FLORA OF PAKISTAN

EDITORS:

E. NASIR

National Herbarium (Stewart Collection)
Pakistan Agricultural Research Council,
Islamabad

AND

S. I. ALI

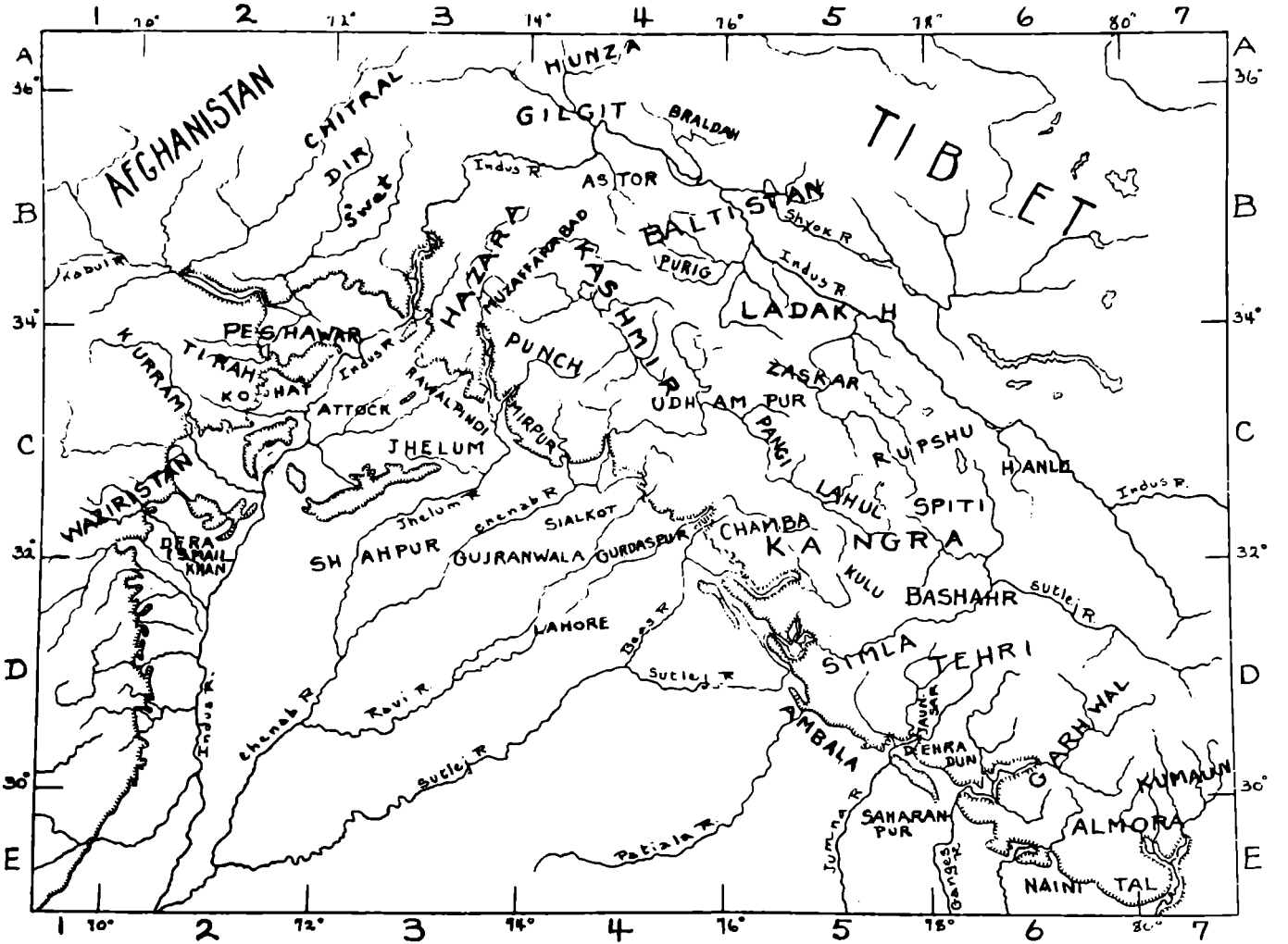
Department of Botany, University of Karachi,
Karachi

HISTORY AND EXPLORATION OF PLANTS IN PAKISTAN AND ADJOINING AREAS

BY

R. R. STEWART
University of Michigan
Ann Arbor, U.S.A.

March, 1982.



