

138. German Botanical and Agricultural Expedition to the Andes 1959

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In 1930 the Max-Planck-Institut für Pflanzenzüchtung formerly the Kaiser-Wilhelm-Institut für Pflanzenzüchtung in Müncheberg/Mark, sponsored its first expedition to the gene-centers in South America. This expedition was made by Professor Dr. Erwin Baur, Professor Dr. H. Schick and Dr. K. v. Rosenstiel. Since then the study of the material collected by this expedition has been completed. Several new points of view came to light, and a second expedition was considered necessary to explore further this gene-center so important for many European cultivated plants (see Prof. Rudolf's article: Item 91 in Newsletter No.5).

Thanks to the initiative taken by Prof. Dr. Rudolf, the Ministerium für Landwirtschaft, the Deutsche Forschungsgemeinschaft, and the Max-Planck-Gesellschaft zur Förderung der Wissenschaften recognized the significance of such an expedition and provided its support.

The expedition also aroused the interest of Prof. Dr. Straub, of the Botanical Institute of the University of Cologne, who planned to investigate the chromosome geography of Andean plant species at different altitudes.

Since Vavilov it has been known that the Andean region represents a center of variation for potatoes, tomatoes, beans, and other cultivated plants. Today plant breeders are very much interested in disease resistance. In this Andean gene-center, the plants and their pathogens have been in contact for a long phylogenetic time. It is therefore to be expected that the plant hosts have developed defence mechanisms of great diversity, while correspondingly the pathogens have increased the number of their mechanisms for aggression. It was one of the main purposes of the expedition to find greater resistance, especially to the leaf-roll virus, Phytophthora infestans, Alternaria solani, Actinomyces scabies, Heterodera rostochiensis, Rhizoctonia solani, and Erwinia phytophthora. Moreover, the great number of wild species of Solanum (sect. Tuberosarium), Lupinus and others required an intensive study of their habitat, ecology, and occurrence in specific plant associations. Variation in resistance to a given pathogen must be greatest where the host species occurs in an environment optimal for the growth of the pathogen. Among species where selection has operated in this manner, forms may exist which can withstand the whole range of pathogenic races, because the parasite may have realized all of its mutative possibilities in the original plant population.

Another important aim was to clarify the taxonomy of certain cultivated species. Order in taxonomy is an urgent necessity, not only for general work with wild species, but also for the solution of special problems.

The importance and large number of wild species of Solanum (about 150) corresponds to the number of investigators in this scientific field. There is a great need for living and herbarium material of the wild relatives of many cultivated plants. After elucidation of the cytogenetic relations among the wild species and the cultivated forms, the way is open for the transfer of resistance genes to the cultivars, and for the understanding of how the cultivated forms have originated and developed.

It is not sufficient for the plant breeder to have only one sample of a wild species. It has been found that within a wild species there may exist different forms which exhibit susceptibility as well as variable types of resistance. To have a susceptible form, as well as a resistant one, is advantageous in the investigations on inheritance, because the results of intraspecific crosses can be interpreted more conclusively than those of interspecific crosses.

The section Tuberarium of the genus Solanum is a polyploid series that is well suited for cytotaxonomic studies. Hawkes (see item 92 in Plant Introduction Newsletter No.5) has presented a hypothesis for the relationship of the Mexican species to the South American ones. With sufficient material at hand, it would be worth while to test this hypothesis.

Another task that should not be forgotten is an investigation, from a plant geographic point of view, of the center of origin not only of the tuberous Solanums as a whole but of the different series of that group.

An indispensable restriction was to concentrate our work in the Andean region on Solanum (sect. Tuberarium), Phaseolus, Lupinus and Lycopersicon. Prof. Rudolf made preparations for the expedition while on a trip which took him from Canada, the United States, and Mexico down to Peru, Bolivia and Argentina. He made contact with officials and colleagues and enlisted their help. Later this proved very useful to the success of the expedition.

The expedition itself was made by Dr. H. Ross and Dr. R. Rimpau, both of the Max-Planck-Institut, Köln-Vogelsang, and by Mr. L. Diers, of the Botanical Institute of the University of Cologne. As is the case with any expedition, it was important to find the right vehicle. Because 4-wheel drive was indispensable, as well as sufficient room for 3 or 4 persons and their baggage, the range of choice in Germany was very limited. Correspondence with people in South America revealed that no suitable vehicle was available for the period it was required. We therefore bought a Dodge truck of 3/4 ton capacity, at an auction held by the U.S. Army in Germany, and transferred it to South America after remodelling it.

