ca 60) 樊鸿修
Vegetable Crop Branch
(same address as above)

Mr. Zhu Wen-Xiang 朱文祥
Vegetable Crop Branch
(same address as above)

Mr. Liao Yian-Xuang 廖炎雄
Vegetable Crop Branch
(same address as above)

3. Gansu Agricultural University

We did not visit this University because it is not in Lanzhou; however, it is a very important source of germplasm and several of its staff attended a seminar given by Sunderman and Thompson on the afternoon of August 4. This seminar attracted 23 cereals specialists from distances of up to 600 km. The seminar was followed by a lengthy discussion period. Dewey caused some commotion by asking point-blank if those in attendance practiced Mendelian or Lysenko genetics. After a lively discussion among themselves, they said they favored Mendelian genetics. Only Mendelian genetics is taught in currently used textbooks; however, it was apparent that several of the plant breeders at the seminar were still strongly influenced by Lysenko genetics.

The Gansu Agricultural University is located about 300 km NW of Lanzhou at Huang Yong Chin (= Yellow Goat Town). Vice President Tsao Er-Chang (who attended the seminar) gave us the following information about the University. It has seven departments: (1) Veterinary Science, (2) Animal Husbandry, (3) Grassland Science, (4) Forestry and Horticulture, (5) Agronomy, (6) Farm Mechanics, and (7) Soil and Water Conservation.

The University is the primary agriculture research and teaching institution in Gansu. A major wheat germplasm collection is maintained at Yellow Goat Town. It is the source of wheat germplasm for the breeding programs which are being conducted in 12 districts throughout Gansu. It is unfortunate that we did not visit the University.

Names and Addresses

Dr. Tsao Er-Chang (Age: ca 65) 曹尔昌
Vice President
Gansu Agricultural University
Huang Yong Chin
Wu Wei, Gansu 730006
People's Republic of China

Dr. Ren Ji-Zhou (Age: ca 60) 任继周
Head, Grassland Science Department
Vice President
(same address as above)

We did not meet Dr. Ren in Gansu; however, he led a Chinese Grassland Delegation to the U.S. in the fall of 1980. Dewey met him in Logan, Utah, at that time. We include his name and address here for the benefit of those who may wish to have a contact with a qualified forage specialist. We met no forage specialists in the Gansu Province.

4. Wild Goose Vegetable and Fruit Commune (August 5)

This Commune, which is located on the outskirts of Lanzhou, furnishes most of the vegetables for the city. They have 750 hectares of land (610 hectares in vegetables and the remainder in fruit trees). There are 3,300 families, 16,660 people, and 7,000 workers. They claim to be growing 103 different kinds of vegetables. Annual production is 40,000,000 kg of vegetables and 6,000,000 kg of fruit (from 60,000 trees).

An unusual cultural practice was observed in this Commune, surface stoning. A field plot is thoroughly tilled and small pebbles about 5 cm in diameter are then placed by hand over as much of the soil surface as possible. Seeds or transplants are introduced into holes dug in the tops of the beds. The entire plot is fertilized over the surface with a mixture of NPK chemical fertilizer and composted manure. At harvest, plants are removed completely by the roots. The field plot is left intact for 4 years at which time the stones are removed by hand and the field is retilled and shaped. All but root crops, such as onions, carrots, and potatoes, were cultured in this manner. Yield increases of 20% for vegetables and over 20% for field crops were claimed. It was felt that the stones acted as buffering agents against evaporation and temperature extremes. Over 70% of the Commune's acreage was surface-stoned. According to vegetable experts in the area, the technique was developed over 200 years ago in Lanzhou and is still relatively specific to the Gansu Province.

Vegetables were extensively intercropped with field crops and particularly with fruit trees. The main vegetables used in intercropping with fruit trees were celery, head cabbage, Chinese cabbage, and bush beans. By adjusting fertilizer application rates, no yield loss was observed in fruit, although the vegetables took a considerably longer time to mature due to lower light intensity.

Names and Addresses

Mrs. Yi Weu-Gui (Age: ca 40)
Vegetable Breeder
Lanzhou Municpal Institute of Agriculture
Lanzhou, Gansu
People's Republic of China

Mrs. Yi is not a member of the Wild Goose Commune; however, she does most of her plot work at the Commune.

5. Lanzhou University - Biology Department (August 5)

An impromptu visit to the Lanzhou University proved to be very fruitful. There was not much going on at the University because of the summer holiday, but we met four members of the Biology Department and visited their herbarium. The herbarium was a disaster, with specimens stacked loose and uncatalogued. They blamed the mess on the Cultural Revolution. It will take years to bring order to the herbarium. Facilities in the University were very modest and the laboratories were poorly equipped. The enrollment is 4,000 students including 200 graduate students. The University is oriented primarily toward a natural science curriculum.

A valuable forage germplasm resource is located on their campus. Their botanists have moved sod pieces from the Qilian Shan Mountains (500 km NW of Lanzhou) and established them in a large sod-transplant garden on the campus. Many of the grasses had flowered and produced seed. Dewey was given permission to collect what he wanted. What a bonanza!

Names and Addresses

Mr. Zhang Peng-Yun (Age: ca 50) 張鵬雲
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Dr. Chen Qing-Cheng (Age: ca 55) 陳庆誠
Associate Professor-Teaching Laboratory
(same address as above)

Dr. Peng Ze-Xiang (Age: ca 50) 彭泽祥
Associate Professor-Plant Taxonomy
(same address as above)

Mr. Zhang Guo-Liang (Age: ca 40) 張国樑
Lecturer
(same address as above)

6. Desert Research Institute (August 6)

This Institute is located in downtown Lanzhou, next to the University. It is much better equipped than other institutions we visited in Lanzhou, probably because it belongs to the Chinese Academy of Science. The following historical information about the Institute was provided by its Director, Dr. Zhu Zhen-Da:

"The Lanzhou Institute of Desert Research was founded in 1978. At the present time, there are 120 research specialists studying the principles of desert formation, transformation and sand movement, and desert reclamation and sand control.

In 1958, a desert control brigade was organized in the Chinese Academy of Sciences. Its main purpose was to survey China's major deserts. The first step was to record the natural desert conditions, such as the resource of water, soil, vegetation, and characteristics of wind movement and sand dune shifting. Based on these scientific observations, the brigade then recommended useful suggestions for desert control to the people. At the same time, a joint desert research station was established among desert related provinces. The station worked on how to control the damage by the drifting sand to the railroad track and to exploit farming possibilities. In 1963, the Desert Control Brigade was merged with the Institute of Geography of the Chinese Academy of Sciences and was renamed Desert Research Laboratory. In 1965, the laboratory was moved to Lanzhou and renamed Arid Land Desert Research Institute by joining the Arid Land Research Laboratory. In 1978, it was named officially Lanzhou Institute of Desert Research.

During the past 20 years, China's major desert research emphasized exploration and survey of natural resource of the desert and provided scientific suggestions for desert reclamation and sand control. At the same time, it conducted experiments on how to prevent drift sand damage to crop fields and the transportation system. It also analyzed the effect and experience of public desert control by the masses.

The Lanzhou Institute of Desert Research consists of of five research laboratories:

— Laboratory of Desert Formation, Transformation, and Sand Movement: Its major responsibility is to study desert formation, transformation, and the principles of development and movement of wind and sand, and their history which involves the study of early geography of 4th century.

— Laboratory of Natural Resources of the Desert: To study desert natural resources (climate, water, soil, and vegetation) and their ecosystem. To conduct exploitation of natural resources and environmental protection program.

— Laboratory of Sand Stabilization by Vegetation: To study the principles of sand stabilization by vegetation. To study the effect of reclamation and its environmental impact, and ecophysiology of arid plants.

— Laboratory of Chemical Sand Control: To develop chemical sand control technology and study its principles and utilization (it is in planning stage).

— Laboratory of Desert Geographical Technology: To conduct geographic mapping of the desert land. To study navigation in the desert. To study and design desert measurement instrument.

Besides the laboratories mentioned above, there is a laboratory for analysis and translation of materials on international desert research. The Shapatou Desert Research Station (located in the center of Ningxia Province, southeast of Tengger Desert) serves as an experimental station in the wilderness. Its main research emphasizes simulated ecosystems (including plantation on both sides of the railroad track, desert reclamation, and its environmental impact)."

Dewey gave a seminar to a group of about 30 staff members. The Institute has a small, but well-curated herbarium. Not much is going here from a plant germplasm standpoint.

Names and Addresses

Dr. Zhu Zhen-Da (Age: ca 60) 朱震达
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People's Republic of China

7. Zuijcazia (Liu Family) Dam and Power Station (August 7)

The power station is located in a narrow gorge of the Yellow River, about 70 km SW of Lanzhou. The Chinese are especially proud of this dam and power station because they built it by themselves. The Soviets had just started construction when they were expelled from China. The Soviets were certain that the Chinese could not build the dam without outside help, but they managed to do it. This power station furnishes most of the power for the Gansu Province and adjacent provinces. We were taken on a tour of the interior of the dam. The water coming out of the dam is clear, but by the time it reaches Lanzhou, it is as muddy as ever.

We benefitted more from the ride to and from the dam than from the visit to the dam itself because we were able to collect seeds enroute. The route leading to the dam goes through low mountains that are used for grazing or terraced for wheat, flax, potatoes, millet, and buckwheat. We started at 1,500 m elevation at Lanzhou, reached a summit of 2,350 m about three-fourths of the way to the dam and dropped to 1,650 m at the reservoir. Sunderman and Thompson were allowed to collect in wheat fields and Dewey and Orton scoured the countryside for wild forages, etc. This was the most productive collecting day of the entire trip.

C. Germplasm Resources of the Lanzhou Area

1. Forages (Dewey)

a. Resources

Although no forage work is being done in and around Lanzhou, this area and the entire Gansu province is a prime source of cool-season forages. Furthermore, the government administration in the Provincial Bureau of Agriculture is cooperative in allowing collecting in the wild. If one area of China had to be singled out for cool-season forage collecting, the Gansu Province would rank very high, if not at the top of the list.

b. Collections and Exchanges

On Sunday afternoon (August 3), we were taken to Five-Springs Mountain Park on the edge of Lanzhou. This is a steep area and grazing is prohibited. Dewey, Orton, and Mr. Liu spent 2 hours on the hillside. We found large populations of a low-growing crested wheatgrass (*Agropyron cristatum*) which was chiefly responsible for erosion control on the mountain. Significant populations of *Elymus dasystachys* were also encountered and collected. I was especially interested in an unidentified species of *Psathrostachys*, which holds great taxonomic interest to me.

The ditchbanks at the Cereal-Vegetable Research Institute in Lanzhou were lined with *Agropyron* and *Elymus* species and some *Hordeum*, all of which were collected.

The sod-transplant garden at Lanzhou University yielded 17 collections of *Agropyron* and *Elymus*. The sod plots come from an alpine meadow in Qilian Shan Mountains at an elevation of 4,300 m. These mountains must contain a vast untapped wealth of cool-season forage grass germplasm. A plant-collecting expedition should be made to those mountains.

The mountains along the road from Lanzhou also contain excellent forage germplasm resources. *Agropyron* and *Elymus* are abundant in this area. Collections were also made of *Lathyrus*, *Melilotus*, *Medicago*, and *Hedysarum*. The trip to the dam netted 19 collections.

2. Wheat and Barley (Sunderman and Thompson)

a. Resources

Gansu Province produces wheat on 1.3 million hectares, about half of which is dryland red winter wheat. Very little winter wheat is irrigated. Most irrigated wheat is red, but there are some white club and common white wheats being grown. Less than 1/3 of the wheat in Gansu Province is irrigated. Average yields under irrigation are 3,700 kg per hectare. No attention is paid to protein content or quality. White and red wheats are binned separately for seed purposes but when ground for flour, all are mixed together.

Barley and oats are not important crops in Gansu Province. Some naked barley is grown for human consumption. The most important locally grown barley was a strain from Tibet adapted to dryland conditions. No seed of this strain was available in Lanzhou, but they said that it would be sent later.

Prior to 1950, all varieties were farmer varieties. In 1950 they grew a Montana wheat and Minister. When rust became prevalent, they were replaced by other varieties. Since 1970, locally bred varieties have generally been grown. Much of the germplasm being used for disease resistance is being obtained from the Crop Germplasm Resources Institute at Beijing.

They are using varieties from Albania, Bulgaria, Russia, Italy & Chile as well as from other countries in their crossing program, so they have access to good parental material. When breeding varieties for the arid regions, crosses were usually between local and foreign varieties.

Stripe rust was first found in China in 1963 in Tienshui Town in Gansu Province. In 1964 the first serious stripe rust epidemic occurred. It is an interesting coincidence that this was just one year after stripe rust became a serious problem in the Western U.S. Stem rust is a serious disease in the three provinces in Manchuria and in some areas of Inner Mongolia. Leaf rust is abundant though not generally serious throughout the wheat growing area of northern China. Stem rust is carried by wind from south to north. Present sources of rust resistance are varieties from Germany, CIMMYT, Korea, Bulgaria, and France. Parents for cold resistance are being obtained from North China, Russia, South America, and Europe.

b. Collections and Exchanges

On a collecting trip on August 6 on the road from Lanzhou to the Luijcazia Hydropower Station (Lui Family Reservoir), the wheat was about 2 weeks from ripe and had stripe rust type-7 infections at about 20% severity. The only wheat found at the dam was an awned white chaffed plant growing in a patch of alfalfa and marijuana. On the return trip we stopped at a dryland grain field located at an elevation of 2,300 m. The field was predominatly awnletted wheat. However, there were eight additional types ranging from early to late, awned to awnless and brown to white chaffed, all of which we selected. One black-awned durum and several two-row and six-row barleys were selected by Rex Thompson. About half of the fields observed on the trip were nonirrigated spring wheat, and yields appeared to vary from about 1,000 to 2,000 kg per hectare. Many of the fields were small and were located on terraces or were planted on rather steep hillsides.

We received excellent cooperation from our host Mr. Lui, from the Gansu Bureau of Agriculture. He permitted, and even encouraged, collecting directly from wheat fields. During our stay in Lanzhou, we obtained 29 wheats, 17 barleys, and 2 oats. We were asked to supply varieties with yellow dwarf resistance as they are lacking parent material with this characteristic.

Collecting local wheats from the area would require going back into some of the more remote farming areas as most farmers in easily accessible areas grow the newer improved varieties.

3. Vegetables (Orton)

a. Resources

The range of types of vegetables grown in Lanzhou was the greatest of all of the areas we visited in China. Moreover, the vegetables appear to be more conspicuous in the Lanzhou diet than any other area.

Melons: The germplasm base for *Cucumis melo* was entirely introduced within the last 30 or so years. Two main types are grown, cantaloupes and honeydews. Of these two, the honeydews are by far the most widely grown. The honeydew was brought to China in the mid 1940's by then Vice President Henry Wallace of the U.S. and for a time was called the "Wallace" melon. There have apparently been very few changes in the germplasm base of honeydews. Virus diseases were particularly severe on honeydews. Yield losses to viruses were estimated to be 30 to 70%. Cantaloupes were being evaluated and bred by the Institute of Vegetables, Gansu Provincial Institute of Agriculture. The fruits were extremely small by U.S. standards and mildew was a big problem.

Tomatoes: Virtually all of the tomato crop in Lanzhou is fresh market. The germplasm base consists of a mixture of older "local" varieties (more than 30-50 years) and recent foreign introductions, particularly from Japan. Diseases of tomatoes observed in the field were particularly severe. Pathogens and symptoms were listed as TMV, leaf stripe, curly top, leaf blight, stem canker, and blossom end rot.

Squash: A comparatively minor crop in the Lanzhou area, grown almost entirely for fresh market consumption. Breeding was by mass selection from a germplasm base of more than 10 different basic fruit types. These were observed growing in adjacent blocks for selection. All of their lines were segregating fruit types and colors possibly due to contaminating pollen from nearby rows. Fruit shapes ranged from long and slender to ovoid and some resembled green and yellow zucchini. Some unusual types with surface "warts" and sectored coloring orange/yellow/green were observed. The foliage was extremely spiny, but fruits were all glabrous. All lines exhibited mild symptoms of a leaf mosaic virus and spider mite damage, but no squash bugs were seen.

Heading Cabbage: Tremendous variability was observed in heading behavior, foliar morphology, and extent of cabbage looper damage. Two types are grown, a small-headed early type for fresh market and a relatively later type for underground storage.

Peppers: Extremely popular in the Lanzhou area, two crops of peppers are produced per year. A summer field crop is seeded in April and harvested through September. A winter crop is grown in heated greenhouses. Two main types are grown, sweet green bells and long hot red fruits for drying, and popular varieties are entirely extracted from locally developed germplasm. Mild symptoms of viruses were observed, but the major disease problem was judged to be a vascular wilt probably caused by a soil-borne fungal pathogen such as Fusarium oxysporum.

Potatoes: Potatoes, grown extensively in the non-irrigated terraced mountainsides surrounding Lanzhou, are perhaps the major crop in the ground during July and August. Within a field, plants were extremely variable with respect to habit, foliage, flowers, and disease. Most are apparently propagated from sexual seed. The existence of programs in potato germplasm collection, maintenance, evaluation, and manipulation in the Lanzhou area is unknown.

Other Vegetables: Chinese cabbage (B. pekinensis)--all introduced lines; 'Exotic' cole crops--Brussel sprouts, broccoli, green cauliflower, Kohlrabi are all introduced from Holland. Tiger lilies--both immature flower buds and bulbs are consumed. Cucumbers--both green and yellow fruited types; local germplasm. Lettuce--introduced both crisphead and butterhead types from England. Celery--both local lines and Southern China lines. The southern lines exhibited a high incidence of bolting whereas local lines exhibited none. Vegetable amaranthus--purple foliage, the immature flower buds are consumed in stir fry's and soups; Asparagus--local wild lines collected in the hills surrounding Lanzhou. "Taro"--not a true taro, but a large woody bush the root of which was eaten like ginger. Cowpeas (yard long beans)--Exhibited symptoms of mosaic-type virus on the foliage. Mostly introduced germplasm. Parsley--used entirely for dried spice; Tibetan safflower--species unknown, seeds were harvested as a spice. Eggplant, pumpkin, white gourd, vegetable rape, radish (red and green), carrots, onions, garlic, and green beans.

The Lanzhou area is very rich in the range and depth of vegetable germplasm which is locally bred and cultured. It is not known the extent to which local breeding collections are duplicated in the national Beijing collection, but a great deal of Provincialism was sensed, suggesting possibly that some local germplasm may be unique. A great deal of morphological variability was observed in field populations of locally bred vegetables suggesting extensive hybridization and absence of attenuating selection. Locally adapted germplasm has been cultured under conditions of low humidity, warm summer temperatures (to 35°C) and generally unchecked pressure from insects and pathogens. A comprehensive exchange to obtain this material for evaluation is strongly urged.

b. Collections and Exchanges

Ten vegetable collections of *Brassica*, *Apium*, *Curcurbita*, *Petroselinium*, *Amaranthus*, and *Raphanus* were presented by the Municpal and Provincial Institutes of Agriculture. Nine collections of *Linum*, *Brassica*, *Angelica*, *Pisum*, and *Daucus* were made by Orton in the field.

