

THE BIRMINGHAM UNIVERSITY PLANT COLLECTING EXPEDITION TO
MEXICO AND CENTRAL AMERICA

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"The houses of the Indians were all supplied with maize, beans and potatoes, rounded tubers which are planted and which produce a stem with branches and leaves, and occasionally some pale purple flowers; and the roots of this said plant, which is two feet high, are produced under the earth, about the size of an egg, some round and others elongated; they are white, purple or yellow, floury roots of good flavour, a very acceptable gift for the Indians and a delicacy even for the Spaniards."

Juan de Castellanos: *Historia del Nuevo Reino de Granada*. Written ca. 1570-1601. Published Madrid, 1886.

Thus wrote the sixteenth-century chronicler of one phase of the Spanish conquest of the New World, and since his time this plant, the potato, which was previously unknown in Europe, has become a staple article of diet far beyond its original home. Yet the more widespread and the more uniform a food plant becomes, the easier it is for disease to spread through it. The history of the potato bears this out. Innumerable varieties were bred from only a few plants brought from South America, all rather similar to each other and all highly susceptible to disease.

By the mid-nineteenth century, when the potato had taken its place as a European food crop, farmers and scientists were saying that it needed "new blood" from the wild forms in its original home to "rejuvenate" it. Hardier, more resistant stocks were needed to prevent a recurrence of such disasters as the Irish potato famine of the 1840s.

This seemed simple enough, but many difficulties arose when attempts were made to collect the original wild potato and hybridise it with our domestic varieties. Instead of one ancestral wild species in South America, it was found eventually that about 120 wild and eight cultivated species existed. Early attempts at using wild species in crossing with our domestic varieties made use of ones that were not particularly disease resistant, were not closely related

to the cultivated forms and did not cross easily with them. Indeed, we knew very little about the wild and primitive cultivated potatoes of South America from the point of view of disease resistance until about thirty years ago.

We know now that the Indians of South America cultivated potatoes in their remote mountain valleys many centuries before Europeans came there. Wild potatoes had spread over a very large area, from Colorado in the U.S.A. to the region of Chiloé in southern Chile. They have been found in the pampas of Argentina, Uruguay and Brazil, and in the high mountain peaks at altitudes of 14,000 ft. in Peru and Bolivia. Resistance to different diseases has been found in various species and is sometimes localised in certain well-defined areas, though frequently there seems to be no regular distribution pattern at all. Many collecting expeditions were needed to help us build up a picture of the geographical pattern in which genes conferring disease resistance are found. We know, for example, that the best area for resistance to late blight (*Phytophthora infestans*) is Mexico; resistance to insect-transmitted viruses was found to be localised in Mexico and the south-west U.S.A. on the one hand and Argentina on the other. But resistance to non-insect-transmitted viruses was found to be scattered apparently at random in many different species and in all kinds of regions.

From the potato breeder's point of view Mexico is of great importance, and several collectors have sent back living material for testing at plant breeding stations in Europe and elsewhere. Despite this, our interest in the potatoes of that country is by no means exhausted, since a number of species have not been fully investigated, while others have remained almost unknown. Adequate collections had not been made in the south-western U.S.A., nor to the south of Mexico in the Central American isthmus, before our expedition.

Mexico and the adjacent regions are also of considerable interest to the botanist as well as the plant

breeder. Studies on the abilities of species to hybridise together showed that in Mexico there were several that would not cross with our cultivated potato at all, and for this and other reasons seemed to be only distantly related to it. This view has recently been confirmed by the results of biochemical (serological) and chromosome studies. It seems likely that wild potatoes (in contrast to cultivated ones) originated in what is now Mexico, and that the remnants of very primitive groups are still to be found there. Some species migrated into South America before the end of the Eocene Age and evolved independently from Oligocene to Pliocene times, when North and South America were separated from each other. Finally, the land bridge was restored in the Pliocene and some species re-migrated from south to north over the Central American isthmus. Here they formed natural hybrids with the species that had remained behind. These more recently formed hybrid species possess a larger number of chromosomes than their parents, and some of them have already been used by the plant breeder with considerable success in crosses with cultivated varieties to produce new blight-resistant sorts.

The above account of potato species evolution is to a large extent a hypothesis, which fits the known facts fairly well. Nevertheless, there are gaps in our knowledge, due principally to the lack of material available in the living state for botanical and cytogenetical research. The Birmingham University Plant Collecting Expedition was designed to try to remedy these gaps by means of detailed collections and observations of the wild species growing in their natural habitats. In addition, we were particularly anxious to have material from Central America to see whether any of it represented relics of the ancient migrations of species from Mexico into South America and *vice versa*.

Plans for the Expedition began in the spring of 1957, some eighteen months before the date of departure. Both the Vice-Chancellor and the late Professor Maskell took a keen interest in this project, and I was given a generous grant from the University Research and Expeditions Fund. Money was also donated by the Royal Society, the Percy Sladen Trust, the Agricultural Research Council, and by plant breeding institutes both in this country and abroad.

By making use of the long vacation, the Christmas vacation, and leave of absence allowed me for the autumn term I was able to stretch the expedition to a period of six months, from July to December inclusive. Since the outward and return journeys total about six weeks, when one has to travel with heavy luggage, no shorter period would have been economical.