Map of Punjab and Adjoining areas

Printed at PanGraphics Ltd., Islamabad.

CONTENTS

ACKNOWLEDGEMENTS

My inspiration for writing a book which would include the history of plant collecting and plant studies in Pakistan and adjacent regions came from I. H. Burkill's "Chapters on the history of botany in India" [In parts, 1963, and book form, published by the Botanical Survey of India (1965)]. Since this book was written I have consulted it hundreds of times and often wished that he had not limited his history to the period up to 1900.

As this book is based on a life-time of work and I have had the privilege of working in many places including India, Pakistan, Great Britain and the U.S.A. and since I have known scores, if not hundreds of people, whose lives have touched mine and provided me with botanical information and aid of some sort or the other, I do not know where to begin and where to end in expressing my gratitude for services received. I am not a self-made man. I have had travel grants and I have had research grants, the latter from the U.S.A, National Science Foundation while working here at the University of Michigan. Since 1962 I have worked fourteen summers at the Royal Botanic Gardens at Kew, with visits to the British Museum and Edinburgh and received help and encouragement everywhere.

As a young student at Columbia University (1907-11) I had scholarships for four years and in 1917 I was given a Cutting Travelling Fellowship which enabled me to collect plants for a year in the Punjab, Chamba and Kashmir. Since 1960, when I retired as Principal Emeritus of Gordon College, Rawalpindi, I have been provided with a place to work in a corner of the fine herbarium of the University of Michigan and enjoyed the friendship and aid of the staff here.

In 1940 I had gone to the U.S.A. on regular furlough and intended to work in the Herbarium of the New York Botanical Garden, naming specimens from India which I had collected in the Himalayas. When the war prevented me from returning to India, Dr. Robbins took me on the staff as Curator of Oriental plants until the way opened for me to return to India in 1944.

Many of those who have cooperated with me and helped me in various ways over the years are no longer living. I enjoyed the cooperation of the staff at Kew for more than 60 years and felt as much at home there as I did at New York or Michigan. Many thanks.

In Pakistan I have enjoyed the friendship of the local botanists since 1911 and those I have known the longest are Dr. Sultan Ahmad of Lahore and Prof. E. Nasir of Rawalpindi. I have a great admiration for the scientific attainments of them both, and appreciate their friendship and help. Prof. Nasir was first my student, then my colleague and then my successor at Gordon College. His work as Joint Editor of the Flora of Pakistan has been outstanding and also his work as Director of the National Herbarium. Dr. S. I. Ali has done a fine piece of work in preparing monographs of all of the genera of the *Leguminosae* and as Joint editor

of the Flora of Pakistan.

I would also like to put on record my appreciation of the great help the authorities at Kew and Edinburgh have been in encouraging the Pakistanis anxious to provide a flora for Pakistan. Mr. Brenan, the Director at Kew, has permitted Mr. Thomas Cope, an agronomist to prepare the Pakistan grass flora and Mr. C. C. Townsend has monographed the *Amaranthaceae*. Messers. B. L. Burtt, Ian Hedge and Miss Jennifer Lamond have encouraged the editors of the Pakistan Flora by reading and editing the fascicles as they are prepared. Their generosity in helping a new, Third World country deserves recognition.

Ralph R. Stewart

The author and the editors are grateful to the United States Department of Agriculture for financing this project under P.L. 480.

FLORA OF PAKISTAN
HISTORY AND EXPLORATION

RALPH R. STEWART*
University of Michigan, Ann Arbor, USA.