Breeders at the Vegetable Institutes are interested in obtaining: (1) tomato lines exhibiting tolerance to virus and/or stem canker, (2) best O.P. heading cabbage lines, (3) lettuce varieties adapted to dry, mild conditions, (4) large petiole celery varieties, (5) large fruit fresh market tomato lines, (6) cucumber lines resistant to powdery mildew, (7) best varieties of honeydew melon, (8) any inbreds for hybrid honeydew and cantaloupe production available to public (9) disease resistant eggplant, pepper, and cucumber lines, (10) a sampler of wild species of tomato--*L. peruvianum*, *L. pimpinellifolium*, *L. hirsutum*.

VI. URUMQI (PRONOUNCED Ü-LÜ-MÜ-CHI AND MEANING "GRASSLAND") AREA, XINJIANG AUTONOMOUS REGION (August 8-15)

A. Climate and Agriculture

Western China has much in common with the western U.S., i.e., it is a vast arid sparsely populated desert area interspersed with rich irrigated valleys and several very high mountain ranges. Flying from Lanzhou to Urumqi (the capital of Xinjiang) we passed over extensive deserts and two snow-capped mountain ranges: (1) the Qilian Shan range in Gansu Province and (2) the Tian Shan range near Urumqi. These mountain ranges with peaks to 6,000 m store huge quantities of water. Nevertheless, the mountains drop almost immediately into barren deserts. These deserts must be underlayed with extensive aquifers, which provide great opportunity for irrigation agriculture.

Xinjiang has traditionally been inhabited by nomadic Moslem, Kazakh, Uygur, and Khirgiz tribes that subsisted almost exclusively on sheep, goats, cattle, camels, and horses. These people had little interest in irrigation agriculture and much of the water resource went unused. Following the Communist Revolution in 1949, large numbers of Han Chinese were encouraged to settle in Xinjiang to reduce the population pressures in the East and to stabilize and consolidate China's western border with the U.S.S.R. The Han Chinese brought with them their style of agriculture, i.e. irrigation farming and pigs. The influx of Han Chinese developed some of the water resources of Xinjiang and diverted large tracts of good grazing land to settlements and crop farming. Removal of some of the best grasslands from livestock grazing has placed increased pressure on the remaining rangeland, much of which is now heavily overgrazed, badly eroded, and nonproductive.

Although Urumqi served as our base of operations in Xinjiang, we traveled to regions up to 180 km from Urumqi, which included desert regions below sea level with almost no precipitation and high mountain areas (surrounding peaks to 6,000 meters) with annual precipitation (largely snow) considerably over 1,000 mm. The climate and agriculture in the vicinity of Urumqi will be described here and the other areas will be described in the section, "Individuals, Institutions, and Locations Visited."

Urumqi (the capital of Xinjiang and a city of 1.2 million) is situated in a broad, flat, arid valley at the base of the Tian Shan mountains. The elevation of the city is between 700 and 900 meters and precipitation is about 200 mm annually, with about 60% of it coming as snow. Winter temperatures get as low as -35°C. Common crops are wheat, corn, sorghum, sunflowers, flax, sugarbeets, and melons. Much of the land has been leveled and all crops in the valley area are grown with some irrigation. About 80% of the irrigation comes from surface streams; the other 20% is from wells. The irrigation system is very inefficient and badly managed. About 70% of the land is tilled mechanically, but all crops except wheat are harvested by hand. Non-cropped areas are grossly mismanaged. Grazing on these lands is unrestricted and weed control is nil.

The latitude of Urumqi is about 44°, and the area is roughly comparable to that of Idaho Falls, Idaho, which also sits at the base of a major mountain range, the Teton Mountains, and relies heavily on irrigation agriculture.

B. Individuals, Institutions, and Locations Visited

1. Government Officers:

On arriving at the Urumqi airport, we were met by Mr. Si Ma Yi Ya Sheng Nov Vice Chairman of the Xinjiang Region Government. He placed us in the hands of Mr. Zhao Kun, Office Director of the Xinjiang Agricultural Academy. Mr. Zhao was our permanent escort during our week in Xinjiang. Mr. Zhao proved to be quite a dour individual and was quite inflexible in developing an itinerary. Consequently, we visited a number of places that we had no interest in. Our success in Xinjiang was limited somewhat by the intransigence of Mr. Zhao and his unwillingness to permit field collecting of cereals.

We were also accompanied throughout the week by Mr. Chen Zu-Xuan, a wheat breeder in the Agricultural Academy. Mr. Chen could speak English and he was very cooperative. Unfortunately, he had little authority and could not override Mr. Zhao's decisions.

Names and Addresses

Mr. Si Ma Yi Ya Sheng Nov 司马仪·雅生诺夫
Vice Chairman, People's Government
Xinjiang Autonomous Region
Urumqi, Xinjiang
People's Republic of China

The addresses of Mr. Zhao and Mr. Chen are given in the next section dealing with the Xinjiang Agricultural Academy.

The following organizations, institutions, and locations visited are not in the sequence that we visited them. When we landed in Urumqi, we were taken directly from the airport to Stone River City about 150 km from Urumqi. We did not return to Urumqi for several days. Inasmuch as Urumqi is the governmental and educational center of Xinjiang, it is logical to treat our visit there first.

2. Xinjiang Academy of Agriculture Sciences (August 13)

We were greeted and oriented by the Director of the Academy, Mr. Ho Zhang, a very personable man who also appeared to be very capable. The Academy had its beginnings in 1956 as an Institute, but was elevated to Academy status in 1965. The Xinjiang Academy is administratively independent of the National Academy, but they coordinate with one another. At present it contains 13 institutes: (1) Horticulture and Vegetables, (2) Soils and Fertilizers, (3) Cereal Crops, (4) Economic Crops, (5) Animal Husbandry, (6) Plant Pathology and Entomology, (7) Uses of Atomic Energy, (8) Farm Mechanics, (9) Veterinary Science, (10) Forestry, (11) Desert Revegetation, (12) Microorganisms, and (13) Information. Until recently, the Academy contained a Grassland Institute, but the Xinjiang Grassland Institute is now a separate entity. Unfortunately, the Grassland Institute has no physical facilities at present.

The Academy is heavily involved in wheat breeding and we were taken through some of the wheat breeding laboratories, which were very poorly equipped. As everywhere else in China, the breeders were using anther culture and irradiation as breeding techniques.

Later in the week the Academy sponsored a seminar that we gave to about 40 people, including the Directors of the Xinjiang Academy of Science and the Xinjiang Academy of Agricultural Science. We found that 35 mm slide projectors are very scarce in China and the few they have usually don't work.

Names and Addresses

Mr. Ho Zheng (Age: ca 60) 侯 真
Director
Xinjiang Academy of Agricultural Sciences
Urumqi, Xinjiang
People's Republic of China

Mr. Zhao Kun (Age: ca 55) 赵 崑
Office Director
(same address as above)

(Mr. Zhao was our escort in Xinjiang)

Mr. Chen Zu-Xuan (Age: ca 50) 陈祖谖
Assistant Wheat Breeder
(same address as above)

(Mr. Chen was also our escort in Xinjiang)

Mr. Zhu Wen-Jing 朱文金
Deputy Director, Institute of Economic Crops
(same address as above)

Mr. Yu Si-Jian 俞斯健
Deputy Director, Institute of Cereal Crops
(same address as above)

Mr. Wang Chuan 王 权
Deputy Director, Institute of Animal Husbandry
(same address as above)

Mr. Qui Jia-Hua 戚家华
Researcher, Cereals Institute
(same address as above)

Miss Sun Kai-Ding 孙开定
Assistant Researcher, Cereals Institute
(same address as above)

Mr. Dao Liang-Zuo 道良佐
Researcher, Animal Husbandry Institute
(same address as above)

3. <u>August 1st Agricultural College (August 13)</u>

The August 1st College is located adjacent to the Academy of Agriculture, yet the two organizations scarcely know what the other is doing. For example, both groups have wheat breeders, but their work is not coordinated. The College is located in very old and inadequate facilities.

We were hosted by a Vice President of the College, Mr. Zhang Zi-Ho, and he gave the following statistics. The College was started in 1952. Today it has 13 departments with a staff of 480 and 1,100 students.

Names and Addresses

Mr. Zhang Zi-Ho (Age: ca 70) 張子厚
Vice President
August 1st Agricultural College
Urumqi, Xinjiang
People's Republic of China

Mr. Fang Chang-Mao 方长茂
Chief, Science and Research Division
(same address as above)

Mr. Huang He-Zang 黄和瓒
Associate Professor, Animal Husbandry Dept.
(same address as above)

Mr. Feng Zu-Sho 冯祖寿
Associate Professor, Agronomy Dept. (Wheat)
(same address as above)

Mr. Xu Peng 許 鹏
Associate Professor, Animal Husbandry Dept. (Forages)
(same address as above)

Professor Peng was in Beijing at the time of our visit. However, Dewey met him in September, 1980 in Utah as part of a Range Delegation to the U.S. Professor Peng is in charge of the forage work at the College and is a good contact.

Mr. Lin Cheng 林 成
Lecturer, Vegetable Crops Dept.
(same address as above)

Mrs. Yi Shu-Zheng 易淑桢
Lecturer, Agronomy Dept. (Rice)
(same address as above)

4. <u>Red Flag Vegetable Commune (August 13)</u>

This commune is in the outskirts of Urumqi. It is a typical vegetable commune and we saw nothing new here.

5. Stone River City (August 8 and 9)

Stone River is a new community 150 km NW of Urumqi settled since 1950 almost exclusively (96%) by Han Chinese. It has a population of almost 600,000 and is organized into 18 state farms encompassing 200,000 hectares. Crops and climate are similar to those around Urumqi. Being a Han Chinese community, much greater emphasis is given to pig raising than is given in communities dominated by ethnic Moslem minorities. All of the cultivated land is irrigated from surface reservoirs or wells.

Stone River is a showcase for foreign visitors. We toured General Farm #145 where they are conducting an impressive pig breeding program. The general farming techniques are moderately advanced. They use commercial fertilizers and a great deal of DDT insecticide. The rangeland in the area is neglected. Considerable alfalfa is grown and ground for pig feed.

Stone River offers little or nothing unique from a germplasm standpoint.

6. Turfan Grape-Growing Region (August 10-11)

In spite of our insistence that we did not care to see grape vineyards, we traveled to Turfan (the grape capital of China) which is about 180 SE of Urumqi. Enroute to Turfan, we encountered the most barren terrain that we saw in China. Shortly after leaving Urumqi, we passed through low hills almost devoid of vegetation. We then entered a long narrow valley with brackish and salt water in the valley bottom. Considerable wheat was growing in this area and a number of collections were made in wheat fields (which were badly infested with wild oats). Mr. Zhao, our escort, was nervous about field collecting of cereals and subsequently he prohibited it. Nevertheless, he had no objection to collecting forages and Dewey made many collections while the others waited in the van.

Before entering Turfan, we crossed an extensive and absolutely barren rock desert. The Turfan area supports a population of 170,000 people (mostly Uygur). The elevations range from slightly above sea level to 150 meters below sea level. Temperatures range from 47.5°C to -22°C and annual rainfall is only 16 mm. Wind storms of destructive proportions occur up to 60 times per year. There is a constant threat of encroachment of fields from nearby shifting sand dunes. Water for agriculture has been conducted to Turfan and surrounding areas via networks of underground channels from mountains 20 to 30 km away. Over 250 km of underground channels are distributed in five networks. In this manner, huge water losses to evaporation have been avoided. Poplar tree belts have been successfully established thus providing protection from wind storms.

Grapes, fruit trees, cotton, spring wheat, millet, corn, and melons are the major crops. Visits to the Red Flag (vegetable) Commune, Red Star (general production) Commune, the Red Willow (grape) Commune, and the Grape Trench Commune were interesting but of little value to our germplasm team. If a horticultural team were to assist Xinjiang, they should certainly include Turfan on their itinerary. Our visit to Turfan itself was unproductive; however, we made some excellent collections in the field enroute to Turfan.

7. South Mountain Grassland (August 12)

The South Mountain Grassland is a field experimental site of the Xinjiang Grassland Institute. It is located about 90 km S of Urumqi. We covered considerable crop land on the way to the mountains. The elevation rose from 900 m in Urumqi to 2,000 m at the grasslands. During the first 30 to 40 km, we saw considerable irrigated winter wheat. Fields looked like they would average 2,700 to 4,000 kg per hectare, and they usually had light to moderate infestations of wild oats. Spring wheat was planted at higher elevations because it was too dry in the fall to germinate winter wheat. Most of the farms were state owned. Occasionally we would see fields of wild oats which under inspection showed they had wheat planted in them.

The Grassland was by far the most impressive grazing land that we saw in China. The Grassland is in low mountains with spruce groves on north-facing slopes, shrubs and grasses on south-facing slopes, and grasses and forbs on the meadows. Mr. Cheng Xiang-Jiao is conducting an extensive forage species and strain evaluation trial on an open meadow.

The people in this area (primarily Kazakhs) are strictly livestock oriented and are caring for the grazing resource quite well. We saw large hay stacks used to store winter feed. These were the first and only stored hay that we encountered in China. At the end of the day we were guests at a Kazakh tent feast consisting of two newly killed sheep, mare's milk, and miscellaneous things.

Names and Addresses

Mr. A Bu Du Re He Man A Ba Si 阿不都杜合满阿巴斯
(Abdurahman Abasi)
Director
Xinjiang Bureau of Animal Husbandry
Urumqi, Xinjiang
People's Republic of China

Mr. Cheng Xiang-Jiao 程向皎
Xinjiang Grassland Institute
Urumqi, Xinjiang
People's Republic of China

8. Tian Lake (= Heavenly or Sky Lake) (August 14)

Tian Lake is a major tourist attraction about 110 km E of Urumqi. The crop and rangeland east of Urumqi is similar to what we had seen previously. The rangeland was badly abused and the irrigated cropland grew wheat, corn, vegetables, etc. About 80 km from Urumchi we left the paved road and drove into high mountains on a steep, winding, rugged road. The road ended at a beautiful alpine lake (1,900 meters elev.) situated at the base of snow-covered mountains that rose to 5,000 meters. The purpose of the trip was to take a boat ride on the lake; however, we managed to get some forage collecting in along the way.

C. Germplasm Resources of the Urumqi Area

1. Forages (Dewey)

a. Resources

Some of the areas that we visited around Urumqi had little to offer by way of forage germplasm (e.g. Stone River and Turfan). However, other areas (South Mountain and Tian Lake) are among the best in China for collecting cool-season forages. The South Mountain area supports a rich mixture of grasses and legumes and forbs including Poa, Agropyron, Elymus, Medicago, Vicia, Astragalus, Achillea, Galium, Poterium, and Geranium. The Tian Lake area is rich in Agropyron, Elymus, and Medicago. Western Xinjiang has got to be very high priority for a range forage collecting expedition.

Extensive stands of Elymus angustus and E. multicaulis occur on the margins of salt lakes between Urumqi and Turfan. These sites will be excellent sources of salt-tolerant forages. The Urumqi area was the only region in China where we encountered Russian wildrye (Elymus junceus). It is an early maturing species, so most of the seed had shattered by mid-August. However, I accidently came across a large colony of E. junceus in the large guest-house compound where we stayed in Urumqi. These plants were undisturbed and the seed had remained in the heads.

b. Collections and Exchanges

I had only limited time to collect at South Mountain; yet, I was able to make 19 collections in less than 2 hours. This site is a must for further collecting. One must work closely with Mr. Cheng Xiang-Jiao of the Grassland Institute in arranging for further collecting on South Mountain. Mr. Cheng is evaluating about 100 entries of forage grasses and legumes, most of which are native collections. He was a little hesitant to let me collect all of his entries, so I only took five of them. I have since sent Mr. Cheng 10 varieties of Agropyron and Elymus species from the U.S. Hopefully, this will open the way for further exchanges. The only other forage specialist that seems to be a useful contact in Urumchi is Prof. Xu Peng of the August 1st Agricultural College. I know him on a personal basis as a consequence of his visit to Logan in the fall of 1980. I sent him the same group of varieties that I sent to Mr. Cheng.

The Tian Lake area is another excellent collecting site. Between boat rides and other recreation activities, I made 10 collections, mostly Agropyron and Elymus. I obtained what appeared to be the Chinese equivalent of North American Agropyron spicatum near Tian Lake. This will be a significant botanical find if the collection is A. spicatum. The extensive travel that we did in the Urumqi area provided the opportunity to collect forages along the road. During the week, I was able to make about 50 forage collections to and from Stone River, Turfan, South Mountain, and Tian Lake. These "enroute collections" were in addition to those made at our destination sites.

2. Wheat and Barley (Sunderman and Thompson)

a. Resources

Wheat is the major crop of the Xinjiang Autonomous Region. Of the 3.3 million hectares of cultivated land in Xinjiang, 2.3 million hectares are seeded to cereals. Wheat accounts for 1.3 million hectares. Fifty-five percent of the wheat grown is winter wheat; all of the nonirrigated wheat is spring wheat as their falls are too dry to germinate fall planted wheat. Snow mold is a problem about once every 10 years. They have both Fusarium and Typhula snow mold. Stripe rust is present about every other year and most winter wheat varieties are susceptible. They have no idea of what races are present, but the pathologist from the Ili region, which is the center for disease work in the region, collects samples every year and makes identifications. Leaf rust causes some problems as does powdery mildew.

Breeding objectives are mainly for higher yield disease resistance, cold, heat and drought tolerance, stiff straw and shatter resistance. In recent years varieties from England, France, Romania, and Russia have been crossed with local varieties to obtain these objectives. Wheat varieties in general have a fairly stiff straw, large heads, and intermediate height.

Apparently little barley was being grown and little or no barley breeding was being done in the areas we visited. We were told that a new program in malting barley research is being conducted at Edin, 600 kilometers east of Urumqi.

b. Collections and Exchanges

Enroute to the Stone River we stopped at a wheat field and collected two samples of irrigated wheat, the currently grown Xinjiang No. 2 and another variety, New Ukraine No. 83. All of the winter wheat crop land near Urumqi is irrigated because the annual rainfall is only 200 mm per year. Winter wheat is irrigated once in the fall and three or four times the next summer. Rotation is wheat-corn or wheat-sunflowers. Occasionally they will grow two crops of wheat. They have about 12 different locally bred winter wheats. Most are 100 to 120 cm tall and their yields average 3,000 to 3,700 kg/hectare.

On the way to Turfan, we stopped and selected spring wheat from two fields with a mixture of types. Seven different types of T. aestivum were selected. The fields in which we found the off-types had leaf rust, stem rust, stripe rust, and bunt in them. Most fields had an exceedingly heavy population of wild oats in them. We asked Mr. Chen why they were not better taken care of and he said they belong to the people (Communes) and the people weren't interested in improving the yields. When we suggested that Commune farms in Gansu province were well managed, he told us the people were different here. State run farms had better stands with only occasional off-types in them and the off-types were usually slightly older varieties. They also had little, if any, smut, only light stripe rust, and light populations of wild oats. Obviously they treated the seed and used chemical control for wild oats.