An essential item for an expedition of this sort was

a strong vehicle. I finally decided on a Jeep station wagon, which I bought in Denver, Colorado, and planned to motor down through Mexico, Guatemala, Honduras and Nicaragua, selling it in the last-named country at the end of the expedition. In fact, I finally sold it in Guatemala, since the market for used cars was very good there, and the local currency can be changed into dollars without restriction. We motored some 12,000 miles in this Jeep without any trouble, and probably covered several hundred more on foot. The total distance travelled, including the journeys out and back, was something in the region of 25,000 miles.

Expeditions frequently tend to stretch beyond the time limits planned for them. Since we had a strictly limited time available I had to make a rigid timetable beforehand. We got behind our schedule badly at times, but its presence was an incentive to put on speed in other places wherever it was possible.

We were a party of three. One of my two assistants was a recently graduated botanist from this University, Richard Lester, who is now working with me for three years on the material we collected. The other was a Danish botanist, Peter Hjerting, who had collected plants for many years in Argentina and had had considerable experience with wild potatoes.

Leaving by boat from Southampton on 9th July, 1958, we arrived at New York on 16th July and continued by train to Denver. We started from Denver on 25th July in the Jeep, pulling a small trailer and heading south through Colorado, New Mexico and Arizona. We entered Mexico at El Paso (Texas) after about three weeks in the United States. We spent two and a half months in Mexico and one month in Guatemala. We continued by plane to Honduras and Nicaragua, spending only about ten days in each of these small republics and receiving generous help with local transport from the United Fruit Company and F.A.O. scientists working in those areas. Finally we flew from Nicaragua to Jamaica, where we embarked for England, arriving in Plymouth on 4th January, 1959.

The preliminary results of the expedition are most promising, though it will of course not be possible to make a final assessment until several years' work on the material have been accomplished. We made 238 collections of potatoes, belonging to 26 different species, and were able to make a number of collections of each species from different parts of its range so as to be able to assess much more thoroughly its botanical and genetical variability. Five species were collected for the first time in the living state, and it seems probable that we have two completely new ones, as yet undescribed. For each collection we tried to dig up at least 50-60 tubers, since we had to distribute a

portion to two plant breeding stations in Great Britain and to similar institutions in Germany, Sweden, Holland, Denmark and the U.S.A. Thus eight sets of small tubers had to be separated from every sample, and at intervals these were packaged up and sent back by air mail. Field notes and progress reports also had to be typed and sent out, thus making the amount of clerical work in connection with the expedition not inconsiderable.

Besides potatoes we made 90 collections of cacti for the botanic gardens at Kew, Copenhagen and Birmingham and 450 collections of seeds, bulbs, cuttings, orchid tubers, etc., also for the same gardens. These were collected for general botanical and horticultural interest, and it is hoped that at least some of them may not have been grown before and may be valuable for ornamental purposes.

We also made 400 collections of dried plants from certain areas, chiefly in Central America, at the request of the Herbaria of Kew, British Museum, Copenhagen, Stockholm and Chicago. Seeds of beans, sweet peppers and tomatoes were obtained for certain plant breeding stations and seeds from certain families and genera for biochemical analysis in Denmark and the United States.

The total number of collections made was over 1,100, and since up to eight duplicates were made of each sample and most material had to be carefully dried and packed, sorted and registered, we had little time for relaxation or sightseeing. Our daily average of motoring was about 100 miles for the entire period, exclusive of the journeys out and back. We used all the available daylight for collecting and travelling, and most of the evenings for sorting and arranging our material. Sundays were treated as any other day, so that a seven-day week was the general rule. Despite this hard, but very enjoyable, work we kept very fit; apart from a few slight attacks of dysentery none of us suffered from any illness.

Physical dangers were, on the whole, few; rattlesnakes and fierce mongrel dogs were occasional hazards, but luckily none of us was bitten. Probably the worst dangers were the narrow winding mountain roads, often with cliffs above and precipices below. On such a road, where there is width for only one vehicle, the smaller must reverse to a passing point when two come from opposite directions. At other times there is room to pass, only with the outer wheels on the very edge of the road; one edges past the other vehicle, generally a wide bus or lorry, with only centimetres to spare.

Road surfaces were very good in Mexico and the United States, provided one kept to the main highways. Attempts to travel along what were marked on the maps as dry-weather tracks often ended in disaster. The rains were very heavy indeed in Mexico during the summer of 1958, and on several occasions we became stuck in the mud and had to wait for a lorry to pull us out.

Everywhere we met with unfailing kindness and courtesy, not only from scientists and government officials, but also from peasants and farm workers. Since many wild potatoes invade cultivated fields as weeds, the friendliness of the owners of these fields is a very important factor in obtaining good collections. The help of scientists and officials is no less necessary; in many cases they accompanied us on our trips, helped us to look for and dig potatoes and other plants, to obtain customs permits and to send postal packets out of the country. We were also given laboratory and office space when we needed it in which to sort out and dry our material.

We now have several years ahead of us with the less spectacular part of the project, in evaluating the material collected. There are no doubts at all in my mind that the expedition itself was a complete success, and I should like to take this opportunity of thanking all those in the University who gave it their help and support.