Introduction

When we remember that there was no Pakistan until 1947 and that the new country had to start from 'scratch' it is fortunate and very creditable that a flora for the whole country is being produced, having begun on September 22, 1970 with the first fascicle of the flora, *Flacourtiaceae*, by Yasin Nasir. This was issued from the Stewart Herbarium, Gordon College, Rawalpindi under the joint Editorship of Prof. E. Nasir and Dr. S. I. Ali. It is now 1981 and 138 fascicles are in print and have been distributed to the leading herbaria and botanical centres of the world and appreciative reviews have been received from various countries. Specialists and plant geographers are pleased that another country will soon have a flora and that gap in the knowledge of the flora of the world is being filled. Plant geographers are dependent upon such floras for the raw materials they need for the completion of their studies.

The book which botanists have been using for their understanding of the flora of Pakistan as a whole is the "Flora of British India" of Sir Joseph Hooker and collaborators which was begun in 1872 and completed in 1897. The first volume is now more than 100 years old and a tremendous amount of work has been done on the plants of the sub-continent since that time. Hundreds of thousands of additional plant specimens have been collected. A vast amount of literature has been printed. Many new species have been described and some areas which were little known are now well known. As the rules of plant nomenclature used today were unknown in Sir Joseph's time and as numbers of large genera have been divided, a good many of Hooker's names need to be changed. When will it be brought up to date? Before 1947 there were two large herbaria in India. The very old herbarium at Calcutta, founded in 1786 which is said to be the largest in Asia and the herbarium of the Forest Research Institute at Dehra Dun, which was formerly at Saharanpur and specializes in forest botany and the plants of North India. Many collections from the Pakistan area are stored at Dehra Dun. There were no large herbaria in the region which is now Pakistan. When I arrived in India in 1911, the College of Agriculture at Lyallpur had a collection to preserve specimens of agricultural interest and there was a small collection at the Government College, Lahore. The Dehra Dun Herbarium was too far away for me to use and I did not find any one who knew the Punjab Flora from whom I could ask questions until I found the Conservator of Forests in Lahore, Mr. R. N. Parker, who was probably working on his Forest Flora at the time. The first edition was issued in 1918 and I found it very useful. He was the only active taxonomists in North India at the time. Prof. Kashyap of the University at Lahore worked chiefly on liverworts.

* Now at Duarte, California.

In my early years in India my botanical work was teaching and collecting plants during vacations and getting them named at the New York Botanical Garden when I was home in the U.S.A. on furlough. I collected plants in order to create for myself a working collection which I could use in naming plants and to help me in my teaching. I had no idea of providing a herbarium for public use. If one sticks to a collecting hobby of any sort, however, the collection tends to grow from your own collecting, and from gifts and exchanges. Over the years small and large collections from surprising places were given to me after the death of the original collector or after the owner got tired of his collection. A Y.M.C.A. friend gave me his father's collection of New Zealand ferns. An early Director of the Punjab Post and Telegraph Department, E. N. Trotter, had been an avid fern collector between 1885 and 1890. Not only did he have many hundreds of specimens of Indian ferns but he had a good collection of the ferns of Mauritius and Bourbon and of the Island of St. Helena. Many years after he died, an heir gave me his ferns and his books. Herbaria accumulate duplicates and the New York Botanical Garden gave me some valuable Indian duplicates and the Royal Botanic Garden at Kew in England gave me large collection of Indian plants collected by J. F. Duthie of the Botanical Survey of India. I helped a number of foreign plant collectors who came to work in the Himalayas and they gave me duplicates in return. Students and members of staff brought in specimens, as interest tends to be catching. Some perhaps wanted to please the Principal, a position I took over in 1934.

As the college grew in size we started B. Sc. classes in Botany and by offering prizes for the best collections of plants a good many useful specimens were added each year, as students came from all sorts of places. From time to time it becomes important to various people to know the scientific name of plants they had some interest in, especially people interested in medicinal plants. One woman came and said that she had been told that a certain plant named yarrow, was good for asthma. She wanted to see what it looked like. Collectors of medicinal plants came for identification of samples and from time to time a forester or someone interested in agricultural plants needed identifications. A student from Karachi came to study the borages we had in our collections. Without any plans to become a reference centre, Gordon College became one.