During the week in Xinjiang we were allowed to collect about 10 wheats, several barleys and one or two oats and rye before being informed that we should not continue collecting. However, at the end of the trip we were presented 22 of their best wheats, one of which Mr. Chen, the breeder, says is the most winterhardy wheat in the world. Total cereal collections obtained from Xinjiang were 34 wheats, 16 barleys, 3 oats, 1 rye, and 3 corn. The wheats were characterized by winter hardiness, drought resistance, earliness, and shatter resistance.

3. Vegetables and Grapes (Orton)

a. Resources

Vegetables have been in Xinjiang mostly since the early 1950's when the Han Chinese migrated here. The level of sophistication with which vegetables were being maintained, acquired, screened, and bred was uniformly low in Xinjiang as compared to the other areas we visited. In at least three of the programs I viewed, germplasm had been arbitrarily discarded because it was "old" or lacked precise marketability in favor of new materials. In a few cases, breeders appeared to have no training in Mendelian genetics. We were told that the CGRI had collected all local varieties in the mid 1960's. I felt that the portion of the CGRI collection lost during the Cultural Revolution may be irreplaceable. Any germplasm which has been developed and maintained in Xinjiang for a long period is adapted to dry, often hot summer conditions (up to 40-45°C). As in other parts of China, disease and insect control is primitive or non-existent.

Tomatoes: The germplasm base is almost entirely introduced, mostly from other parts of China and more recently from abroad. A few of the best locally bred materials have been maintained for use in hybridization. In Urumqi, tomato lines were being bred at the Academy of Agriculture for disease resistance, earliness, and yield. At the August 1st College of Agriculture breeding programs were being conducted for indeterminant (bush) types, pink beefsteak tomatoes, prolonged shelf life, and earliness. Both Stone River and Turfan tomato lines were all obtained from Urumqi, as were all other vegetable lines. Symptoms of viruses were extremely severe and lesions typical of *Pytophthora infestans* were observed. There are no problems with soil-borne vascular wilt pathogens. White flies are virtually absent from Xinjiang with the exception of Turpan, although aphids are quite prevalent.

Chinese cabbage: Vegetable breeders at Stone River are breeding fast growing, early, disease resistant varieties via mass selection from a germplasm base acquired from the Xinjiang Academy of Agriculture. A small collection of locally adapted and introduced varieties is maintained by Mr. Lin of the Department of Agronomy, August 1st College of Agriculture in Urumqi. The range of germplasm is extremely small, generally limited to lines exhibiting acceptable market qualities.

Hami melon: A variety of *C. melo* which was probably introduced into Xinjiang from Asia Minor as a consequence of trade along the "Silk Road." It is a source of local pride and has been in Xinjiang for at least 800 years. The melon resembles a type grown in Iran (according to D. R.Dewey) and has white flesh that is similar to an apple or pear in taste and consistency. It takes its name from an area where it has been extensively cultivated; Hami, which is east of Turpan. Virus diseases were observed to be severe and were attributed primarily to cucumber mosaic. The crop commands a very high priority in research. It was the only vegetable in all of Xinjiang receiving attention by plant pathologists toward disease control and breeding for resistance. The state of germplasm,where it is stored, and breeding techniques were not queried.

Brassica oilseeds: These are grown very extensively in Xinjiang, apparently leading off in a double-crop combination possibly with winter wheat. The area borders on centers of origin/diversity of 8- and 10-chromosome Brassica species that are substrates for important oilseed crops, so local oilseed lines are possibly rich repositories of useful germplasm. After intense queries to Mr. Zhu Wen-Jing of the Institute of Economic Crops, Xinjiang Academy of Agricultural Sciences, it was discerned that several major groups are presently being grown: B. campestris introduced from Canada, early types (local); B. nigra, high yielding medium to late maturing types, (B. juncea), a heading type which then bolts a large raceme which is harvested for oil (probably B. campestris or B. napus), and a "wild oilseed rape" which is sometimes sown and reaped (probably B. campestris , but could be B. napus). The B. campestris lines from Canada were introduced recently and are used in harsh environments where they perform much better than local varieties. There is clearly a panacea of germplasm in Xinjiang for the breeding of Brassica oilseed varieties and a thorough exploration by an expert in this area is strongly urged.

Grapes: The Turpan County area is renowned for grapes. Mostly, these are table grapes, but a steadily increasing demand for raisins and wine was sensed. Common varieties grown were identified as "Horsemilk," "Chinese Red," and "Seedless" - all were bred locally. All of the vineyards are direct seeded and trestled the second year. Very little winter pruning of vines was evident. Some local varieties were claimed to be over 1,000 years old and to the knowledge of grape growers at the Red Star People's Commune, no one else in the world had obtained this germplasm. They were very reluctant when I asked for seed. The Red Willow River Farm is 15 km NW of Turpan and was growing 60 distinct grape varieties, mostly local white (seeded and seedless) and pink skin and white flesh types. Their enology procedures are quite different from U.S. techniques. Grapes are crushed and juice is filtered and fermented to 0% sugar with yeast. The yeast is removed and blended 16:84 with unfermented grape juice. Chinese preferences tend very strongly toward sweet wines of low alcoholic content.

b. Collections and Exchanges:

The Red Flag Commune at Turpan presented four varieties of Capsicum, Solanum, and Lycopersicon. Another four varieties of Capsicum, Solanum, and Phaseolus were obtained from the Xinjiang Academy of Agriculture. The Stone River farm provided nine varieties of Lycopersicon, Brassica, Cucumis, Solanum, Capsicum, and Apium. The Urumqi area was fruitful for collecting in the wild, where I made 29 collections of Brassica, Daucus, Phaseolus, Vigna, Allium, Apium, Pisum, and Peucedanium.

Vegetable breeders at Stone River are interested in obtaining virus tolerant pepper lines and disease resistant and determinant tomato breeding lines. Vegetable breeders at the Red Flag People's Commune in Turpan wanted lines exhibiting high temperature fruit set in peppers, tomatoes, and eggplant. Breeders at the August 1st College of Agriculture want determinant, pink-fruited, early, processing and extended shelf tomato lines (including RIN/NOR mutant stocks), germplasm inventories from USDA and public/private breeders, and "primitive" vegetables lines (wild?).

VII. SHANGHAI MUNICIPALITY (August 16-18)

A. Climate and Agriculture

Shanghai is China's (and possibly the world's) largest city with a population of 11 million. It is China's busiest port city and is located at the confluence of the Huang Po and Yangtze Rivers.

The climate in Shanghai was a tremendous departure from the North and Northwest provinces. The latitude is 31° North, or about the same as that of New Orleans. The mean temperature is 15.4°C and ranges from -5° to 35°C. The growing season extends from mid-March to mid-November, approximately 230 days. The precipitation (1,100 mm annually) is distributed as follows: 22% spring, 41% summer, 23% fall, and 13% winter. The rainiest months are June and July, but it rained every day we were in Shanghai. The humidity is consistently high, varying from 84% in July to 77% in December. The soil is alluvial and tends toward very slight alkalinity and ranges from sandy loam ("the best") to a hard clay ("worst"). Elevations range from sea level to 10-20 meters above sea level.

Rice and vegetables are the major crops around Shanghai. Of the 360,000 hectares of cultivated land in the municipality, 213,000 hectares are planted to rice and much of the remainder is in vegetables. Wheat and barley are grown to a limited extent, and forage crops are virtually nonexistent. The only grasses in the area are weedy annuals--*Setaria*, *Digitaria*, and *Echinochloa*--and they are everywhere present. These are used for pig feed.

B. Individuals and Institutions Visited

1. Government Officers:

We were met by Mr. Yang Yu-Chen, Office Director of the Municipal Bureau of Agriculture. He presented an itinerary that was heavy on sightseeing and light on scientific substance. Our visit to Shanghai was probably the least productive, but most relaxing, of any in China. Shanghai was visited by three of the four previous delegations, so the important agricultural institutions have probably been visited by one delegation or another.

Name and Address:

Mr. Yang Yu-Chen
Office Director
Municipal Bureau of Agriculture
Shanghai
People's Republic of China

2. Institute of Horticulture (August 16)

The Institute is part of the Shanghai Academy of Agriculture and has at least three laboratories (1) Vegetable Crops, (2) Fruit Trees, and (3) Mushrooms. The Vegetable Laboratory has 35 researchers, 5 of whom are involved in germplasm work per se. The Vegetable Laboratory is doing applied research in the following areas: germplasm, breeding, storage, production, and plant protection.

Because of rain, most of our time was spent indoors in discussions at a seminar presented by Sunderman, Thompson, and Orton. No one had an interest in Dewey's forage program. We engaged in a rather long and lively discussion of germplasm exchange. They view germplasm as a "national treasure" and were reluctant to give any away without getting some back immediately. Unfortunately, we had no seed with us at this stage of our trip. Nevertheless, at the end of our visit, they presented us with some seed.

A Plant-Breeding Institute is located in the same compound as the Horticultural Institute and we were taken to see the anther-culture work in the Plant-Breeding Institute. The breeders are heavily involved in rice anther culturing, and one rice variety, Shen Sui, has been released. They are also using anther culture in broccoli breeding.

The research work at the Vegetable Laboratory was less than impressive. The work at the Plant Breeding Institute was also routine.

Names and Addresses:

Mr. Liu Ri-Xin
Director
Institute of Horticulture
Shanghai Academy of Agriculture
Shanghai
People's Republic of China

Mr. Shen Yian-Sung
Vegetable Breeder
(same address as above)

Mr. Ma Ju-Hu
Wheat Breeder
Plant Breeding Institute
Shanghai Academy of Science
Shanghai
People's Republic of China

3. Shanghai Produce-Meat Market (August 17)

This market (1 of 150 in Shanghai) had little to do with our germplasm mission, but the visit was an enlightening experience in marketing. The manager of the market gave us a personal tour of the market starting at 5:00 a.m. The Chinese shop for produce daily and most go to the market early to get the best produce. The place was jammed with shoppers by 5:00 a.m. although the market stays open until midnight.

The market is indoors and resembles a huge vegetable-meat section of our supermarkets. It has a staff of 480 people who are split into three shifts. The market serves a neighborhood of 70,000 people and has about 10,000 customers per day. On an average day they sell 30,000 kg of vegetables, 120 pigs, 800 poultry, 4,000 kg of eggs, and 2,000 kg of fish. All produce comes from local communes.

The market has a profit incentive. Prices are set by the Municipal Vegetable Board. An average 15% mark-up is applied to the wholesale price. The market makes a profit of 20,000 Yuan ($12,000) a month. The profits apparently are returned to the workers over and above their salaries.

4. Long March Vegetable Commune (August 18)

We gained a good insight into how communes function from this visit. Although designated as a vegetable commune, it has many other enterprises and tries to become almost self-sufficient. The Long March Commune has 7,300 families, 28,000 people, and 19,000 workers. In addition to vegetable production, they have 59,000 pigs, 7,900 sheep, 290,000 poultry. They have 20,000 sq meters of cellars for mushroom growing. The commune also has a farm machinery and tool factory and a phosphate fertilizer plant. They also have a good-looking Holstein dairy herd.

Each worker is given a performance rating by his co-workers twice a year. The better workers get premium pay. We were told that this system causes a lot of arguments and bad feelings among people who work closely together.

An average laborer receives 621 yuan ($373) per year. Medical treatment is free. A person can retire at age 65 and receives about 25 yuan ($15) per month. His living expenses amount to only 15 yuan ($9) per month. We were told that 7% of the land in a commune is privately owned.

C. Germplasm Resources of the Shanghai Area

1. Forages (Dewey)

Shanghai is no place to look for forage germplasm.

2. Wheat and Barley (Sunderman and Thompson)

a. Resources

About 200,000 hectares of fall planted spring wheat are grown in the 10 counties around Shanghai. Wheat is planted about November 1 and harvested in early June. Rice is planted for the summer crop. Scab is the major problem and no resistant varieties are available. Some varieties are better than average, with the Mexican varieties being very susceptible.

Our visit was after the wheat and barley harvest and not a good time to understand germplasm availability or needs. Barley was mentioned here for livestock feed in contrast to previous implications that barley was primarily used only for human food or beer.

b. Collections and Exchanges

Germplasm exchange efforts were not very fruitful. The breeders at the Institute of Plant Breeding were reluctant to part with any seeds. Eventually they provided four wheats with scab resistance or tolerance. Requests were made by the Chinese for early varieties and sources of scab resistance.

3. Vegetables (Orton)

a. Resources

Soybeans are grown entirely as a vegetable in the Shanghai area. The pods are hand-harvested when the seeds are still green and tender. The product is sold in the pod and shelled by the consumer. Soybeans were said to be the main Shanghai vegetable during the months of July, August, and September. They are not actually doing any soybean breeding, only line evaluation at this stage. Germplasm was almost entirely introduced from Japan via the CGRI at Beijing. The main criteria for evaluating lines is resistance to vascular wilt pathogens and virus, which were both observed to be extremely severe.

Tomatoes: They were said to be one of the most important crops, particularly among those planted in the spring. Over 400 different varieties are grown on approximately 2,000 hectares, about 100 of which are "native local" varieties. An extensive collection of germplasm comprised of "local" lines and domestic and foreign introductions is maintained by the Laboratory of Vegetables in connection with the tomato breeding program. About 40% of Shanghai tomato area is grown to hybrids, particularly Pou Hang #1. The inbreds are released to communes which independently produce the hybrid seed via hand pollination.

Another 20% of the area is planted in a potpourri of red-fruited fresh market types, including "local" lines. The remaining 40% of the area consists of pink fruited varieties introduced from Japan and used mainly for processing. Their main breeding objective is resistance to cucumber mosaic virus. They have achieved a fairly good level of tolerance to tobacco mosaic by employing the allele for resistance at the TMV-2 locus. They are also breeding resistance to Fusarium wilt, Phytophtora infestans, stem canker, Septoria leaf spot, and bacterial wilts.

Chinese Cabbage: One variety of late heading type is grown during autumn and spring, introduced from Chengdu. Numerous varieties of local early types occupy a small area during the fall. They are best adapted to cooler conditions and are grown on a total area of 2,500 to 3,300 hectares annually. They are breeding for CMV, TMV, powdery mildew, and bacterial wilt resistance.

Heading Cabbage: All varieties are foreign introductions since 1940, mostly from the U.S. and Great Britain. Preferred plant type is exhibited by British "heart headed" lines. The U.S. variety "Succession" was introduced in 1941 and is still quite popular. The primary breeding objective is cold hardiness. Earliness, high temperature tolerance, and powdery mildew resistance are also under consideration. They are working on the use of anther culture as a tool for rapid production of cabbage inbreds.

Peppers: All varieties were pure lines, most of which were adapted from Beijing collections, but a few were local lines which had apparently been developed in Shanghai a long time ago. The virus problems were astounding and yield losses were estimated at 50% or more.

Cowpea: To my knowledge, the Laboratory of Vegetables in Shanghai was the only organization in China where hybrid cowpeas were being bred. The hybrids are all synthesized via hand pollination and a significant proportion of the crop had already shifted to these varieties. The main disease problem was said to be powdery mildew. The source of germplasm was vaguely identified as a mixture of "local" and introduced.

Globe Artichokes: This was the only place in China where these are grown both according to personal observations and the knowledge of vegetable breeders at the Laboratory of Vegetables. They were said to have been introduced from South Central Europe 80 to 100 years ago and have been bred to embody new characteristics since then, particularly cold hardiness. There might be genetic variability of possible direct introduction into the U.S. globe artichoke germplasm base to extend its range.

Eggplant: Very little breeding or germplasm work is done on this crop in Shanghai. Most of the popular varieties were bred locally over 40 years ago. They are unlike varieties observed elsewhere in China; plants were extremely spindly and "vinelike." The fruits were deep purple, long, slender, and curved and amounted to relatively poor yield compared to eggplants in other parts of China.

Cauliflower: No cauliflower breeding is done in Shanghai, but some communes have a rigorous varietal testing program. The source of this germplasm was the CGRI, Beijing via the Laboratory of Vegetables. Cauliflower is a major winter crop along with heading cabbage and accordingly exhibits a high degree of cold hardiness.

White Gourd: We arrived in Shanghai at the peak of the white gourd harvest (mid-August), and they seemed to be everywhere. The crop is used much as a staple during this period. Ease of culture and excess of supply over demand bear on the low priority of white gourd as a candidate for genetic improvement. All varieties are mass selected and open-pollinated, and the main disease problems are virus and Phytophthora sp.

Potatoes: A huge area around Shanghai is grown to potatoes and they are consumed as a major staple. In the Long March People's Commune, 250 hectares of potatoes are grown annually to a variety developed in Manchuria. They produce their own vegetative seed pieces and have very serious virus problems.

Okra: A very minor vegetable crop in the Shanghai area, okra was introduced from India over 60 years ago. This was the only place in China that okra was observed and possibly embodies a pool of germplasm adapted to the local warm/humid Shanghai climate.

Strawberries (ad hoc "vegetable"): The Laboratory of Vegetables breeders appeared flattered when excitement was exhibited over the sight of strawberries. They claimed that they are grown in no other place in China. Although the present familiarity and demand was relatively low, they predicted that strawberries would expand in significance in the next 10-20 years.

The Laboratory of Vegetables maintains a large body of germplasm developed locally, some of which has been in Shanghai for 100 years or more. Until the CGRI completes the collection of vegetables, much of Shanghai's collection may be unique. They collaborate very closely with the CGRI and are content to fall under their jurisdiction with respect to germplasm exchange.

Another possible source of vegetable germplasm is the local communes. Some communes have vegetable breeding programs independent of the Laboratory of Vegetables. Some operations seemed relatively sophisticated and it seemed likely that some communes maintain unique germplasm.

Any old varieties developed locally in Shanghai are well adapted to warm, wet, and humid conditions. Diseases are almost completely unchecked and this was the only area of all those we visited in which soil borne pathogens were a problem. Possibly some resistance or tolerance has evolved.

Insect control is crude and very recent; perhaps tolerance mechanisms have evolved in this regard as well. Some older varieties of cole crops and artichokes are grown under much colder conditions than they are in the U.S., perhaps owing to a higher degree of genetic cold hardiness.

b. Collections and Exchanges

The Laboratory of Vegetables of the Institute of Horticulture presented (with some reluctance) the following collections (mostly varieties): 2 cowpeas, 1 French bean, 2 tomatoes, and 5 cabbages.

They would like to receive: (1) any virus resistant tomatoes, particularly CMV, (2) advanced red pole tomato lines from Southern State AES, (3) best determinant processing tomato lines, (4) tomato germplasm seed inventories, (5) best O.P. varieties of heading cabbage; cold and/or heat tolerant; mildew resistance, (6) celery "Tall Utah 5270R," "Tendercrisp." "Calmario," "Florimart," "Florida 683," "Lathom Self Blanching," and (7) any virus resistant pepper lines.

VIII. NANJING AREA (August 19-20)

A. Climate and Agriculture

The 5-hour (300 km) train ride from Shanghai to Nanjing (meaning Southern Capital) took us through a low-lying (5-15 m) rich alluvial agricultural area interlaced with canals and rivers and dotted with ponds and lakes. The Jiangsu Province, of which Nanjing is the capital, has about 5 million hectares of cultivated land. Rice is the most important crop, being grown on 2.8 million hectares, followed by wheat, which is grown on 1.5 million hectares. Other important crops include vegetables, soybeans, barley, corn, cotton, potatoes, and sweet potatoes. Much of the land is double-cropped, either with two crops of rice or rice and wheat.