We reached Buenos Aires on 30 January 1959. After paying visits to several institutes we began the real expedition in Tucuman, accompanied by Dr. Vervoorst of the I.N.T.A. In addition to the Solanums, it was Phaseolus aborigineus which interested us in northern Argentina. The mountains of the Aconquiya, the valleys of the Rio Santa Maria and of Humahuaca, the bolsones, and the beginning of the Puna were the places where we studied plant formations and collected 13 of the approximately 15 Argentinian Solanum species.

After reaching the Bolivian border the expedition split into two, as Mr. Diers had to make sprout tip preparations of as many species as possible of the main plant societies in the Andes, and his best way to work was to stay for some weeks in one place, making excursions to the plant associations nearby. He first went back to Tucuman to work in the Aconquija mountains and then by train without a stop to Cochabamba, where we met again later.

The other part of the expedition went immediately into Bolivia. In this country we were accompanied by Professor Dr. Cardenas and Ing. Agr. Alandia of the University of Cochabamba. Our investigations in the central plateaux and mountain ranges were completed by longer excursions to the eastern borders of the Andes, one trip taking us from Sucre to Monteagudo, the other from Cochabamba to Santa Cruz. In these regions we collected not only Lupinus and Solanums, but also ornamentals such as orchids.

The car did well on the roads which were mostly in bad condition and which we could sometimes use in one direction only on alternate days. Its shortcomings were weak springs and low speed, but a jeep was often put at our disposal by the Interamerican Agricultural Service to which we are indebted in many respects.

Although the year 1959 was not a favourable one for collecting potatoes, we succeeded in getting most of the Bolivian species and made many important observations with regard to their association with special plant formations. It was of great interest to study the relationship of species development and distribution to the agricultural activities of man. Some species seem to accompany man and occur very frequently on the edges of paths, on walls and in cultivated fields among cultivated potatoes, maize and other crops; but we observed as a general trend within nearly all Solanum species that they colonize open places and also occur in sparse formations in quite natural and undisturbed plant societies. It seems that from these places they have invaded man-created habitats because of their natural weakness in competition with other species and because, especially on the Altiplano, the original habitats are largely used for agriculture.

The very interesting plant society of the "Ceja de la montana" was studied near Comarapa and other places. This formation is characterized by high altitude, fog nearly every day and frost in the winter. Here occur the series Conicibaccata and Circaeifolia, which may include species with pronounced resistance to late blight.

Time was devoted to the region of Lake Titicaca, with its widely spread culture of Solanum andigena and other cultivated Solanum species with frost resistance, and we made a large collection of the cultivated forms from this and other regions. During this time, it was observed that not only the cultivated species S. juzezcukii, S. curtilobum and S. ajanhuiri have resistance to frost, but that some forms of S. andigena are also frost resistant. It was also found that virus diseases are very common in Bolivia and Peru, and that the viruses Y and X are particularly prevalent (as shown by the tubers on return to Germany). On all the collecting expeditions we tried to obtain berries, tubers and herbarium specimens, the tubers being sent immediately to Germany by diplomatic channels.

We crossed the Peruvian border at Yunguyo. In Peru we enjoyed the company of Professor Dr. Vargas, Dr. Carrillo (specialist in Lupinus) and Señor Perez and are grateful for the help they gave us. We also have to thank Dr. Vervoorst, Prof. Dr. Cardenas and Ing. Agr. Alandia for their assistance and kindness to us. They did a great deal to make the expedition a success.

Going out from Puno near Lake Titicaca, we first made collections in the Departamentos Tacna, Moquegua and Arequipa, which are situated in southern Peru; we received only a few visits from collectors of Solanum and most parts have not been visited by them at all. We found some interesting species at high altitudes above 4,000 m., and studied the Puna formation of the pass regions of the western Andes. We then went down to the region of the Volcan Misti near the town of Arequipa, and on to Tacna and Moquegua. In these arid formations we were able to study the Solanum species of xerophytic habitats, and it was here that we found our first Lycopersicum species - L. chilense and L. peruvianum.