In 1960, wnen I was 70, it was time for me to retire to the U.S.A., according to the rules of the society to which I belonged. The problem then arose as to the future of the herbarium I had started which probably amounted to 50,000 specimens. I had no thought of taking it away with me as its greatest use would naturally be in Pakistan. It was not a project of the college as a large herbarium was not needed. One year I had a Cutting travelling fellowship from Columbia University but otherwise I was responsible for the travelling expenses connected with my collecting activities in all parts of Kashmir and Pakistan. Part of the expense was recouped by selling Herbarium specimens and Prof. Nasir and I sold botanical and zoological materials to colleges to use in their practical classes which we or an assistant could collect, as Rawalpindi, at the edge of the hills, was near sources of

supply of most of the materials prescribed by the University for study.

Fortunately for Prof. Nasir and the herbarium, he was now in charge of, the U. S. Department of Agriculture was given the use of blocked funds belonging to the U. S. Government which could be spent in Pakistan but which could not be repatriated. The Agriculture 'Department officials developed a collecting scheme for Pakistan, India, and a number of other countries where there were such funds. The scheme was to make contacts with local scientists providing them with funds which they were to use for sending our plant collectors in order to gather plant materials with a reputation for being useful agriculturally, medicinally or in any other way. A herbarium specimen of each collection with a sample of the fibre, seeds or leaves had to be sent to Beltsville, Maryland for study. Prof. Nasir sent out collectors for five years and made annual reports. No doubt on account of diminishing returns this scheme was brought to an end about 1967 and a new one started.

The new scheme was to provide Pakistan with a flora. In order to implement the plan, Dr. S. I. Ali and Prof. Nasir, appointed as Joint Editors and provided with funds for the work of artists, printing, typing, etc. The editors set to work and, as already mentioned, the first fascicle was published in 1970 and the 139th this year, 1981. Most of the small families have now been published and four large ones, *Umbelliferae* by E. Nasir, *Brassicaceae* by S. M. H. Jafri, *Malvaceae* by Sultanul Abedin and *Papilionaceae* by S. I. Ali. Dr. Thomas Cope of Kew, an agrostologist, has completed work on the grasses and it should soon be published. Estimates of the length of time necessary for such a work are usually less than is required for completion and it will probably take more than five years to complete the flora. One reason for this is that the oil-rich countries have offered such large salaries to the trained Pakistani botanists that most of the best men who have collaborated in preparing the early fascicles have left Pakistan.

In 1975 an important change took place in the management of the Stewart Herbarium. The first 96 fascicles of the Flora of West Pakistan were issued by "E. Nasir, Stewart Herbarium," while No. 97 of Jan. 1976 was published "from National Herbarium (Stewart Collection), Agricultural Research Council, Rawalpindi." The address of the Council is listed now as Islamabad. There is still no Botanical Survey and I wonder how many people in Pakistan know that they have a National Herbarium. This must be the first time a nation has been given a National Herbarium which is largely the work of two men.

What of the future? A National Herbarium should not only have a collection of ferns and flowering plants, but should also be a laboratory for the study of the so-called lower plants. Every country suffers from plant diseases and there should be at least one plant pathologist and a good collection of fungi of all sorts. In the large herbarium at the University of Michigan, where I work, half of the space is given to the collections of fungi, mosses, liverworts, lichens and algae. I only know of one person, Dr. Sultan Ahmad of Lahore, who had done much

collecting of fungi. I have seen fields of oats half ruined by oat smut and if a mycologist could find a kind of oats which is immune to this disease or find a spray, harmless to people, which would kill the parasite, the savings would pay for his salary many times over. The seaweeds, algae, growing in the sea, are not known to most Pakistanis, but in Japan seaweeds are a valuable source of revenue and something might be done along the Sind and Baluchi coasts to develop industries using seaweeds as the Japanese do.

A National Herbarium should not only be a Museum where specimens of a country's plants are stored for study but it should be a centre for the preparation of books and pamphlets for all sorts of people, for gardeners of pretty flowers and of vegetables; also for those who would like to raise and take care of fruit and ornamental trees. The possibilities are endless for books and pamphlets on trees, shrubs and flowers, on water plants fruit trees, poisonous plants, plants for the different zones of the country, on alpine plants, desert plants, ferns, grasses, etc.