Nanjing itself is located on the Yangtze River in undulating hills at elevations from 10 m to 50 meters. Annual precipitation is about 1,000 mm, with most of it coming in the summer months. The mean annual temperature is 15.4°C, with a winter extreme of -13°C and a summer extreme of 43°C. The growing season is about 200 days, extending from early April to the end of October. At a North Latitude of 32°, Nanjing is something of a climate analog of Montgomery, Alabama.

B. Individuals and Institutions Visited

1. Nanjing Agricultural College

We were welcomed by a vice-president of the College (Prof. Xia Zu-Shuo) who gave us the following historical information. The college was established in 1952 by combining two previously existing colleges. It has been in its present location since 1958. In 1971, Lin Piao ordered the College to be disbanded. It was reestablished in 1979 with six departments: (1) Agronomy, (2) Plant Pathology and Entomology, (3) Soils, (4) Horticulture, (5) Animal Husbandry, and (6) Agricultural Economics. The College has an enrollment of 800 and a staff of 400. They have a graduate program with 55 students. The College is operating in only two classroom buildings.

The Nanjing Agricultural College has been visited previously by several agricultural delegations. In 1979 an agricultural team came from the University of Wisconsin. Cornell University has established a "sister-school" relationship with the Nanjing Agricultural College, and a student and professor exchange agreement was signed in March 1980. In May 1980, a UN-FAO agricultural delegation visited Nanjing to consider financial support for the College. The Nanjing Agricultural College has the attention of U.S. and U.N. delegations and it needs all the help it can get. One of the professors, Dr. Liu Da-Jun, is spending a year at the University of Missouri with Dr. Gordon Kimber.

The College has a substantial cereal improvement program led by Dr. Wu Chao-Su, a graduate of the University of Minnesota. The vegetable program is under the direction of Prof. (Mrs.) Cao Sho-Hao. No forage work of consequence is underway at the College.

Names and Addresses

Xia Zu-Shuo 夏祖灼
Vice President
Nanjing Agricultural College
Nanjing, Jiangsu Province
People's Republic of China

Xu Guang-De 徐光德
Deputy Director
(same address as above)

Prof. (Mrs.) Cao Sho-Hao 曹寿椿
Vegetable Breeder
Department of Horticulture
(same address as above)

Mr. Wu Zhi-Xin 吴志行
Lecturer in Vegetables
Department of Horticulture
(same address as above)

Prof. Liang Zu-Duo
Department of Animal Husbandry
(same address as above)

Dr. Wu Chao-Su 梁祖鐸
Professor of Crop Breeding
(same address as above)

Dr. Wu graduated from University of Minnesota in 1950, where he studied with H. K. Hayes and E. C. Stakman.

2. Jiangsu Academy of Agriculture

The Academy of Agriculture appears to be a relative well-funded and adequately equipped institution with some capable staff and a wealth of germplasm. The Academy has a 50-year history, commencing in 1931. It was originally a National Center of Agriculture, but since 1949 it has been a provincial Academy. Although it is no longer a national institution, it has national stature and influence.

The Academy consists of nine institutes and two laboratories:

– Cereal (Food) Crops Institute . Their program involves breeding and cultural methods for rice, wheat, corn, and sweet potatoes.

– Economic Crops Institute. Breeding and culture of cotton, oilseeds, soybeans, and rape.

– Soils and Fertilizer Institute. Study of saline and alkaline soils and manures and fertilizers.

– Plant Protection Institute. Disease and insect development and forecasting.

– Animal Husbandry Institute. Primary emphasis on pigs and secondary emphasis on sheep and rabbits.

– Horticulture Institute. Breeding and culture of peaches, apples, and other fruit trees.

– Vegetable Institute. Breeding and culture.

– Genetics and Plant Physiology Institute.

– Agricultural Modernization Institute. Mechanization of agriculture, use of chemicals, new cropping systems, and improved planting methods.

– Laboratory of Physics, Chemistry, and Atomic Energy.

– Laboratory of Agricultural Information.

The Academy has a staff of 930 people, 420 of whom are researchers and technicians. The Academy has 80 hectares of land. This is the major plant-breeding and germplasm center in Jiangsu. It has seven local academies under its supervision and it services the germplasm needs of much of southern China. We visited with personnel of the Cereals Institute and they claim to have 10,000 rice collections and 6,000 wheat collections. The Director of the Cereals Institute, Prof. Mei Ji-Fang, has visited Beltsville and the National Seed Storage Laboratory at Ft. Collins, Colorado.

The activities of the Genetics and Physiology Institute were described by its director, Prof. Xi Yuan-Ling. A new building is being constructed to house this Institute. They, like many other institutes, are heavily involved in tissue culture, including anther culture and protoplast fusion. Wide hybridization is also being emphasized. They claim to have a hybrid between wheat and *Lolium*. There is some reason to doubt this claim. The physiological work includes studies of photosynthetic efficiency, photorespiration, plant growth regulators, and plant tolerance to humidity.

Forage work at the Academy is restricted to green manure crops including *Astragalus sinicas*, *Vicia villosa*, *Medicago hispida*, and *Vicia faba*.

Names and Addresses

Prof. Mei Ji-Fang (wheat breeder) 梅籍芳
Director, Cereal Crop Institute
Jiangsu Academy of Agriculture
Nanjing, Jiangsu Province
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Prof. Zhou Tai-Fu (rice breeder) 周太福
Deputy Director, Cereal Crops Institute
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Associate Prof. Bo Yuan-Jia (wheat breeder)
Cereal Crops Institute
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Prof. Xi Yuan-Ling (geneticist) 奚元令
Director, Genetics and Physiology Institute
(same address as above)

Associate Prof. Pan Weu-Gui 潘文桂
Animal Husbandry Institute
(same address as above)

Mrs. Wang Ze-Sheng (green manure) 王泽圣
Animal Husbandry Institute
(same address as above)

Mr. Ding Li-Ping (vegetable breeder) 丁犁平
Vegetable Institute
(same address as above)

Mr. Zhao Hua-Lun (vegetable breeder) 赵华伦
Vegetable Institute
(same address as above)

Mrs. Lin Yi-Lu (soybeans) 林以录
Vegetable Institute
(same address as above)

3. <u>Nanjing Botanical Institute (August 20)</u>

The Nanjing Botanical Institute is one of the major botanical institutions in China. It was established in 1929 and was destroyed in World War II. It was reconstructed in 1954 as an institution of Academia Sinica. Since 1972, it has operated a provincial institute. The botanical garden occupies 186 hectares and contains 2,000 taxa. The herbarium has 500,000 specimens.

The Institute has five major functions: (1) Plant biosystematics, (2) Surveying, exploiting, utilizing, and conserving plant resources, (3) Selection and breeding of subtropical economic plants, (4) Ecology and physiology of plants, (5) Chemataxonomy of economic plants.

The Institute has five research departments: (1) Plant taxonomy and morphology, (2) Geobotony and morphology, (3) Phytochemistry, (4) Medicinal plants, and (5) Botanical garden.

The Institute is playing a major role in the new 80-volume Flora of China. Four of the five volumes of the Flora dealing with the Gramineae are being prepared by Mrs. Chen Shou-Liang. The other Gramineae volume is being done by the staff of the University of Nanjing. Dewey reviewed Mrs. Chen's draft treatment of the Triticeae tribe. She does not have access to the most recent foreign literature. Consequently her treatment sometimes reflects some outdated taxonomic viewpoints.

Names and Addresses

Dr. Shen Ren-Hua 单人骅
Director and Professor of Plant Taxonomy (umbelliferae)
Hortas Botanicus Nanjingensis
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People's Republic of China

Mrs. Chen Shou-Liang 陈守良
Associate Professor of Plant Taxonomy (Gramineae)
(same address as above)

C. Germplasm Resources

1. Forages (Dewey)

a. Resources

I had little opportunity to observe forages in the wild, so I have no basis for assessing the native forage germplasm in and around Nanjing. Few, if any, forage germplasm resources are maintained at the Nanjing Agricultural College or at the Jiangsu Academy of Agriculture.

The best opportunity for obtaining forage germplasm from Jiangsu is through Mrs. Chen at the Nanjing Botanical Institute. She gets into the field occasionally and has the opportunity to collect seeds. I am making a strong effort to develop a close working relationship with Mrs. Chen.

b. Collections and Exchanges

One collection of *Agropyron kamoji* was made alongside a road and another collection was provided by Mrs. Chen.

Prof. Liang Zu-Duo of the Animal Husbandry Department of the Nanjing Agricultural College would like to receive *Lolium*, *Trifolium*, and *Dactylis* germplasm.

Mr. Wang Ze-Sheng of the Jiangsu Academy of Agriculture would welcome germplasm of annual species of *Astragalus*, *Vicia*, *Medicago*, for green manure and species of *Sesbania*, *Melilotus*, *Azola*, *Lolium*, and *Trifolium* for saline sites.

2. Wheat and Barley (Sunderman and Thompson)

a. Resources

Nanjing is on the southern edge of the winter wheat belt in China. Usually spring wheat and barley are planted in the winter in double cropping systems with two crops of rice in the summer. Wheat quality ranges from a hard wheat in the northern part of the province to soft reds in the south. For the first time in our stay in China, some interest in wheat quality was expressed. Breeders were primarily interested in variety adaptations for earliness and scab resistance. High yield, high fertility (6 to 8 seeds per spikelet), rust resistance, powdery mildew resistance, and resistance to cold, drought, and wetness were additional breeder objectives.

The following summary of the wheat breeding and germplasm program at the Nanjing Agricultural College was prepared by Dr. Wu Chao-Su:

> "The Nanjing Agricultural College is the earliest institution working on wheat improvement in our country; the work began in the 1920's. For a long time under the direction of Professor S. B. King, former Dean of our College and now Director of the Academy of Agricultural Science of China, basic studies in association with regular breeding programs of what have been undertaken. Investigation on Chinese wheat genetic resources, wheat introduction, and breeding work have been well done.
>
> With respect to genetic resources, in the mid 1950's over 5,000 indigenous varieties throughout our country have been collected, and the "genetic treasuries" have been kept. Through systematic investigation, species, subspecies, and botanical varieties have been identified. A new species (T. yunnanese King) and many new botanical varieties have been designated, and a comprehensive classification of Chinese wheat has been suggested. On the basis of research on the ecological characteristics of the varieties of the different regions, such as characters of growth and development, seed dormancy, reactions to adverse environmental conditions, and others, Chinese indigenous varieties of common wheat have been primarily classified into 14 ecological types, and then 10 ecotypes. Accordingly, 10 to 14 wheat ecological regions of our country have been suggested. These suggestions have been well accepted.
>
> In the introduction of germplasm from foreign countries, varieties Nanda 2419 and Ailiduo, of Italian origin, were developed and distributed in the 1950's, and in 1960 they were grown on 5 million hectares. Nanda 2419 has been the most widely adapted variety in our country, and also has been successfully used as parent in crosses, a great many of new varieties of various regions have it as a parent. The development of the two varieties is the most successful example of wheat improvement through introduction in our country.

Through hybridization, the variety Nannong-daheimang and its derivative variety Zhongshan 6 were developed. Nannong-daheimang, developed from the cross of Nanda 2419 and branched turgidum wheat, is the first variety bred through inter-specific crossing in our country. It was distributed in 1964, and Zhongshan 6 in 1970.

The Wheat Varieties Research Laboratory was established here by the Academy of Agricultural Science of China in cooperation with our college in 1964. Since then the work has progressed well. Due to the destruction by the "Gang of Four," the Laboratory was cancelled. As our college has restored to be one of the key institutions of higher learning in the Ministry of Agriculture last year, and the work on genetics and cytogenetics of wheat has been subordinated to national plans, the Laboratory has been requested to be restored. Now there are nine professors and instructors and six graduate students working in this field. Progress in this work is greatly dependent upon the enlargement of the number of personnel, the cooperative work of specialists in the related field, the acquisition of modern equipment, and enough information on findings and germplasm sources.

The main aspects of the research project of Wheat Varieties Research Laboratory are: (1) systematic screening of indigenous germplasm and foreign introductions for useful traits; (2) studies on the inheritance of characters of economic importance; (3) investigation in the techniques and implications of whole- or part-chromosome transfers from related genera to wheat; (4) breed new varieties well adapted to the growing conditions of central and eastern Yangtze Valley, with high yield capacity, good quality, early maturity, and resistance to rusts, head scab, and powdery mildew."

The Cereals Institute of the Jiangsu Academy of Agriculture is second only to CGRI at Beijing as a wheat germplasm resource. They have 6,000 wheat germplasm selections. Local collections are 2,000; another 2,000 are introductions from 47 countries, and the rest are varieties and selections from China hybridization. Part of these are duplicated in Beijing, but Jiangsu has most of the older collections, mainly from the south of the Yantze River. They were willing to exchange any or all of this material, but we were not given any of this seed as they felt their requests to the United States were being ignored. In addition to increased exchange cooperation they would like to have an annual updated version of the most complete information on lines and varieties available.

Inquiry about barley research and germplasm brought the information that the main barley research center in China was Zhejiang Agricultural Research Institute in Hangzhou, Zhejiang Province.

b. Collections and Exchanges

The Jiangsu Academy of Agriculture has a direct exchange program with Dr. Warren Kronstad at Oregon State University. The breeders stated they preferred direct exchange rather than going through Beijing. We were given samples of two local bariey varieties, one a two-row variety used for feed and beer, and the other a hulless variety used for human consumption.

The Academy is interested in obtaining seed of Extra Early Blackhull wheat. Thompson promised to send seeds of his early wheat male-sterile facilitated recurrent selection for their use. Orton promised to send seeds of the original line from C.O. Qualset, University of California.

Dr. Mei had requested seeds of wheat, rice, and soybeans from Beltsville in 1979. He had not received a response to this request.

3. Vegetables (Orton)

a. Resources

The overall level of sophistication in collection, maintenance, evaluation, and mobilization of vegetable germplasm was the highest in Nanjing of all the areas visited, including Beijing. China's most comprehensive collection of radish and Bok Choy germplasm is maintained by Professor Cao at the Department of Horticulture, Nanjing Agricultural College. She also maintains a large store of local varieties of most other vegetables for her variety trial and extension program. At least some of these materials are probably unique. Breeders at the Institute of Vegetables, Jiangsu Provincial Academy of Agriculture, have amassed about 500 different vegetable varieties (mostly introduced) composed of tomato, soybean, Bok Choy, radish, eggplant, lettuce, cowpea, pepper, celery, squash, cucumber, Chinese cabbage, head cabbage, onion, and melon. Some of these may not be included in the CGRI or Nanjing Agricultural College collections. The Institute of Vegetables is constructing refrigerated facilities for germplasm storage and is developing a running seed inventory, which will be made available by the end of the year.

Bok Choy: This crop is grown all year round in Nanjing except July and August, suggesting that it must be very cold-hardy (average January temperature is -1°C). Professor Cao of the Department of Vegetables, Nanjing Agricultural College, probably has the most complete collection in the entire country. The primary breeding objectives are resistance to temperature extremes, slow bolting of winter types, and resistance to bacterial wilt, viruses, and downy mildew. The disease screening effort was the best observed.

The Institute of Vegetables, Jiangsu Academy of Agriculture has also collected Bok Choy varieties, but the collection is not extensive and they are presently not breeding the crop.

Radish: Like Bok Choy, radish is grown in Jiangsu the whole year except mid-summer, suggesting a possible genetic basis for cold tolerance. The range of types grown is tremendous with respect to skin and flesh color, shape, and size. The preferred type is a white-fleshed, red-skinned tap root which is spherical and about 8 cm in diameter (60 days to maturity). The small, early U.S. types are not popular. Professor Cao has amassed over 200 unique radish lines, most of which are older "local" varieties. Many of the recent introductions are from Japan. The breeding objectives were identical to those of the Bok Choy breeding program. Their biggest problem is breeding resistance to virus, which is severe during hot dry weather or during periods of heavy aphid infestation.

Tomatoes: Most of the germplasm collection and varietal development work appeared to be in progress at the Institute of Vegetables, Jiangsu Academy of Agriculture. Mr. Zhao and Mr. Ding maintained a small germplasm collection consisting of local and introduced lines. Professor Cao estimated from her trials that more than 100 different varieties are grown in the area, only 15 of which are "local." Some Italian processing lines are being grown and Florida AES fresh market lines are becoming very popular. Cucumber mosaic virus is their most serious disease problem.

Peppers: The Institute of Vegetables at the Academy of Agriculture maintains a small collection of local and introduced lines. They are developing an F_1 hybrid variety of inbreds derived from local and U.S. O.P.'s.

Head Cabbage: All germplasm has been introduced within the last 30 years or so, the most popular varieties of which have been O.P.'s developed in the U.S.: "Success" and "All Season."

Eggplant: The Institute of Vegetables has collected a small number of local varieties (about 20) and presently is conducting a program to breed "local" x Japanese F_1 hybrid varieties.

Chinese Cabbage: The Institute of Vegetables has collected four local varieties and also maintains a collection of local lines from Hubei Province that are considered to be genetically superior. They have released a hybrid variety constructed entirely of Hubei-derived inbreds which is presently planted on 30 to 50% of the Chinese cabbage fields, particularly near urban centers.

b. Collections and Exchanges

I collected one accession of *Apium leptophyllum*.

Prof. (Mrs.) Cao Sho-Hao of the Nanjing Agricultural College would like the best processing and fresh market tomato lines from southeast states and wild tomato species *L. peruvianum*, *L. hirsutum*, *L. pimpinellifolium*, and *L. cheesmanii*.

Mr. Zhao Hua-Lun of the Academy of Agriculture needs male-sterile cabbage and pepper lines and virus resistant (CMV) pepper and tomato lines.

IX. EXITING CHINA

The Delegation left Nanjing at 3:30 p.m. August 20 and traveled by train to Beijing, arriving at 6:30 a.m. August 21. We were met at the train station by Mr. Wang Xing-Hai and Mr. Liu Chun-Meng of the Ministry of Agriculture. We were taken directly to the Beijing International Airport for our 10:35 a.m. flight to Tokyo. At the airport we were joined by Dr. William Tai (Michigan State University) and Dr. Shao Qi-Quan (Associate Director of Institute of Genetics). Dr. Shao's purpose for being at the airport was to finalize commitments for a visit to Dewey's laboratory in 1981.

We had hand-carried all of the seed that we had accumulated throughout the trip, and we were unsure of what to do with it at this point. The seed filled two medium-sized boxes. Inasmuch as we were not met at the airport by any of the U.S. Embassy staff, we decided to take the seed with us. Mr. Wang Xing-Hai gave the Ministry's permission to do this, although it was an unprecedented procedure. Our exit through customs was expedited and none of our baggage was checked. No problems were experienced in getting the seed through customs into Japan.

Friday August 22 was spent at the Narita International Hotel in report writing and repacking seed for shipment home. Orton hand-carried one box of seed, which was left at U.S. Customs in San Francisco and subsequently forwarded to the Plant Quarantine Station at Beltsville, MD. Dewey repacked his seed into two boxes and gave them to the Agricultural Attache at the U.S. Embassy in Tokyo. This seed was sent directly to the Plant Quarantine Station at Beltsville via the APO mail system. All seed arrived safely at the Quarantine Station. The seed has been subsequently threshed and cleaned and is now in the Plant Introduction System.