Back in Puno we took the inter-Andean route to Cuzco through the Altiplano. Abundant splitting off of forms and species of the series Tuberosa, which often have sharply separated zones of distribution, made it evident that the Altiplano is the center of origin of this series. Interesting observations were made concerning the relationship of wild and semi-wild Solanum species and agriculture. Dr. Carrillo, as a specialist in the genus, was very keen on finding and diagnosing species of Lupinus on our excursions.

Starting from Cuzco we visited the famous Urubamba valley with the ancient Inca town Machu-picchu. While the lower part of the valley was fruitful for obtaining wild species of Phaseolus as well as cultivated forms, we found higher up some species of Solanum series Conicibaccata which might be of importance because of their resistance to Phytophthora infestans. 14 collections of Solanum were made between Pisac and Cedrobamba. The expedition moved on via Sicuani to Huancayo, en route crossing several dry hot valleys of the inner part of the Andes which gave us a clear impression of their typical xerophile and mesophile formations. It became evident that the conditions of the mesophile formations are particularly favourable for the development of aphids. It may be assumed that the Solanum species of these formations exhibit some resistance to aphid-transmitted viruses such as the leaf-roll virus and virus Y.

We tried to collect not only wild species of potatoes but also cultivated ones, and a great number of these could be obtained in the markets or directly from the fields. Ing. Carlos Ochoa, whom we met in Huancayo, was kind enough to supply us with many cultivated forms from his collection.

Continuing our journey, we went on to Lima, collecting on the way some interesting species of Lycopersicum in the Rimac Valley. Lima (more specifically the Humboldthaus - a good place for working, and the living quarters of German scientists travelling in Peru) became our temporary headquarters, where we joined up with Mr. Diers again. There followed some excursions to the east-west valleys which lie north of Lima and to Huaraz. Here again we were surprised to find interesting Solanum species, some probably new ones.

After these excursions the car needed some urgent repairs, so we continued our travels by air, and the car was sold in Lima some weeks later. The Agricultural Experiment Station in Piura kindly supplied us with a car to make an excursion to Ayabaca in the northern Peruvian Andes, where we hoped to find species of the little known series Piurana; we found at least two species, including S. piruae. The expedition was concluded with a short trip from Quito in a southerly direction, and in the surroundings of Guayaquil. On 17 May we embarked at Guayaquil, where we joined our luggage which Mr. Diers had put on board in Lima. Mr. Diers followed on 26 July by air.

While it is very interesting for a foreigner to travel in the Andes, it should not be forgotten that living conditions for the inhabitants are hard because of extremes of climate, the isolated situation, and the long distances between centres of civilization. These countries are in no way favoured to develop by themselves and one has to acknowledge the endeavours made by people and government to improve their situation, especially in Bolivia and Peru where we made longer visits.

We would like to say that the officials and other people that we met in the Andes were always very helpful and friendly, and followed our undertaking with great interest.

The following material was brought back:-

	<u>Number of collections</u>
<u>Solanum</u> , wild species	282
<u>Solanum</u> , cultivated forms	550
<u>Phaseolus vulgaris</u>	150
Other <u>Phaseolus</u> species	48
<u>Lupinus</u> species	64
<u>Lycopersicum</u> , wild species	22
<u>Capsicum</u> , cultivated forms	30
<u>Zea mays</u>	56
Cereals	26
Other cultivated plants	52
Ornamentals and plants for chromosome geographic investigations	187
Orchids	40
Mr. Diers' collection	500
Sprout tip preparations of Mr. Diers	1,350

In conclusion, a word should be said about the maintenance of collections. The Max-Planck-Institut has had much experience for many decades in the culture of primitive and wild plant material. In many cases these plants come from regions with climatic conditions differing from those of Europe and it has been found extremely difficult to maintain a collection over long periods. Moreover, it is always difficult to obtain hybrids, and owing to natural climatic selection (including photoperiod) many forms become lost. If the potential value of an expedition is to be realized, prompt attention has to be given to the proper maintenance of collections, and the best way is undoubtedly to make suitable arrangements for this to be done in the regions where the species are native. Since the Andes represent one of the largest gene-centres for so many cultivated plants, we fully realize the importance of a station with similar objectives in the Andean region of South America and support the endeavours of Prof. Dr. Rudolf in this respect.