When I was last at the Royal Botanic Gardens at Kew a couple of men were at work studying which plants were endangered species and likely to become extinct. When a species becomes extinct its 'germ pool' is lost. Many plants which are of little value in themselves have characteristics of hardihood, quick ripening or ability to fit into a particular niche which is worth preserving. This is an important new field, for with the population explosion, forests are being cut down in order to use the land for plowing. Swamps are drained, deserts are being irrigated, productive fields are being replaced by towns and cities. Other areas are being polluted by industrial wastes and the original flora is destroyed and only some hardy weeds can survive. Number of species of birds and other animals are known to be extinct and others are on the verge of extinction. What about Pakistan? Are there Pakistani plants which are potentially valuable, on the edge of extinction? No one knows. As forests disappear, habitats disappear, and with the habitat plants and animals go. Trained botanists are needed to study such problems which are of practical importance.

When the Pakistan flora is completed and published it will not be the end of systematic work in Pakistan. First drafts of floras are never entirely satisfactory. As soon as they are down in black and white, people notice that this or that has been left out and that someone in Germany or France has demonstrated that a certain *Rosa* or *Viola* has an earlier name that the monographer has missed. My Annotated Catalogue of the plants of Pakistan is only nine years old and already there are scores of names which need to be changed or added.

It should also be pointed out that the forthcoming flora has been prepared in Pakistan and not in London where there are better libraries and large plant collections. In critical cases it is necessary for plant taxonomists to see the 'type' specimens. Few of them are stored in Pakistan. Among the Pakistani plants stored in London, Edinburgh, Dublin, Paris, etc. there are no doubt species which Pakistani monographers have not seen, though the editors have repeatedly visited the

important European herbaria with a view to edit the manuscripts.

Through the very great kindness of Messrs. Burtt and Hedge and Mrs. J. Wood in Edinburgh, most of the manuscripts for this flora have been read before publication and corrected if necessary. I do not know how many specimens have been borrowed from Britain for study but no herbarium can afford to lend all of its material, sending it to distant countries at risk of fire, water and loss through accident or theft. If errors, however, have arisen from not seeing enough material they can be corrected in Edition two or three. A country needs a flora even if it is not perfect, and it looks as though Pakistan will have one, years before India does, although India has had a Botanical Survey with a large staff for many years.

The Joint Editors deserve great credit for producing a flora which does not reveal that the work has been done at two different centres by two sets of people. After ten years the two editors are still in Pakistan at work. Rapid changes of editors would have delayed and flawed the work. It is hoped that both can continue until the work is finished. The U.S. Department of Agriculture deserves credit for their wise choice of editors and for financing so much plant collecting and for the publishing of the flora. Too much, so called aid, given by my country to other nations, has been in the way of bombs and ammunition.

In the first edition of my "Annotated Catalogue of Pakistan" there are 128 pteridophytes, 23 gymnosperms, 1140 monocotyledons and 4492 dicotyledons, a total of 5783 taxa. Within 20 years the total taxa should prove to be at least 6000.

Few countries have the diversity of climate and terrain found in Pakistan. The country is to be found on the map between India and Afghanistan. It stretches from the Arabian Sea on the West to the wilds of Tibet in Central Asia. The average rainfall varies from less than 75 mm a year to 1650 mm and, beginning at sea level, the country rises to 7063 m at K-2 in the Karakorum Mts. Egypt is said to be the creation of the Nile River. It is equally true to say that Pakistan is the creation of the Indus. All of Pakistan is in the watershed of this great river.

Until 1947 there was only one University in Pakistan, the affiliating University of Lahore. Since 1947 Karachi, Sind, Baluchistan, Gomal and Islamabad Universities have been founded. In 1947 the colleges and schools of Sind and Baluchistan were connected with Bombay. Those of the N.W.F.P. and Kashmir were connected with Lahore. The new Universities have done a great deal of collecting in recent years. The chief centres for taxonomic work have been Karachi and Rawalpindi with Lahore taking little interest in taxonomy except for the work of Dr. Sultan Ahmad, the mycologist. Peshawar University has been chiefly interested in the N.W.F.P., especially in Peshawar District and Dir, an area which has only been open for plant exploration in recent years.