X. CONCLUSIONS

The U.S. and P.R.C. are entering into an era of unprecedented scientific cooperation that can be beneficial to both countries. The Chinese are not agriculturally self-sufficient even though 85% of their work force is engaged in agricultural pursuits. Consequently, they need academic training, technology, and germplasm from the U.S. to increase agricultural production while freeing more people to work in industry. The U.S. stands to gain from a germplasm resource that has been "locked up" since 1949. In spite of visits of four germplasm delegations and two botanical delegations (a second botanical team visited China in 1980), we still have only a sketchy picture of the germplasm resources of China.

China stands to gain considerably more than the U.S. from agricultural exchanges. Nevertheless, there is a prevailing sentiment among Chinese agriculturalists that their germplasm is a "national treasure" that must not be exploited by outside interests without adequate reciprocal benefits. What they don't seem to realize is that they are indeed on the "long end" of the overall scientific exchange. There is reluctance on the part of some individuals and institutions to freely share their germplasm. Some of this reluctance is prompted by an ignorance of just what their germplasm resource entails, and they hesitate to part with something of undetermined value. This attitude is unfortunate and contrasts sharply with the U.S. policy of giving virtually unlimited access to its germplasm resources to all bonafide users, foreign or domestic.

The willingness in China to share germplasm varies widely with individuals, institutions, and crops. Germplasm delegations must be alert and sensitive to these differences and use considerable discretion in knowing when to "back off" from requests for seeds or for the privilege to collect in the wild.

Assessment of China's Forage Germplasm Resources and Strategies for Its Collection and Exchange

Less is known of China's forage germplasm resource than of its other major crops because little attention has been given by Chinese agriculturists to that resource. Nevertheless, it is evident from botanical literature and reports from early plant explorers that China is rich in forage germplasm. A further glimpse of that richness was obtained by the present delegation.

Because China's land mass, topography, and climate is comparable to that of the U.S., it is reasonable to expect that much of the wild forages adapted to China will be well adapted to the U.S. Many of the important forage species currently in use in the U.S. are based on germplasm derived from the U.S.S.R. There is no reason to think that the forage germplasm from China cannot be as valuable to us as has that from the U.S.S.R.

On-site observations by the present delegation leaves no doubt that China has a vast reservoir of germplasm in two large groups of economically important grasses: (1) *Agropyron* s. lat. (wheatgrasses) and (2) *Elymus* s. lat (wildrye grasses). Species in the crested wheatgrass complex,

A. cristatum s. lat., are a major component of the Inner Mongolian prairies, and they were observed and collected also in the Gansu Province and the Xinjiang Autonomous Region. Crested wheatgrass breeders can look forward to expanded gene resources as new collections are made available.

The caespitose self-fertilizing species of Agropyron (which belong to Nevski's genus Roegneria) are very common throughout China. These species are not particularly important as forage grasses, but they are of great interest from phylogenetic and cytotaxonomic standpoints.

Because the Inner Mongolian prairies are so similar to the grasslands of the Northern Great Plains, the dominant species of the Mongolian prairie, E. chinensis and E. dasystachys, may be valuable species in the Dakotas and Canadian prairie provinces. Neither of these species have received any attention from North American grass breeders, but they certainly warrant attention. In recent years, Canadian breeders have recognized the value of E. angustus (Altai wildrye) and have bred an improved variety, Prairieland. All of the E. angustus germplasm has come from the U.S.S.R. This species is very common in Xinjiang, and the new germplasm will add a new dimension to E. angustus breeding.

Some consider Russian wildrye, E. junceus, to be the grass of the future for western U.S. rangeland. The germplasm resource of this species available to U.S. breeders is very limited and all of it comes from the U.S.S.R. New gene resources are badly needed. This species is a common grass in western China, which offers an expanded germplasm resource to U.S. breeders.

Northern and Western China appear to be valuable sources of several legumes in the following genera: Medicago, Hedysarum, Astragalus, Vicia, and Trifolium. The distribution and importance of these and other legumes remain to be determined. We saw small populations of legumes in native range in most locations.

The Chinese have accumulated only very small collections of forages and their breeding programs are just commencing. Consequently, most of the forage germplasm remains to be collected in the wild. The Chinese apparently have no plans for large-scale and systematic collecting of forages, so it may be necessary for U.S. collectors to make their own collections. Fortunately, the Chinese officials and scientists at all levels and locations seem willing to permit collecting of forage germplasm in the wild.

Negotiations should be implemented immediately to organize a series of plant explorations for forage germplasm in all parts of China. Any exploration should involve both U.S. and Chinese explorers and all germplasm should be divided between the two countries. At least four major collecting regions for cool-season forages were identified by the 1980 Germplasm Delegation. Those areas are: (1) The Inner Mongolian Prairies, (2) The Gansu Province, particularly the Qilian Mountains, (3) Xinjiang, including the Tian Shan and Altai Mountains, and (4) a route along the Great Wall between Beijing to Lanzhou.

Assessment of China's Vegetable Germplasm Resource and Strategies for Its Collection and Exchange

Very few of the vegetable species presently grown and bred in China originated in Southeast Asia. Of those that did, the most significant are vegetable amaranth (Amaranthus tricolor), mung bean (Phaseolus aureus), Chinese cabbage (Brassica campestris, pekinensis group), Bok Choy (B. campestris, chinensis group), soybean (Glycine max), broadbean (Vicia faba), true yam (Discorea batatas), possibly onion (Allium cepa), and taro (Colocasia esculenta). Of these, onion and B. campestris were actually observed in the wild even in the course of our superficial excursions into the "wild." Moreover, only Chinese cabbage, Bok Choy, soybean, and onion are cultivated to the extent that some visual assessment of domesticated (and presumably accessible) variability could be made. At least six morphological types of Bok Choy are grown, primarily along the coast and south of Nanjing. It was visually difficult to assess variability in Chinese cabbage due to the undifferentiated plant type. All of the soybeans observed were too diseased to make any solid judgments. Onions and related crops were observed in numerous locations around China. The degree of variability observed was great, both within and between fields, areas, and varieties. It is strongly recommended that scientists or teams of scientists specifically trained in the systematics, ecology, and genetics of these species make long term expeditions to China and, jointly with Chinese scientists, collect or describe both wild and endemic cultivated germplasm. These are the most significant germplasm resources in China and the habitats for wild germplasm have been progressively destroyed for a long time.

Some introduced vegetable germplasm in China has probably been there for a long time, perhaps up to 1,000-2,000 years, largely attributable to silk trade with the West. Vegetables which could have been introduced at this time are celery, eggplant, cucumber, onion, pea, chick pea, melon, cowpea, sugarbeet, and heading cabbage. Many of these crops exhibited a tremendous overall degree of morphological variability, even though all or most are cross pollinating, and are indicative of a variable underlying pool of germplasm. More importantly, they have been in China long enough that they have likely accumulated unique genes. The country is still relatively primitive and decentralized, somany of the varieties presently in use are direct descendents of such early introductions. Further exploration and germplasm acquisition by specialists familiar with these species and exchange of blocks of germplasm, particularly of amassed local varieties, are recommended.

One of the areas in which the existence of unique significant germplasm is likely among Chinese vegetables is in tolerance or resistance to insects, pathogens, and stress (particularly cold). The degree of exposure to such adverse forces is almost universally unchecked or control measures are primitive. It is recommended that a team of plant pathologists with broad expertise visit China and collect samples of pathogens, particularly viruses, make precise identifications, and determine the relation of Chinese pathogens to the world picture.

China has a rich store of endemic germplasm in the genus Brassica. Orton collected seed from about 20 populations of wild Brassicas, mostly in the Gansu Province and the Xinjiang Autonomous Region. It is speculated that at least six different species are represented based on morphology and apparent reproductive isolation in sympatric populations. Several populations resemble wild B. campestris and may have actually originated near the point of collection. A tremendous degree of variation was observed.

Other observations were made, bearing the distribution of wild Brassica in China, at two herbaria: Institute of Botany, Beijing and Institute of Botany, Nanjing. Time limitations precluded a thorough review of all preserved specimens. At the Institute of Botany in Beijing a listing was made of wild species collected in the areas that we were to visit.

Jiangsu Province:	B. alboglabrata, B. campestris, B. chinensis, B. dubrosa, B. integrifolia, B. marinosa, B. peleinensis, B. rapa
Gansu Province:	B. caulorapa, B. chinensis
Xinjiang:	B. chinensis, B. napus
Inner Mongolia:	B. chinensis, B. elongata, B. juncea
Beijing:	B. parachinensis

Many of their specimens were quite old and the nomenclature had not been revised. The nomenclature given above reflects precisely what was on herbarium specimens.

The Brassica collection in Nanjing was not as extensive as that in Beijing with exception of B. campestris. Collections of this species had been made in a number of diverse locations in China, such as Chekiang, Xinjiang, Hangchow, Jiangsu, Sichuan, and Tibet. The collection embodied a tremendous morphological variability with respect to habit, leaf shape, succulence and pubescence, pod morphology and color, and flower color and size. Professor Chu of the Institute has completed a volume on cruciferae which will be published in the "Flora of China" series.

The Brassicas include numerous domesticated types of great importance. Moreover, they appear to represent a model system for interspecific gene transfer. Wild materials in China are most likely both extensive and unique. To the knowledge of the author, no collection of viable materials has been made. It is strongly urged that exploration be made to wild Chinese habitats for purposes of collecting viable seeds and/or live specimens in an effort to determine the range and depth of Brassica germplasm.

Assessment of China's Wheat and Barley Germplasm and Strategies for Its Collection and Exchange

It is difficult to make an accurate assessment of the range of germplasm available as almost all of the barley and winter wheat and much of the spring was harvested in the areas visited. Secondly, our itinerary didn't include stops at the centers of cereal research in most provinces visited.

Most cereal varieties that we observed in China were introduced or developed since about 1950. The wheat varieties developed in China were derived from introduced varieties with good agronomic characteristics and resistance to leaf, stem or stripe rust as one of the parents crossed with some of the local varieties. This limits, to a large extent, the variability available in presently grown varieties.

Many older, low producing cereal varieties were removed from cultivation when the People's Republic of China was established. Intensive small grain culture on hillsides in remote and hard to get to areas were seen from the plane, Beijing to Inner Mongolia, and from the train and bus in Gansu Province. These observations suggest that some old landrace varieties remain to be collected if it is possible to reach them. Collection undertakings to remote mountainous areas of grain production in China would most likely be successful if made in conjunction with Chinese counterparts and with a sharing of the results.

Barley seems to be a relatively minor crop and receives little research attention in any area visited. However, barley is grown throughout China for local food needs and to make beer. In the Yangtze River Delta area it was also identified as a feed crop. Zhejiang Agricultural Research Institute, in Zhejiang Province in Hangzhou, was given as the main barley research center in China. Contact with this institute seems a likely source of germplasm information and exchange.

Spring wheat and barley varieties observed in Inner Mongolia appeared to have limited potential as a valuable source of germplasm either for agronomic improvement or disease resistance.

Agronomic characteristics of spring wheat observed in the area around Lanzhou was variable with a number of different genotypes growing in some fields. However, we found no plants that were outstanding for agronomic type or for resistance to the stripe rust observed in the area. Although old landrace winter wheats have all been replaced by introductions or locally bred varieties, the apparent environmental variability of the province both in elevation and climate would suggest some of the varieties might be valuable as germplasm for resistance to moisture stress and cold. We were told that the old varieties as well as more recent ones are stored at Gansu Agricultural University and the establishment of a germplasm exchange with the University is recommended.

Most irrigated wheats observed in the vicinity of Urumqi were characterized as having large lax heads, moderately stiff straw and moderate susceptibility to strip, leaf and stem rust. Our travel failed to cover areas of dryland winter wheat production, but we were told winter wheats grown in much of

Xinjiang Province are early maturing and require as much or more cold tolerance than those grown anywhere else in the world. Low annual rainfall in mucn of the area coupled with extreme cold winters should make wheats from this area valuable sources of germplasm for winterhardiness and drought tolerance. Spring varieties grown on dryland require tolerance to drought and may be useful as germplasm for this characteristic. Germplasm exchange with the Xinjiang Academy of Agricultural Science Germplasm Institute would be mutually beneficial.

No wheat or barley was observed in the Shanghai and Nanjing area; however, their varieties are early and apparently resistant to leaf diseases and scab. They were interested in obtaining early spring wheat varieties with resistance to these diseases. The Jiangsu Academy of Agricultural Science at Nanjing probably has a better wheat germplasm collection of the native and locally developed spring wheats of southern China than Beijing and they were willing to exchange material. They insisted, however, that it be a two-way exchange, as in the past they have given germplasm but have received very little in return. It would be mutually advantageous to establish a direct germplasm exchange with the germplasm institute in this province.

Under the present organization of germplasm collection and storage in China, it appears the National Germplasm Institute is marginally effective in distributing foreign germplasm to the provinces and has access to only material stored at Beijing for foreign exchange. Thus, for the immediate future, it will be necessary to establish direct exchanges with province germplasm storages if their material is desired.

Appendix 1. Germplasm presented to the P.R.C. by the U.S. 1980 Germplasm Delegation (Unless specified otherwise, the collections were presented to the Crop Germplasm Resources Laboratory at Beijing in July 25, 1980.)

FORAGES (DEWEY)

Species	Source	PI or Nursery No.
Agropyron abolinii	U.S.S.R.	CS-10-46
A. acutum	Belgium	PI 202727
A. alatavicum	U.S.S.R.	CS-5-21
A. albicans	Montana, U.S.A.	RS-5-21
A. angustiglume	U.S.S.R.	CS-8-71
A. batalinii	U.S.S.R.	CS-5-6
A. caespitosum	U.S.S.R.	A-62-52
A. campestre	France	RS-3-31
A. caninum	Italy	PI 252044
A. caucasicum	U.S.S.R.	CS-7-11
A. ciliare	Japan	CS-9-11
A. confusum	U.S.S.R.	CS-10-21
A. cristatum	U.S.S.R.	PI 314599
A. cristatum	Australia	PI 316120
A. cristatum ssp. tarbagaticum	U.S.S.R.	PI 406442
A. curvatum	U.S.S.R.	CS-11-81
A. curvifolium	U.S.S.R.	CS-5-11
A. czimgamicum	U.S.S.R.	CS-10-61
A. dasystachyum	Idaho, U.S.A.	GC-80-55
A. desertorum	North Dakota, U.S.A.	Cg-125-50
A. drobovii	U.S.S.R.	PI 314194
A. elongatum	Aegean	CS-5-61
A. elongatum	U.S.S.R.	PI 315352
A. ferganense	U.S.S.R.	CS-5-31
A. fibrosum	U.S.S.R.	PI 315491
A. fragile	U.S.S.R.	PI 406449
A. imbricatum	Iran	PI 229574
A. inerme	Idaho, U.S.A.	CS-4-11
A. intermedium	Latvia	RS-10-31
A. junceum-mediterraneum	France	CS-7-61
A. leptourum	Iran	PI 229520
A. libanoticum	Iran	PI 228391
A. littorale	France	RS-3-21
A. longearistatum	Iran	CS-11-68
A. mutabile	U.S.S.R.	PI 314622
A. nodosum	U.S.S.R.	A-63-85
A. oschense	U.S.S.R.	CS-10-31
A. podperae	Iran	CS-6-44
A. riparium	'Sodar' U.S.A.	RS-5-41
A. scabriglume	Argentina	CJ-1-31
A. scirpeum	Italy	CS-5-51
A. scythicum	U.S.S.R.	PI 283272
A. semicostatum	Afghanistan	PI 275305
A. sibiricum	U.S.S.R.	PI 314056
A. smithii	New Mexico, U.S.A.	RS-8-16
A. spicatum	Wyoming, U.S.A.	CJ-6-66
A. spicatum	Washington, U.S.A.	CS-20-1
A. stipifolium	U.S.S.R.	PI 313960
A. stipifolium	U.S.S.R.	CS-4-72
A. subsecundum	Montana, U.S.A.	B-70-68
A. tauri	Iran	CS-17-76
A. tianshanicum	U.R.R.S.	CS-10-1
A. tilcarense	Argentina	CS-12-75
A. trachycaulum	Nevada, U.S.A.	B-41-32

Appendix 1 cont'd. Seed presented to P.R.C.

Species	Source	PI or Nursery No.
A. trichophorum	Iran	A-32
A. tsukushiense	Japan	CS-7-1
A. ugamicum	U.S.S.R.	PI 314209
A. yezoense	Japan	PI 275776
Elymus ambiguus	Utah. U.S.A.	CS-18-81
E. angustus	U.S.S.R.	PI 314663
E. arenarius	Baltic Sea	RS-7-27
E. canadensis	Montana, U.S.A.	PI 232249
E. cinereus	Utah, U.S.A.	CS-18-61
E. cinereus	Canada	PI 236809
E. dahuricus	U.S.S.R.	CS-30-61
E. giganteus	U.S.S.R.	RS-6-11
E. glaucus	Idaho, U.S.A.	CS-13-14
E. junceus	U.S.S.R.	CS-19-81
E. karataviensis	U.S.S.R.	PI 314671
E. mollis	Alaska, U.S.A.	TS-13-1
E. multicaulis	U.S.S.R.	PI 314666
E. nutans	W. Pakistan	PI 275327
E. patagonicus	Chile	PI 286201
E. sabulosus	U.S.S.R.	RS-6-21
E. salina	Utah, U.S.A.	CS-18-41
E. sibiricus	U.S.S.R.	PI 314619
E. triticoides	Oregon, U.S.A.	RS-4-21
E. virginicus	Czechoslovakia	PI 315864
Hordeum bogdanii	Afghanistan	PI 269406
H. bulbosum	Iran	PI 343189
H. californicum	California, U.S.A.	CS-15-21
H. parodii	Argentina	CS-16-71
H. turkestanicum	U.S.S.R.	CS-17-81
H. violaceum	Iran	A-31
H. violaceum	Iran	A-26
H. violaceum	Iran	CS-26-81
Psathrostachys fragilis	Iran	PI 343192
Secale montanum	Turkey	
Sitanion hystrix	Arizona, U.S.A.	CS-14-21
A. fibrosum X A. trachycaulum	Induced amphiploid	HD-34-33
A. libanoticum X A. caninum	Induced amphiploid	CS-22-66
A. libanoticum x E. sibiricus	Induced amphiploid	CS-21-32
A. repens X A. cristatum	F_8 generation	HF-2-37
A. repens X A. curvifolium	Induced amphiploid	HF-10-10
A. repens X A. desertorum	Induced amphiploid	HF-10-20
E. canadensis X A. libanoticum	Induced amphiploid	CS-22-57

Appendix 1 cont'd. Seed presented to P.R.C.

Forage Collections sent to P.R.C. by Dewey after return to the U.S.

Species	Cultivar or strain
Agropyron cristatum	'Fairway'
" *desertorum*	'Nordan'
" *elongatum*	'Alkar'
" *inerme*	'Whitmar'
" *intermedium*	'Greenar'
" *sibiricum*	'P-27'
" *trachycaulum*	wild collection
Elymus junceus	'Vinall'
A. repens X *A. spicatum*	RS-1
A. repens X *A. spicatum*	RS-2

Each of the above collections were sent to the following individuals:

Mrs. Li Yan-Qin, Institute of Animal Husbandry, Hohhot, Inner Mongolia

Mrs. Wang Bi-De, Agricultural College, Hohhot, Inner Mongolia

Mr. Ma Zhi-Guang, Grassland Institute, Xilinhot, Inner Mongolia

Mr. Lo Song-Shan, Bureau of Grassland, Xilinhot, Inner Mongolia

Prof. Ren Ji-Zhou, Agricultural University, WuWei, Gansu

Mr. Cheng Xiang-Jiao, Grassland Institute, Urumqi, Xinjiang ppendix 1 cont'd. Seed presented to P.R.C.

Species	PI or Dewey Nursery No.	Origin
Agropyron caninum	PI 314612	U.S.S.R.
" *elongatum*-70	PI 315352	U.S.S.R.
" *elongatum*-28	CS-5-61	Aegean
" *libanoticum*	PI 228391	Iran
" *podperae*	CL-3-13	Iran
Elymus giganteus	RS-6-1	U.S.S.R.
Hordeum bulbosum-14	GBC-77	Canada
Hordeum bulbosum-28	PI 343189	Iran
Secale montanum	Acikgoz	Turkey
E. arenarius X *E. giganteus*	RS-12-27	Induced amphiploid
E. canadensis X *A. libanoticum*	CS-22-57	Induced amphiploid
T. aestivum X *A. podperae*	HE-44-46	Induced amphiploid
T. timopheevi X *H. bogdanii*	HE-49-4	Induced amphiploid

The above 13 collections were sent to: .

Prof. Hu Han, Institute of Genetics, Beijing

Appendix 1 cont'd. Seed presented to P.R.C.

CEREALS (Sunderman)

Species	Cultivar or Selection
Winter wheat	Heglar, Jeff, Ranger, Franklin, Arbon, Neeley, Weston
Spring Wheat	Sawtell, Borah, Peak 72, Bannock, Moran, Peak, McKay, Fieldwin, Fielder, Twin, Sterling, Crestone, Dirkwin
Oats	Corbit, Otana, 75Ab1170
Barley	Steve, Klages, Karl, Butte, Caribou, 74Ab4302, 76Ab5988, 78Ab10239

Winter wheat

Norstar	A74140W-7-1	UT89099
Caldwell	WA6363	TX73V165
Auburn	A7393W-1-3	TX69A569-1
Wanser	A74140W-5-3	A74124W-2-2
Nugaines	A74140W-7-2	A71235W-17-1-1
Itana	A74140W-21-2	85
Stephens	A74233W-10-2	A7389W-338-1
ID0180	A71236W-39-2-1-19	A7018W
ID0179	A75300W-4	A72243W-A-77-2
A71255WS-11-3	A75300W-6	A71243W-25-2
A7145W-59-1	A70172W-B-1-13-1-1	A7327W-1-3
A7145W-51-1	A74240W	A7453W-28-3-3
A70246SW-B-3-3	A7242W-3	A71236W-39-2-1
A72244W-A-36-5-2	A75233W	32
A72244W-B-67-3-2	A75235W-2	WA6367
A7321W-44-2	A75235W-3	A71236W-45-3
A73160W-17-3-2	A75232W	A71243W-20-2
A73163W-1C-18-3-1	ID0158-1	A74222W-26-4-
A7399W-4-2	ID0158-4	ID0221
A74136W-8-3-1	ID0158-201-2	ID0223
		ID02222
		A74243W-72-9-
		A71111W-7-2-4.

Spring wheat	ID 0185	ID 0183

Appendix 1 cont'd. Seed presented to P.R.C.

CEREALS ETC. (Thompson)

Species	Selection
Barley	MSFRS, Gus, E-5 Dryland, Early Short Straw, Naked
Spring Wheat	MSFRS, AZ195-2, AZ906
Oats	Mesa
Alfalfa	Lew
Cotton	Short Staple
Okra	Unspecified
Cucumber	Unspecified

Appendix 1 cont'd. Seed presented to P.R.C.

VEGETABLES (Orton)

Species	Cultivar or Selection No.			
Brassica campestris	77-74	77-212	77-269	77-1029
	77-75	77-223	77-271	77-1045
	77-76	77-235	77-278	77-1046
	77-161	77-240	77-282	77-1092
	77-210	77-254	77-1003	
Brassica carinata	77-1226	77-1299	77-1310	
	77-1283	77-1300	77-1314	
	77-1284	77-1304	77-1316	
	77-1296	77-1308	77-1320	
	77-1297	77-1309	77-1321	
Brassica juncea	77-145	77-375	77-563	77-1064
	77-149	77-400	77-573	77-1101
	77-150	77-417	77-580	77-1103
	77-331	77-437	77-589	77-1110
	77-337	77-445	77-594	77-1231
	77-341	77-470	77-604	77-1324
	77-344	77-528	77-898	77-1333
	77-345	77-540	77-920	77-1334
	77-350	77-547	77-931	77-1339
	77-356	77-548	77-948	77-1356
		77-553	77-959	
		77-555		
Brassica napus	77-33	79-89	Asahi	Dong-Hae 18
	77-35	79-90	Natane	Dong-Hae 23
	77-70	79-95	Norin 16	Kuju 35
	77-1376	79-186		Kuju 57
	79-59	79-201	Buk Wuk 13	Norin 25
	79-75	79-300	Dae Chosen	Norin 34
		79-312	Dong-Hae 16	

Brassica oleracea italica group cv Emporer
cv Green Duke
acephala group 71B-10-3X46-1
botrytis group cv Snowball 42"

Appendix 1 cont'd. Seed presented to P.R.C.

Vegetable Collections Sent to P.R.C. by Orton After Return of U.S.

Species	Cultivar or Selection No.
To: Crop Germplasm Resources Institute, Beijing	
Apium graveolens var. dulce (Celery)	Florida 683 Tendercrisp Florida 2-14 Tall Utah 52-70HK Tall Utah 52-70R
Brassica oleracea (broccoli)	Topper
(cauliflower)	339 Imperial 10-6
"	Snowball Y
(cabbage)	Greenback Y.R.
"	Buderich
"	Vienna
"	Marion Market
Capsicum annum (pepper)	Yolo Wonder I Yolo Wonder L 80Y54 Miss Belle
Cucumis melo (melon)	Crenshaw Honeydew Cantaloupe
Cucumis sativus (cucumber)	Poinsett 76 Marketmore 76
Lactuca sativa (lettuce)	Salinas
Lycopersicon esculentum (tomato)	VFN8 Florida MH-1 Tropic VF 65-4 "Rin" mutant "Nor" mutant
Lycopersicon cheesmanii	LA 1449-73L1902-1 LA 317-73L1893-2 LA 166-73L18792-2
Lycopersicon chilense	LA 458-73L2068-1
Lycopersicon hirsutum	LA 1392-71L1548-1 LA 1223-72L2136-1
Lycopersicon parviflorum	LA 1326-72L-1
Lycopersicon chmielewski	LA 1306-71L1537-1

Appendix 1. cont'd. Seed presented to P.R.C.

Species	Cultivar or Selection No.
Lycopersicon peruvianum	LA 111-76L1782-1783 LA 1292-72L2129-1 LA 385-75L2156-1
Lycopersicon pimpinellifolium	LA 722-73L1922-1
Phaseolus vulgaris (snapbean)	CV Stringless Blue Lake
Solanum melongena (eggplant)	CV Midnite CV Gator CV Viserba
Solanum pennellii (wild tomato)	LA 716-73L578-5
Triticum aestivum	cv Black-hulled early cv Black-hulled extra early cv Black-hulled estra extra early

To Institute of Vegetables, Chinese Academy of Agricultural Sciences, Beijing

Apium graveolens var *dulce* (celery)	Florida 683 Tendercrisp Florida 2-14 Tall Utah 52-70HK Tall Utah 52-70R
Brassica oleracea (broccoli)	Topper
(cauliflower)	339 Imperial 10-6
"	Snowball Y
(cabbage)	Greenback Y.R.
"	Buderich
"	Vienna
"	Marion Market
Capsicum annum (pepper)	Yolo Wonder I Yolo Wonder L 80Y54 Miss Belle
Cucumis melo (melon)	Crenshaw Honeydew Cantaloupe
Cucumis sativus (cucumber)	Poinsett 76 Marketmore 76
Lactuca sativa (lettuce)	Salinas
Lycopersicon esculentum (tomato)	VFN8 Florida MH-1 Tropic VF 65-4 "Rin" mutant "Nor" mutant

Appendix 1 cont'd. Seed presented to P.R.C.

Species	Cultivar or Selection No.
Lycopersicon cheesmannii	LA 1449-73L1902-1 LA 317-73L1893-2 LA 166-73L1892-2
Lycopersicon chilense	LA 458-73L2068-1
Lycopersicon hirsutum	LA 1392-71L1548-1 LA 1223-72L2136-1
Lycopersicon parviflorum	LA 1326-72L-1
Lycopersicon chmielewski	LA 1306-71L1537-1
Lycopersicon peruvianum	LA 111-76L1782-1783 LA 1292-72L2129-1 LA 385-75L2156-1
Lycopersicon pimpinellifolium	LA 722-73L1922-1
Phaseolus vulgaris (snap bean)	Stringless Blue Lake
Solanum melongena (egg plant)	Midnite Gator Viserba
Solanum pennellii (wild tomato)	LA716-73L578-5

To Mr. Jiao Le Shao Bu, Farm Leader, Vegetable Commune, Xilinhot, Inner Mongolia

Apium graveolens (celery)	Tall Utah 52-70R Tall Utah 52-70HK Tendercrisp
Capsicum annum (pepper)	Yolo Wonder L Yolo Wonder I
Cucumis sativus (cucumber)	Marketmore 76 Poinsett 76
Lycopersicon esculentum (tomato)	VF65-4 VFN-8
Solanum melongena (eggplant)	Viserba Midnite
Phaseolus vulgaris (bean)	Stringless Blue Lake

Appendix 1 cont'd. Seed presented to P.R.C.

Species	Cultivar or Selection No.
To: Mr. Zhao Qing-Yan, Dept. of Vegetables, College of Agriculture, Hohhot, Inner Montolia	
Capsicum annuum (pepper)	Yolo Wonder L Yolo Wonder I 80Y51 Miss Belle
Cucumis sativus (cucumber)	Poinsett 76 Marketmore 76
Lycopersicon esculentum (tomato)	VFN 8 VF65-4 "Rin" Mutant "Nor" Mutant
Solanum melongena (eggplant)	Midnite Gator Viserba
To: Mrs. Yi Weu-Gui, Lanzhou Municipal Institute of Agriculture and Fruit Trees Lanzhou, Gansu	
Apium graveolens (celery)	CV Tall Utah 52-70HK
Capsicum annuum (pepper)	CV Yolo Wonder L CV Yolo Wonder Y 80Y51
Cucumis melo (melon)	CV Honeydew CV Cantaloupe CV Crenshaw
Cucumis sativus (cucumber)	CV Poinsett 76 CV Marketmore 76
Lactuca sativa (lettuce)	CV Salinas
Lycopersicon esculentum (tomato)	CV VFN-8 CV Tropic CV Florida MH-1
Lycopersicon chmielewskii	TGC-LA 1306-71L1537-1
Lycopersicon peruvianum	TGC-LA111-76L1782-1783 TGC-LA1292-72L2129-1 TGC-LA385-75L2156-1
Lycopersicon pimpinellifolium	TGC-LA722-73 L1922-1
Lycopersicon cheesmanii	TGC-LA1449-73L1902-1 TGC-LA317-73L1893-2 TGC-LA166-73L1892-2

Appendix 1 cont'd. Seed presented to P.R.C..

Species	Cultivar or Selection No.
Lycopersicon chilense	TGC-LA458-73L2068-1
Lycopersicon hirsutum	TGC-LA1392-71L1548-1 TGC-LA1223-72L2136-1
Lycopersicon parviflorum	TGC-LA1326-72L1-12
Solanum melongena (eggplant)	CV Midnite CV Gator CV Viserba
Solanum pennellii (wild tomato)	TGC-LA 1306 71L1537-1

Mr. Lin Cheng, Dept. of Vegetables, August 1 College of Agriculture, Urumqi, X

Capsicum annum (pepper)	CV Yolo Wonder I CV Miss Belle CV Yolo Wonder Y
Lycopersicon esculentum (tomato)	CV Tropic CV Florida MH-1 CV VFN-8 CV VF65-4 "Rin" Mutant "Nor" Mutant

Mr. Shen Yian-Sung, Laboratory of Vegetables, Institute of Horticulture, Shanghai Academy of Agricultural Sciences

Apium graveolens (celery).	CV Tendercrisp CV Tall Utah 52-70R CV Florida 683 CV Florida 2-14
Brassica oleracea (cabbage)	CV Marion Market CV Vienna CV Buderich CV Greenback Y.R.
Capsicum annuum (pepper)	CV Miss Belle CV Yolo Wonder L CV Yolo Wonder I CV 80Y51
Lycopersicon esculentum (tomato)	CV VF65-4 CV Tropic CV Florida MH-1 CV VFN-8

Appendix 1 cont'd. Seed presented to P.R.C.

Species	Cultivar or Selection No.
Mr. Zhao Hua-Lun, Institute of Vegetables, Jiangsu Academy of Agriculture, Jiangsu	
Lycopersicon esculentum (tomato)	CV VFN-8 CV VF65-4
Capsicum annuum (pepper)	CV Miss Belle CV Yolo Wonder L
Professor Cao Sho-Hao, Dept. of Horticulture, Nanjing Agricultural College, Nanjing, Jiangsu	
Lycopersicon esculentum (tomato)	CV Tropic CV Florida MH-1
Lycopersicon cheesmanii	TGC-LA1449-73L1902-1 TGC-LA317-73L1893-2 TGC-LA166-73L1892-2
Lycopersicon chilense	TGC-LA458-73L2068-1
Lycopersicon hirsutun	TGC-LA1392-71L1548-1 TGC-LA1223-72L2136-1
Lycopersicon parviflorum	TGC-LA1326-72L-1
Lycopersicon chmielewski	TGC-LA1306-71L1537-1
Lycopersicon peruvianum	TGC-LA111-76L1782-1783 TGC-LA1292-72L2129-1 TGC-LA385-75L2156-1
Lycopersicon pimpinellifolium	TGC-LA722-73L1922-1
Solanum pennellii (wild potato)	LA716-73L578-5

Appendix 2. Germplasm obtained from the P.R.C. by the U.S. 1980 Germplasm Delegation.

FORAGES (Dewey)

Collection No.	Species	Source and Notes
D-2501	Agropyron tsukushiense? (Roegneria)	Roadside near Narita International Hotel, Narita, Japan. Caespitose, culms to 60 cm. 24 July 1980
D-2502	A. tsukushiense? (Roegneria)	Same location as D-2501. Caespitose, culms to 75 cm, arched spikes, awned lemmas. 24 July 1980.
D-2503	A. ciliare? (Roegneria)	Roadside near Friendship Hotel, Beijing, China. Caespitose, culms to 80 cm. Self-fertile. 27 July 1980
D-2504	Elymus	50 km N Beijing toward Great Wall. Low mountains. Caespitose, culms to 100 cm, straight awns to 1.5 cm. Similar to E. glaucus. 27 July 1980
D-2505	Elymus sibiricus?	Same site as D-2504. Caespitose, culms to 60 cm. Drooping spike. 27 July 1980.
D-2506	E. dahuricus?	60 km N Beijing toward Great Wall. 700 m. Caespitose, culms to 75 cm, Dense unilateral spike. 27 July 1980
D-2507	E. dahuricus?	Along Great Wall 70 km N Beijing. Caespitose, culms to 100 cm, robust plants, straight awns. 27 July 1980.
D-2508	E. dahuricus?	Same site as D-2507. Caespitose, culms to 125 cm. Spreading awns to 2 cm. 27 July 1980.
D-2509	A. yezoense? (Roegneria)	Same site as D-2507. Caespitose, fine culms, slender spikes, straight awns. 27 July 1980.
D-2510	E. dasystachys? (Leymus)	Ditchbank at Vegetable Commune, Xilinhot, Inner Mongolia. Strong rhizomes. 29 July 1980.
D-2511	E. dasystachys (Leymus)	Same site as D-2510, 900 m. Rhizomatous culms to 125 cm. 29 July 1980.
D-2512	E. dasystachys (Leymus)	Same site as D-2510, Rhizomatous, culms to 100 cm, purplish spikes. 29 July 198

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Source and Notes
D-2513	E. dahuricus	Ditchbank at Grassland Institute, Xilinhot, 900 m. Caespitose, culms to 125 cm, dense spike. 29 July 1980.
D-2514	E. sibiricus	Same site as D-2513. Caespitose, culms to 100 cm. Drooping spikes. 29 July 1980.
D-2515	E. sibiricus	Same site as D-2513. Caespitose, culms to 115 cm. Pendulous, purplish spikes. 29 July 1980.
D-2516	E. dasystachys (Leymus)	5 km NE Xilinhot, native prairie, 920 m. Rhizomatous, dense spikes. 30 July 1980.
D-2517	E. chinensis (Leymus)	7 km NE Xilinhot, native prairie, Rhizomatous, culms to 60 cm, slender spikes, single spikelets. Dominant species. 30 July 1980.
D-2518	A. cristatum s. lat.	Same site as D-2517. Dense spikes, pubescent spikelets. 30 July 1980.
D-2519	Medicago or Trigonella?	Same site as D-2517. Prostrate, purple flowers, flat pods. 30 July 1980.
D-2520	Bromus inermis	22 km NE Xilinhot, native prairie, 1,010 m. Typical. 30 July 1980.
D-2521	E. chinensis (Leymus)	Same site as D-2520. Rhizomatous, narrow spikes, single spikelets. 30 July 1980.
D-2522	A. cristatum s. lat.	Same site as D-2520. 30 July 1980.
D-2523	E. chinensis (Leymus)	42 km NE Xilinhot, native prairie, 1,000 m. Rhizomatous, culms to 60 cm. Narrow spikes, single spikelets. 30 July 1980.
D-2524	E. sibiricus	In temple courtyard, 100 km NE Xilinhot, 1,000 m. Typical. 30 July 1980.
D-2525	E. dasystachys (Leymus)	Same site as D-2524. Rhizomatous, culms to 125 cm, dense spikes. 30 July 1980.
D-2526	Medicago falcata	Same site as D-2524. Typical, yellow flowered. 30 July 1980.
D-2527	Astragalus adsurgens	Same site as D-2524. Culms to 60 cm, dense inflorescence. Immature seed. 30 July 1980.
D-2528	Agropyron cristatum s. lat.	90 km NE Xilinhot, native prairie. Dense spikes, pubescent lemmas. 30 July 1980.