What needs to be done? Much more thorough collecting needs to be done. Dr. Hulten in his work on the alpine floras has prepared a little map giving the

distribution of each species. Great Britain and a number of other countries have done or are doing the same thing. Many of our plants have only been reported once or only on a few occasions. There are areas in almost every district which have not been visited in the search for higher plants and when it comes to the cryptograms only the vascular cryptogams have been fairly well collected. Lichens, liverworts, mosses, fungi and algae are largely open, untouched fields. The fleshy fungi are an inviting field I would like to work on if I had another botanical life to live.

In addition the production of literature is a crying need. Books on the flora of Pakistan are needed by people of all sorts from school and college students to the intelligent laymen and visitors from the outside. These books should be illustrated. Books are needed on trees, shrubs and herbs. They are needed for garden lovers and for farmers who need to know more about the plants they are cultivating as well as others that they might want to collect. The field is wide open. At the present time most good botanical text-books come from abroad and naturally foreign species are used as illustrations. It is time that we used local species as illustrations in our text-books.

SIND

Sind is the southernmost of the four provinces of Pakistan. The Arabian Sea and Baluchistan lie to the west and south, the Punjab to the north and the Great Indian desert toward the east and south. Sind lies between 24'and 31′ North and 66.8'and 71′ East. Only Sind and Baluchistan have a sea coast.

Sind is much like Egypt. It is a desert through which a great river flows and the life of the country is as dependent on the water of the Indus River as Egypt is on that of the Nile. Both Sind and Egypt have developed great canal systems. In both countries the cultivated land is a great alluvial plain. That of the Indus in Sind is roughly 70-80 miles each side. There are some dry, rocky hills north of Karachi and along the border with Baluchistan, but most of the country does not rise 200 m. above sea level. The summers are very hot and the winters mild, while in adjacent Baluchistan there is little level land and mountains rise to 3669 m and in most of the country the winters are cold. The total area is 57,114 sq. miles. There are c. 8 million people and more than three million of these live in the port city of Karachi. There are more than ten million irrigated acres and the staple crops are wheat, rice and cotton.

There are areas of desert scrub which are too high to be irrigated from the Indus and there are 1200 sq. miles of riverain forest. *Acacia nilotica* (*arabica*) is the tree most characteristic of lower Sind. *Prosopis spicigera* gives fuel and fodder. Jacobabad in northwestern Sind has the highest temperatures of the sub-

continent, going up to 127° F. The commonest wild trees are *Tamarix*, *Salvadora*, *Acacias*, and *Populus euphratica*. The trees in towns and cities are largely introduced.

The Coast of Sind is low and alluvial. The Indus has a large delta and the water channels change during the summer flood. The water of the delta is brackish and conditions are unhealthful, while Karachi enjoys strong breezes from the sea and is considered to be well situated and healthy. Near the river there are often great grasses up to 12 and even 18 ft. high.

There are tidal mangrove swamps along the Sind Coast but compared with those of the Ganges Delta, the Sind mangroves are stunted. There are also far fewer species than there are in the Sunderbans of Bengal where there are jungles which are dense enough to provide shelter for tigers. Of the seashore plants of Bengal *Avicennia*, *Sonneratia*, *Rhizophora*, *Ceriops* and *Aegiceras* are also found in Sind. *Scaevola* is the only genus of mangroves in Sind which does not occur in Bengal. The rich alluvium above the delta can yield two or even three crops a year. All of the soils, however, are not equally useful for there are saltpetre and waterlogged areas.