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Source and Notes
D-2529	E. dasystachys (Leymus)	62 km NE Xilinhot, native prairie 1,010 m. Rhizomatous, culms to 1,000 cm, blue leaves. Dense spikes. 30 July 1980.
D-2530	A. mongolicum?	10 km NE Xilinhot, native prairies. Narrow spike. 30 July 1980
D-2531	Bromus inermis	Forage plots of Animal Husbandry Institute, Hohhot, Inner Mongolia. Presented by Mrs. Na Sen. Originally from Inner Mongolia. 31 July 1980.
D-2532	Bromus inermis	Same site as D-2531. Originally from Wuwei, Gansu Prov. 31 July 1980.
D-2533	Elymus sibiricus	Same site as D-2531. Originally from Shandan, Gansu Prov. 31 July 1980.
D-2534	E. sibiricus	Same site as D-2531. Originally from Inner Mongolia. 31 July 1980.
D-2535	A. cristatum	Same site as D-2531. Originally from Inner Mongolia. 31 July 1980.
D-2536	E. dahuricus	Same site as D-2531. Originally from Inner Mongolia. 31 July 1980.
D-2537	E. dahuricus	Same site as D-2531. Originally from Inner Mongolia. 31 July 1980.
D-2538	Medicago sativa	Same site as D-2531. Originally from Inner Mongolia. 31 July 1980.
D-2539	M. falcata	Same site as D-2531. Originally from Inner Mongolia. 31 July 1980.
D-2540	E. dasystachys (Leymus)	Same site as D-2531. Culms to 150 cm tall. Originally from Inner Mongolia. 31 July 1980.
D-2541	E. chinensis (Leymus)	Same site as D-2531. Originally from Inner Mongolia. 31 July 1980.
D-2542	A. cristatum	Field plots of College of Agriculture, Hohhot, Inner Mongolia. Originally from western Inner Mongolia. 1 August 1980.
D-2543	E. nutans?	Same site as D-2542. Originally from Gansu Prov. Slender pendulous spikes. 1 August 1980.

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Source and Notes
D-2544	A. sibiricum or A. mongolicum	Same site as D-2542. Origin unknown. Narrow spikes. 1 August 1980.
D-2545	Trifolium lupinaster	Same site as D-2542. Originally from Inner Mongolia. Red blossoms. Over winters in Hohhot. 1 August 1980.
D-2546	E. sibiricus	Same site as D-2542. Originally from Shandan, Gansu Prov. 1 August 1980.
D-2547	E. excelus?	Same site as D-2542. Originally from Inner Mongolia. Very robust, culms to 180 cm, like a large strain of E. dahuricus. 1 August 1980.
D-2548	Agropyron sp. (Roegneria)	Same site as D-2542. Originally from Qinghai Prov. Caespitose, culms to 90 cm, like Japanese Agropyron. 1 August 1980.
D-2549	Hordeum brevisubulatum?	Same site as D-2542. Origin unknown. Slender spikes, culms to 80 cm. 1 August 1980.
D-2550	M. sativa X M. falcata	Same site as D-2542. Yellow flowered. F_6 or F_7 generation. 1 August 1980.
D-2551	M. sativa X M. falcata	Same site as D-2542. Purple flowered. F_6 or F_7. 1 August 1980.
D-2552	Bromus inermis	Same site as D-2542. Originally from Zhangbei, Hebei Prov. 1 August 1980.
D-2553	A. sibiricum	Same site as D-2542. Originally from Ningxia Prov. Narrow spikes. 1 August 1980
D-2554	A. cristatum	Seeds presented by Grassland Research Institute, Xilinhot, Inner Mongolia. Origin unknown. 31 July 1980.
D-2555	A. mongolicum	Same source as D-2554, 31 July 1980.
D-2556	E. sibiricus	Same source as D-2554, 31 July 1980.
D-2557	E. dahuricus	Same source as D-2554, 31 July 1980.
D-2558	E. chinensis (Leymus)	Same source as D-2554, 31 July 1980.
D-2559	Hordeum bogdanii	Same source as D-2554, 31 July 1980.
D-2560	H. brevisubulatum	Same source as D-2554, 31 July 1980.

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Source and Notes
D-2561	A. cristatum	Steep slope on 5-SpringsMountain on south outskirts of Lanzhou, Gansu Prov. 1,600 m. Short compact spikes like Fairway. 3 August 1980.
D-2562	Psathyrostachys sp.	Same site as D-2561. Caespitose, culms to 80 cm, fragile rachis, multiple spikelets An early maturing grass. Only lower spikelets intact on 3 August 1980.
D-2563	E. dasystachys (Leymus)	Same site as D-2561. 1,650 m. Strong rhizomes. 3 August 1980.
D-2564	E. dasytachys (Leymus)	Same site as D-2561. Strong rhizomes, bronze chaff. 3 August 1980.
D-2565	A. cristatum	Same site as D-2561. 1,740 m. Sod forming, 1,000 growing. Good grass for erosion control. 3 August 1980.
D-2566	E. dasystachys (Leymus)	Same site as D-2561. 1,750 m. Rhizomatous, culms to 130 cm.
D-2567	Elymus sp.	Same site as D-2561. 1,600 m, near pagoda. Slender arched spikes, caespitose. 3 August 1980.
D-2568	A. turczaninovii? (Roegneria)	Along ditchbank at Cereal-Vegetable Research Institute, Lanzhou, Gansu Prov. 1,500 m. Caespitose, awns to 2 cm. 4 August 1980.
D-2569	E. dahuricus	Same site as D-2568. Caespitose, slender spikes. 4 August 1980.
D-2570	H. bogdanii	Forage plots of Cereal-Vegetable Research Institute, Lanzhou, Gansu Prov. Probably introduced. 4 August 1980.
D-2571	A. turczaninovii? (Roegneria)	Same site as D-2568. 4 August 1980.
D-2572	E. dahuricus?	Same site as D-2568. Late maturing. 4 August 1980.
D-2573	E. dasystachys (Leymus)	Same site as D-2568. Blue leaves, strong rhizomes. 4 August 1980.
D-2574	Agrostis alba	Same site as D-2568. 4 August 1980.

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Source and Notes
D-2575	*H. bogdanii*?	On roadside in front of Friendship Hotel. Lanzhou, Gansu Prov. Very small slender spikes. 4 August 1980.
D-2576	*E. dahuricus*?	Same site as D-2575. Spikes more slender than typical. 4 August 1980.
D-2577	*E. sibiricus*	From the grounds of University of Lanzhou. Typical. 5 August 1980.
D-2578	*A. turczaninovii*	Same site as D-2577. Caespitose, arched spikes, awned. 5 August 1980.
D-2579	*E. dasystachys* (*Leymus*)	Same site as D-2577. Typical. 5 August 198
D-2580	*E. sibiricus*	From a sod transplant graden at the University of Lanzhou. Sod came originally from Qi Lien Mountains ca 500 km NW of Lanzhou, alpine meadow 4,300 m. 5 August 1980.
D-2581	*E. nutans*	Same site as D-2580. Similar to *E. sibiricus* but with single spikelets. 5 August 1980.
D-2582	*E. nutans*	Same site as D-2580. Similar to *E. sibiricus* but with mixed single and double spikelets. 5 August 1980.
D-2583	*Elymus* hybrid?	Same site as D-2580. Slender bronze spikes with 2 spikelets per node. Sterile. 5 August 1980.
D-2584	*Elymus* sp.	Same site as D-2580. Dense unilateral spikes, double spikelets, large glumes. 5 August 1980.
D-2585	*Elymus* sp.	Same site as D-2580. Caespitose, culms to 100 cm. Arched spikes, double spikelets, very short awns. 5 August 1980.
D-2586	*Agropyron* sp. (*Roegneria*)	Same site as D-2580. Caespitose, culms to 30 cm, pendulous spikes, distant spikelets, awns to 2 cm. 5 August 1980.
D-2587	*Poa pratensis*	Same site as D-2580. Typical. 5 August 1980.
D-2588	*Agropyron* (*Roegneria*)	Same site as D-2580. Culms to 75 cm, erect spikes, awnless, many florets = 1 spikelet 5 August 1980.

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Source and Notes
D-2589	Elymus sp.	Same site as D-2580. Culms to 80 cm, arched spikes, bronze chaff, awns to 2 cm. 5 August 1980.
D-2590	(An umbelliferae given to T. J. Orton)	
D-2591	Elymus sp.	Same site as D-2580. Culms to 100 cm, dense spikes, large glumes, bronze chaff. 5 August 1980.
D-2592	Elymus sp.	Same site as D-2580. Culms to 70 cm, bronze chaff. 5 August 1980.
D-2593	Agropyron sp. (Elytrigia?)	Same site as D-2580. Slender erect spikes, distant spikelets, awns. Resembles A. spicatum. 6 August 1980.
D-2594	Elymus sp.	Same site as D-2580. Similar to E. sibiricus but without awns.
D-2595	Agropyron (Roegneria)	Same site as D-2580. Pendulous spikes, distant spikelets, awns to 5 cm. 6 August 1980.
D-2596	Elymus	Same site as D-2580. Culms to 130 cm, slender erect spikes, short awns. 6 August 1980.
D-2597	Elymus dasystachys (Leymus)	White Tower Park at North outskirts of Lanzhou, Gansu Prov. 1,700 m. Typical. 6 August 1980.
D-2598	Medicago sativa	Same site as D-2597. Purple flowers. 6 August 1980.
D-2599	Elymus dahuricus	Same site as D-2597. Typical. 6 August 1980.
D-2600	Gramineae	Mileage marker 13 km on road from Lanzhou to Yellow River Dam. 1,940 m. Coarse, caespitose, culms to 130 cm. Unpalatable. 7 August 1980.
D-2601	Agropyron sp. (Roegneria)	Same site as D-2600. Culms to 70 cm, slender spikes, awns to 1.5 cm. 7 August 1980.
D-2602	Elymus	Same site as D-2600. Caespitose, similar to E. dahuricus but with slender spikes. 7 August 1980.

A

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Source and Notes
D-2603	*E. dahuricus*	Mileage marker 17 km on road from Lanzhou to Yellow River Dam. 2,100 m. Typical. 7 August 1980.
D-2604	*Agropyron* (*Roegneria*)	Same site as D-2603. Caespitose, slender spikes, distant spikelets.
D-2605	*Hedysarum*	Same site as D-2603. Semi-woody perennial, culms to 30 cm. 7 August 1980.
D-2606	*Agropyron* sp. (*Roegneria*)	Mileage marker 23 km on road from Lanzhou to Yellow River Dam, 2,350 m. Purple semi-dense spikes, awned. 7 August 1980.
D-2607	*E. dasystachys*? (*Leymus*)	Same site as D-2606. Appears to be self-fertile?
D-2608	*Lathyrus* sp.	Same site as D-2606. Rare. 7 August 1980.
D-2609	*Elymus dahuricus*	Yellow River Dam 60 km SW of Lanznou,1,650 m
D-2610	*Melilotus officinalis* and *M. alba*	At Yellow River Dam, 60 km SW of Lanzhou, Gansu Prov. 7 August 1980.
D-2611	*Medicago sativa*	Same site as D-2610. Growing in a marijuana patch. 7 August 1980.
D-2612	*Agropyron* sp. (*Roegneria*)	Mileage marker 24 km on road between Lanzhou and Yellow River Dam, 2,300 m. Purple, erect, slender spikes with awns. 7 August 1980.
D-2613	*E. dasystachys*? (*Leymus*)	Mileage marker 23 km on road between Lanzhou and Yellow River Dam, 2,300 m. Typical. Self-fertile? 7 August 1980.
D-2614	*Brachypodium* sp.	Mileage marker 18 km on road between Lanzhou and Yellow River Dam, 2,200 m. Drooping spikes, light-green flat leaves. 7 August 1980.
D-2615	*Agropyron* sp. (*Roegneria*)	Same site as D-2614. Slender purple spikes with awns. 7 August 1980.
D-2616	*E. dahuricus*?	Same site as D-2614. Large coarse spikes. 7 August 1980.
D-2617	*Hedysarum* sp.	Same site as D-2614. Woody perennial. Very common. 7 August 1980.
D-2618	Iris sp.	Same site as D-2614. Leaves to 20 cm long and culms to 50 cm. 7 August 1980.

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Source and Notes
D-2619	*Elymus sibiricus*	Near Friendship Hotel, Lanzhou Gansu Prov.
D-2620	*Trifolium fragiferum*	Roadside 15 km W of Urumqi, Xinjiang Prov. on road to Stone River City. Wet area. 8 August 1980.
D-2621	*Agropyron* sp. (*Elytrigia*)	Roadside 97 km W of Urumqi toward Stone River City 550 m. Spike like *A. ferganense*. 8 August 1980
D-2622	*Elymus ramosus*? (*Leymus*)	Same site as D-2621. Rhizomatous, one spikelet per node. 8 August 1980.
D-2623	*E. dahuricus*	Near guest house on Stone River State Farm ca 150 km W of Urumqi, Xinjiang Prov. 500 m. 8 August 1980.
D-2624	*A. repens*?	Same site as D-2623. Very small spikes. 8 August 1980.
D-2625	*Medicago sativa*	Same site as D-2623. Purple flowers. 8 August 1980.
D-2626	*E. dahuricus*?	Same site as D-2623. Culms to 90 cm, very narrow spikes, awns to 1.5 cm. 8 August 1980.
D-2627	*Melilotus alba*	Same site as D-2623. Typical, 8 August 1980.
D-2628	*E. dahuricus*	General Farm #145 Stone River City ca 150 km W of Urumqi, Xinjiang Prov. 400 m. Typical. 9 August 1980.
D-2629	*E. dasystachys* (*Leymus*)	Same site as D-2628. Typical. 9 August 1980.
D-2630	*E. dahuricus*	Same site as D-2628, wet meadow. Purple spikes. 9 August 1980.
D-2631	*Hordeum bogdanii*	Same site as D-2628. Wet meadow, typical. 9 August 1980.
D-2632	*E. angustus* (*Leymus*)	Same site as D-2628. Saline site. Culms to 150 cm, slender spikes. 9 August 1980.
D-2633	*Festuca arundinacea*?	Same site as D-2628. Wet meadow. 9 August 19[illegible]
D-2634	*A. loliodes*? (*Elytrigia*)	In a tree planting 104 km W of Urumqi toward Stone River. Xinjiang Prov. 530 m. Rhizomatous, slender spikes. 9 August 1980.
D-2635	*Lotus* sp.	Same site as D-2634. 9 August 1980.
D-2636	*E. dahuricus*?	Same site as D-2634. Culms to 150 cm. 9 August 1980.

Appendix 2 cont'd. Seed obtained from P.R.C

A

Collection No.	Species	Source and Notes
D-2637	E. angustus (Leymus)	40 km. SE of Urumqi toward Turfan, Xinjiang Prov. Heavy poorly drained soil 1,050 m. Narrow spikes. Large population. 10 August 1980.
D-2638	E. angustus (Leymus)	Same site as D-2637. Exceptionally robust. 10 August 1980.
D-2639	E. angustus	Same site as D-2637. Along a railroad track. Narrow leaves and small spikes. 10 August 1980
D-2640	H. bogdanii	Same site as D-2637. Along an irrigation ditch. Typical. 10 August 1980.
D-2641	E. nutans?	Same site as D-2637. Along an irrigation ditch. Pendulous spikes. Without awns. 10 August 1980.
D-2642	E. nutans	Same site as D-2637. Along an irrigation ditch. Pendulous spikes with awns to 2 cm. 10 August 1980.
D-2643	A. loliodes (Elytrigia)	80 km SE of Urumqi toward Turfan, Xinjiang Prov. In a cultivated valley bottom, 1,050 m. Rhizomatous, slender spikes, large glumes. 10 August 1980.
D-2644	Astragalus sp.	Same site as D-2643. Rhizomatous? Prostrate. 10 August 1980.
D-2645	Medicago sativa	Same site as D-2643. Purple flowers. 10 August 1980.
D-2646	E. dasystachys (Leymus)	Same site as D-2643. Bronze spikes, strong rhizomes. 10 August 1980.
D-2647	E. dahuricus	Same site as D-2643. Purple spikes. 10 August 1980.
D-2648	E. angustus (Leymus)	Same site as D-2643. Narrow spikes. 10 August 1980.
D-2649	E. dasystachys	85 km SE of Urumqi toward Turfan, Xinjiang Prov. 1,050 m. Rhizomatous, large brown spikes. 11 August 1980.
D-2650	Astragalus sp.	Same site as D-2649. Prostrate stems to 1 meter long. 11 August 1980.
D-2651	Agropyron loliodes	Same site as D-2649. Rhizomatous, culms to 75 cm, small spikes. 11 August 1980.

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Source and Notes
D-2652	E. angustus (Leymus)	On shores of a salt lake ca 85 km SE of Urumqi toward Turfun, Xinjiang Prov. Typical. 11 August 1980.
D-2653	E. dasystachys (Leymus)	Same site as D-2652. Strong rhizomes, brown spikes. 10 August 1980.
D-2654	E. angustus (Leymus)	Dry hillside S of Urumqi toward South Mountain Grassland. 1,200 m. Typical. 12 August 1980.
D-2655	Medicago falcata	North-facing slope on South Mountain Grassland 60 km S of Urumqi, Xinjiang 2,050 m. Yellow flowers. 12 August 1980.
D-2656	Vicia sp.	Same site as D-2655, 12 August 1980.
D-2657	Astragalus sp.	Same site as D-2655, 12 August 1980.
D-2658	Trifolium repens	Same site as D-2655, 12 August 1980.
D-2659	E. dahuricus?	On open meadow at South Mountain Grassland, 2,100 m. 60 km S Urumqi, Xinjiang Prov. Short spikes and culms. 12 August 1980.
D-2660	Agropyron sp. (Roegneria)	Same site as D-2659. Dark purple or reddish spikes, curved awns to 3 cm, distant spikelets. 12 August 1980.
D-2661	E. nutans?	Same site as D-2659. Purple, pendulous spikes; single and double spikelets. 12 August 1980.
D-2662	Dactylis glomerata	Same site as D-2659. Typical. 12 August 1980.
D-2663	Agropyron sp.	South-facing slope at South Mountain Grassland, 2,000 m, 60 km S of Urumqi, Xinjiang. Caespitose, drooping spike, curved awns, small glumes. 12 August 1980.
D-2664	Agropyron sp. (Roegneria)	Same site as D-2663. Dense spike, mucronate, large glumes. 12 August 1980.
D-2665	Bromus inermis	Same site as D-2663. Typical. 12 August 1980.
D-2666	Onobrychis sp.	Same site as D-2663. 12 August 1980.
D-2667	A. cristatum	Same site as D-2663. Dense short spikes, pubescent. 12 August 1980.
D-2668	E. junceus	Forage test nursery of the Xinjiang Grassland Institute on South Mountain Grassland. 2,000 m Xinjiang. 12 August 1980.

A Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Source and Notes
D-2669	E. nutans	Same site as D-2668. Culms to 150 cm, large drooping spikes. 12 August 1980.
D-2670	Agropyron (Roegneria)	Same site as D-2668. Caespitose. Culms to 150 cm, reddish-purple spikes, awns to 3 cm. 12 August 1980.
D-2671	A. trachycaulum? (Roegneria)	Same site as D-2668. Culms to 125 cm, awnless. large glumes. 12 August 1980.
D-2672	Festuca arundinacea	Same site as D-2668. Typical. 12 August 1980.
D-2673	Dactylis glomerata	Same site as D-2668. Very robust, culms to 150 cm. 12 August 1980.
D-2674	E. multicaulis (Leymus)	Red Flag vegetable commune at the outskirts of Urumqi, Xinjiang. Rhizomatous, wide green leaves, bronze spikes. 13 August 1980.
D-2675	Medicago sativa	Experimental plots August 1st Agricultural College. Purple flowered. Native to China. 13 August 1980.
D-2676	Trifolium sp.	Same site as D-2675. Red flowers, elongated head. Native to China. 13 August 1980.
D-2677	Astragalus?	Same site as D-2675. Inflated pod. Native to China. 13 August 1980.
D-2678	A. caninum? (Roegneria)	Same site as D-2675. Culms to 120 cm, awns to 2 cm. Native to China. 13 August 1980.
D-2679	Medicago sativa	Same site as D-2675. Purple flowers. Bulk of several plots. 14 August 1980.
D-2680	Agropyron sp. (Elytrigia)	In rugged hills adjacent to Tian Lake ca 100 km E of Urumqi, Xinjiang. In mountains at 1,850 m. Looks like A. spicatum. 14 August 198
D-2681	E. dahuricus	Same site as D-2680. Near lake shore. Very robust. 14 August 1980.
D-2682	Poa pratensis	Same site as D-2680. Near lake short. Culms to 75 cm. 14 August 1980.
D-2683	E. nutans?	Same site as D-2680, near lake shore. Culms to 130 cm. 14 August 1980.
D-2684	Elymus	Same site as D-2680. Near lake short. Culms to 140 cm, unilateral spikes, mixed single and double spikelets. 14 August 1980.
-2685	E. nutans?	Same site as D-2680. Near a stream at 1,770 m. Purple pendulous spikes. 14 August 1980.

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Source and Notes
D-2686	A. caninum (Roegneria)	Same site as D-2680. Near a stream at 1,770 m. Typical. 14 August 1980.
D-2687	A. caninum	Same site as D-2680. On a dry shrubby hillside at 1,740 m. Culms to 125 cm, very large purple glumes. 14 August 1980.
D-2688	Medicago falcata	Same site as D-2680 on a dry shrubby hillside at 1,740 m. Yellow flowers. 14 August 1980.
D-2689	Cornus sp.	Same site as D-2680. On a stream at 1,720 m. Small tree. Ornamental value? 14 August 1980.
D-2690	Elymus sp.	In guest-hotel compound (about a 40-acre fenced area) on the outskirts of Urumqi, Xinjiang Straw-colored curved spike, awns to 1 cm. 14 August 1980.
D-2691	E. sibiricus	Same site as D-2690. Typical. 14 August 1980
D-2692	Elymus sp.	Same site as D-2690. Arched spike, awns less than 1 cm. 14 August 1980.
D-2693	E. dahuricus	Same site as D-2690. Robust plants. 14 August 1980.
D-2694	E. multicaulis (Leymus)	Same site as D-2690. Rhizomatous, bronze spikes. 14 August 1980.
D-2695	E. ramosus? (Leymus)	Same site as D-2690.
D-2696	E. angustus (Leymus)	Same site as D-2690, on dry sandy soil. Typical. 14 August 1980.
D-2697	E. junceus (Psathyrostachys)	Same site as D-2690, dry sandy soil. Typical. Bulk of many plants. 14 August 1980.
D-2698	A. loliodes? (Elytrigia)	Same site as D-2690. Rhizomatous, small spike narrow leaves. 14 August 1980.
D-2699	A. loliodes?	Same site as D-2690. Rhizomatous, small spikes, very fertile. 14 August 1980.
D-2700	Poa pratensis	Same site as D-2690. Typical. 14 August 1980.
D-2701	Bromus inermis	Same site as D-2690. Typical. 14 August 1980.
D-2702	Medicago sativa	Same site as D-2690. Purple flowers. 14 August 1980.
D-2703	Medicago sativa	Same site as D-2690. Fine leaves. 14 August 1980.

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Source and Notes
D-2704	*Astragalus* sp.	Same site as D-2690. Rhizomatous. 14 August 1980.
D-2705	*Melilotus officinalis*	Same site as D-2690. Mixed yellow and white flowered. 14 August 1980.
D-2706	A. *kamoji* (*Roegneria*)	Near Nanjing Botanical Garden. 30 m. Culms to 100 cm and awns to 3 cm.
D-2707	*Medicago sativa*	Presented by General Farm #145 at Stone River City ca 150 km W. of Urumqi. Cultivated variety. 8 August 1980.
D-2708	*Agropyron* sp. (*Roegneria*)	Near Tian Lake ca 100 km E. Urumqi, Xinjiang 1,850 m. Culms to 75 cm, broad glumes, awnless. 14 August 1980.

Appendix 2 cont'd. Seed obtained from P.R.C.

CEREALS (Sunderman and Thompson)

Collection No.	Species	Selection and Source
PI 447277	*Avena sativa*	A0001, Grassland Institute, Xilinhot, Inner Mongolia
PI 447278	" "	A0002 " " "
PI 447279	" "	A0004
PI 447280	" "	A0007 " " "
PI 447281	" "	A0008 " " "
PI 447282	" "	A0010 " " "
PI 447283	" "	A0012 " " "
PI 447284	" "	A0014 " " "
PI 447285	" "	A0015 " " "
PI 447286	" "	A0016 " " "
PI 447287	" "	A0017 " " "
PI 447288	" "	A0041 " " "
PI 447289	" "	A0056 " " "
PI 447290	" "	A0058 " " "
PI 447291	" "	A0121 " " "
PI 447292	" "	A0145 " " "
PI 447293	" "	Ma li ta ba er. College of Agriculture, Hohhot, Inner Mongolia
PI 447294	" "	Xi le na " "
PI 447272	Avena nuda	A0146, Grassland Institute, Xilinhot, Inner Mongolia
PI 447273	" "	Forage oat, Animal Husbandry Institute, Hohhot, Inner Mongolia
PI 447274	" "	Chih chi tiaò mai, College of Agriculture Hohhot, Inner Mongolia
PI 447275	" "	Hua bei no. 2 " " "
PI 447276	" "	Yung 492 " " "

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Selection and Source
PI 447295	*Avena sativa*	Forage oat, Stone River Farm, Xinjiang Prov
PI 447296	" "	Urumqi, Xinjiang Province
PI 447297	" "	" "
PI 447298	*Avena fatua*	Cereal-Vegetable Institute, Lanzhou, Gansu Prov.
PI 447299	" "	Wild, S. W. Lanzhou. Liu Family Power Dam - Gansu Province
PI 447300	*Hordeum vulgare*	Research plots, Grassland Institute Xilinhot, Inner Mongolia
PI 447301	" "	Research plots, College of Agriculture, Hohhot, Inner Mongolia
PI 447302	" "	Railway Platform, Gantang Ningxia Prov.
PI 447303	" "	" " "
PI 447304	" "	Wheat field 24 km W. Lanzhou, Gansu Prov.
PI 447305	" "	" " "
PI 447306	" "	" " "
PI 447307	" "	" " "
PI 447308	" "	" " "
PI 447310	" "	" " "
PI 447311	" "	" " "
PI 447312	" "	" " "
PI 447313	" "	" " "
PI 447309	*Hordeum vulgare*	Garden area, Liu Family Power Dam, Gansu Prov.
PI 447314	" "	" " "
PI 447315	" "	Threshing Group, Airport Road, Lanzhou, Gansu Province
PI 447316	" "	Field Collection " "

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Selection and Source
PI 447317	*Hordeum vulgare*	Field Collection, Airport Road, Lanzhou, Gansu Province
PI 447318	" "	" " "
PI 447319	" "	Wheat field, 40 km E Urumqi, Xinjiang Prov.
PI 447320	" "	" " "
PI 447321	" "	" " "
PI 447322	" "	" " "
PI 447323	" "	Research Plot, South Mountain Xinjiang Prov
PI 447324	" "	" " "
PI 447325	" "	" " "
PI 447326	" "	" " "
PI 447327	" "	" " "
PI 447328	" "	" " "
PI 447329	" "	Huocheng, Academy of Science, Urumqi, Xinjiang Province
PI 447330	" "	Huotian " "
PI 447331	" "	Tacheng " "
PI 447332	" "	Changji " "
PI 447333	" "	Shawan " "
PI 447334	" "	Ili " "
PI 447335	" "	Tsao " "
PI 447336	" "	Che No. 114 Yaun ma " "
PI 435108	" "	Jing Xuan no. 4 Duplicate from Nat'l Acad. Sci.
PI 390915	" "	Peking #15 " " "
PI 414599	" "	" " " " "
ST-77	*Secale*	75 km N. Urumgi, Xinjiang Province
PI 447338	*Triticum aestivum*	42 km NE Xilinhot, Inner Mongolia
PI 447339	" "	60 km " "
PI 447340	" "	Mung Za, College of Agriculture, Hohhot, Inner Mongolia

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species		Selection and Source
PI 447341	Triticum	aestivum	Railway platform, Gan Tang Ningxia Prov.
PI 447342	"	"	Kan Ming No. 8, Gansu Agric. Univ. Ga
PI 447343	"	"	Gansu Spring No. 11 "
PI 447344	"	"	Gansu Spring No. 12 " "
PI 447345	"	"	Local Variety " "
PI 447346	"	"	Gan Mai No. 6, Gansu Agricultural Academy Gansu Province
PI 447347	"	"	Gan Mai No. 19 " " "
PI 447348	"	"	Gan Mai No. 24 " " "
PI 447349	"	"	Gan Mai No. 33 " " "
PI 447350	"	"	Lung Chun No. 1 " " "
PI 447351	"	"	Lung Chun No. 2 " " "
PI 447352	"	"	Lung Chun No. 5 " " "
PI 447353	"	"	Lung Chun No. 6 " " "
PI 447354	"	"	Lung Chun No. 7 " " "
PI 447355	"	"	Collected-field, 24 km W Lanzhou Gansu Prov
PI 447356	"	"	" " " "
PI 447357	"	"	" " " "
PI 447358	"	"	" " " "
PI 447359	"	"	" " " "
PI 447360	"	"	" " " "
PI 447361	"	"	" " " "
PI 447362	"	"	" " " "
PI 447363	"	"	" " " "
PI 447364	"	"	" " " "
PI 447365	"	"	Garden area Liu Family Power Dam Gansu Pr
PI 447366	"	"	Collected field W of Lanzhou Gansu Prov.
PI 447367	"	"	" " "

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species		Selection and Source
PI 447368	*Triticum*	*aestivum*	75 km NW Urumqi Xinjiang Province, Russian #8
PI 447369	"	"	Xinjiang No. 2, 75 km NW Urumqi Xinjiang Prov
PI 447370	"	"	Field Collection, 40 km " "
PI 447371	"	"	" " " "
PI 447372	"	"	" " " "
PI 447373	"	"	" " " "
PI 447374	"	"	" " " "
PI 447375	"	"	Big Head Field Collection 80 km E Urumqi Xinjiang Prov
PI 447376	"	"	Field Collection 80 km E Urumqi Xinjiang Prov
PI 447377	"	"	Big Head Field Collection 80 km E Urumqi Xinjiang Prov.
PI 447378	"	"	Xin dong no. 3, Stone River State Farm Xinjiang Province
PI 447379	"	"	Xin dong no. 2, " "
PI 447380	"	"	Kashigaer baipi, Urumqi Xinjiang Prov. Academy of Science
PI 447381	"	"	Hami 85 " " "
PI 447382	"	"	Ili chun #2 " " "
PI 447383	"	"	Ili chun #1 " " "
PI 447384	"	"	Xin chun #1 " " "
PI 447385	"	"	Qitai chun #4 " " "
PI 447386	"	"	Turpan shan yueh huang chun ma. Urumqi Xinjiang Prov. Academy of Science
PI 447387	"	"	Toksun Spring #1, Academy of Sci., Xinjiang Prov.
PI 447388	"	"	Toksun Spring #2 " "
PI 447389	"	"	Changji bai dong mai " "
PI 447390	"	"	Turpan bai dong mai " "
PI 447391	"	"	Kuerle dong mai " "
PI 447392	"	"	Kuerle bali basi " "

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species		Selection and Source			
PI 447393	*Triticum*	*aestivum*	Kashigaer bakefuke,	Urumqi Academy of Sci. Xinjiang Province		
PI 447394	"	"	Xin dong #1	"	"	
PI 447395	"	"	Xin dong #2	"	"	
PI 447396	"	"	Xin dong #3	"	"	
PI 447397	"	"	Xin dong #4	"	"	
PI 447398	"	"	Xin dong #5	"	"	
PI 447399	"	"	Xin dong #6	"	"	
PI 447400	"	"	Xin dong #7	"	"	
PI 447401	"	"	Xin dong #11	"	"	
PI 447402	"	"	Cai zi huang	Shanghai Academy of Agricultur		
PI 447403	"	"	Wan nian #2	"	"	"
PI 447404	"	"	Yang mai #1	"	"	"
PI 447405	"	"	Fu mai #3	"	"	"
PI 447406	"	"	Xiao bai mai,	Crop Germplasm Resources Inst. Beijing		
PI 447407	"	"	79-4187	"	"	"
PI 447408	"	"	79-4090	"	"	"
PI 447409	"	"	Jingai no. 7	"	"	"
PI 447410	"	"	Dian xi yang mai	"	"	"
PI 447411	"	"	79-3174	"	"	"
PI 447413	"	"	79-4164	"	"	"
PI 447412	"	"	79-4045	"	"	"
PI 447414	"	"	79-4141	"	"	"
PI 447415	"	"	79-2249	"	"	"
PI 447416	"	"	Beijing 18	"	"	"
PI 447417	"	"	Bei lu mai (Yan 1369)"	"	"	
PI 447418	"	"	79-4189	"	"	"
PI 447419	"	"	6303	"	"	"
PI 447420	"	"	79-4138	"	"	"

Appendix 2 cont'd. Seed obtained from P.R.C.

Collection No.	Species	Selection and Source
PI 447421	Triticum durum	Introduction from Xinjiang, Wheat Institute c Lanzhou, Gansu Province
PI 447422	" "	Field Collection, 24 km W Lanzhou, Gansu Prov
ST-99	*Zea mays*	Presented by Stone River Farm, Xinjiang Prov.
ST-100	" "	" "
ST-101	" "	" "
ST-102	*Glycine max*	Soybeans " "
ST-103	" "	" "

Seeds Received from P.R. C. after return to U.S.

Species	Cultivar	Source
Hongtutou	*Triticum aestivum* (spring)	Gansu Bureau of Agriculture Lanzhou, Gansu
Hongduanmong	" "	" "
Baitutou	" "	" "
Hong guangtou	" "	" "
Honghuamai	" "	" "
Dulihuang	*Hordeum vulgare* (naked)	" "

Appendix 2 cont'd. Seed obtained from P.R.C.

VEGETABLES (Orton)

Donor Institution or Collecting Site	Species
Institute of Vegetables CAAS, Beijing	Apium graveolens var. dulce local OP (2 lines) Solanum melongena (eggplant; globular type)
Crop Germplasm Resources Institute CAAS, Beijing	Beta vulgaris (sugarbeet, 2 lines)
Field collected, Beijing Area	Apium graveolens var. dulce Daucus carota (wild), wild unidentified cruciferae
Vegetable Commune Xilinhot, Inner Mongolia	Allium sp. (leek), Brassica oleracea var. capitata (local), Allium sativa, Cucumis sativus, Lycopersicon esculentum, Brassica campestris (turnip), Raphanus sativa, Apium graveolens var. dulce, Capsicum annuum (green bell), Brassica pekinensis
Field collected in Xilinhot Area	Brassica (cult. oilseed) (2 lines), Angelica archangelica (6 lines), Daucus carota (wild), wild unknown cruciferae
Dept. of Vegetables College of Agriculture Hohhot, Inner Mongolia	Solanum melongena "Precious Stone" local, Lycopersicon esculentum cv. 224 local Apium graveolens var. dulce local Cucumis sativus Tientsin #3 Capsicum annuum intro. Shanghai Capsicum annuum Local Raphanus sativa intro. Beijing Spinacea oleracea Vigna sinensis yard-long bean
Field collected in Hohhot Area	Angelica archangelica Raphanus sativa escape cultivated
Municipal Institute of Agriculture, Lanzhou, Ganzu	Brassica napus: vegetable rape (local) Petroselinium crispum: spice parsley Raphanus sativa: globular, large radish with green skin and flesh
Provincial Institute of Agriculture, Lanzhou, Ganzu	Brassica oleracea var. capitata: large headed cabbage (local) Brassica oleracea var. capitata: small headed cabbage (local) Apium graveolens var. dulce: local Lanchow Apium graveolens var. dulce: Gansu Prov. Apium graveolens var. dulce: South China Cucurbita pepo: red squash Amaranthus tricolor: Vegetable Amaranth
Field collected in Lanzhou Area	Linum sp. wild flax, Brassica sp. oilseed type (2 lines), Angelica archangelica (2 lines), Pisum sativum cultivated, Daucus carota wild, Brassica sp. (wild) 2 lines

Appendix 2 cont'd. Seed obtained from P.R.C.

Donor Institution or Collecting Site	Species
Institute of Horticulture	Capsicum annuum: "Local" sweet hot gr[illegible] ell type
Provincial Acad. Agric.	Capsicum annuum: Long hot red bre[illegible] i[illegible] [illegible]estern
Urumqi, Xinjiang	Sinkiang, Phaseolus vulgaris: "Loca[illegible]"
	Solancum melongena: "Local" long fruited
State Farm #145	Lycopersicon esculentum: "Local",
Stone River, Xinjiang	Brassica oleracea: small cabbage "Local",
	Brassica sp. oilseed type (?),
	Cucumis sativus: "Local"
	Solanum melongena: "Local"
	Capsicum annuum: Sweet green bell "Local"
	Capsicum annuum: Long hot red fresh "Local"
	Capsicum annuum: Hot drying "Local"
	Apium graveolens var. dulce
Red Flag Commune	Capsicum annuum: "Tientsin long hot red"
Turfan, Xinjiang	Capsicum annuum: "Local: Green Sweet Bell
	Solanum melongena: "Local"
	Lycopersicon esculentum: "Local"
Field collected in Xinjiang	Brassica sp. cult. oilseed types (7 lines)
	Brassica sp. wild (9 lines)
	Unknown Cruciferae
	Daucus carota: cult. yellow root
	Daucus carota: wild
	Phaseolus vulgaris: cult. green bean
	Vigna sinensis: cult. cowpea
	Allium cepa: cult bunching type
	Allium cepa (?) wild onion
	Apium sp. wild (?)
	Unknown umbelliferae (3 lines)
	Pisum sativum wild
	Peucedanium sp. wild
Laboratory of Vegetables	Vigna sinensis cowpea "Red Beak"
Institute of Horticulture	Vigna sinensis cowpea "Eel"
Shanghai Acad. Agric.	Phaseolus vulgaris "local" French bean
	Lycopersicon esculentum "Pou Hang #1
	Lycopersicon esculentum "Pou Hang #2"
	Brassica campestris (chinensis group)
	Brassica campestris (pekinensis group)
	Brassica oleracea (capitata group) F_1 hybrid of local x introduced inbreds
	Brassica oleracea (capitata group) "local" OP variety
	Brassica oleracea (Botrytis group) "local" OP variety

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