The flora of Sind is poor compared with that of the other Pakistan provinces because there are fewer habitats and there is less climatic and altitudinal variation. There is no up-to-date check-list of Sind plants and the floristic list. What I have is swollen by the introduction of a large number of adventives. Recently a copy of the "Flora of Patiala," published in 1978 by the Punjabi University of Patiala by M. Sharma and S. S. Bir was sent to me which I have gone through with a good deal of interest as the area discussed is not far from northern Sind and many of the same species are included. In this flora 1185 species are recorded but only 423 are said to be wild or naturalized. This seems to me to be 'padding' a flora. Hasanain and Obaidur Rahman in their "Plants of Sind and Karachi" list 901 taxa and 94 genera are starred as being introduced. I do not suppose that 500 of the 901 taxa are really wild. There are more than three times that number of wild plants in both Hazara and Rawalpindi Districts.

Sind has few tourist attractions so that while many foreign explorers have done a great deal of work in the Himalayan parts of Pakistan the workers in Sind have been government servants, military and civil, and educators. Not until after the division of India did men living and employed in Sind begin to take an important part in collecting and writing about the Sind flora. Since 1947 most of the work has been done by botanists connected with either the Sind or the Punjab University. Before 1947 the plants collected were deposited in herbaria outside of Sind especially in Bombay, Calcutta, Dehra Dun or Kew in Britain. There is now a growing herbarium at the University of Karachi and much Sind material is available in Islamabad and Peshawar.

As in so many other places it was due to military operations that collectors

found an opportunity to collect Sind plants. When there were military expeditions of any size from E. I. Company days onward, some one was assigned to the task of collecting plants. These military operations were frequently in country which was unknown botanically so that there was curiosity to know what new and potentially useful plants might be growing in the areas the troops were to visit. In the three Trans-Himalayan districts of Kashmir and in Kashmir proper, the first plant collectors were not soldiers or professional botanists while in Sind, Baluchistan, Waziristan, Chitral etc. on the frontier, the first collectors were either army men or civilian servants of government, able to get to the scene of operations through the army organization. If there had not been a First Afghan War of 1839-42 it would probably have been many years later that anyone would have started to collect in Sind, Baluchistan and many places in the N.W.F.P. and in Afghanistan as well. The first collecting in Waziristan was done by J. L. Stewart during the 1860 Waziri Expedition.

In the First Afghan War the British did not attack through the Khyber Pass, the natural route, because the Punjab was ruled by the war-like Sikhs with a strong army led by experienced European officers needing work after the end of the Napoleonic wars. Although the Sikhs were enemies of the Afghans, the British did not think it wise to leave a strong foreign army in their rear. They therefore decided to attack through Sind as the Amirs of Sind, based in Hyderabad, were weak and divided. In 1839 the British Army based in Karachi advanced northward through the Bolan Pass, the only good route. At that time Quetta was only a small village called Shawlkot. The army entered Afghanistan through the Kojack Pass.

The first to do any collecting in Sind was Maj. Nathaniel Vicary (fl. 1832-59), a good amateur botanist who went to Sind in 1838 with his regiment. He at once began to collect in Sind and soon after in the Khyber area. He collected in Sind several times and in 1847 published "Notes on the botany of Sind in Roy. Asiat. Soc. Bengal, 16: 1156-1168". In the same year, teste Jafri, he published "Botany of Sind" in Nat. Hist., 1: 420.

Wm. Griffith (1810-45), Sup't of the Calcutta Botanic Garden, seems to have been the next. Instead of entering Sind at Karachi he entered from Upper Sind. Dr. David Ritchie, I.M.S. (1809-66) was next and they were all collecting at about the same time (1839-40) as their presence was due to the war. The fourth collector who did more work in Sind and Baluchistan than the preceding three was Dr. J. E. Stocks (1822-54) who died while still a young man. Griffith, the second to work in Sind, and the first in much of Afghanistan, was a brilliant botanist and he too died young. He had done important work in Assam and Burma before he travelled cross-country from Calcutta to Sind. He died of malaria.

Stocks was an I.M.S. vaccinator who was assigned to his work in Sind in 1848, after a short period of service in the Bombay Presidency, where he did some good collecting. He collected both in Sind and Baluchistan and in 1853 went to Kew where Bentham was prepared to help him name his plants, but he died the

next year. His plants were not left neglected, the way Falconer's were, but a set was sent to Boissier at Geneva who was at work on his great *Flora Orientalis* (1867-84). He described Stock's plants and later they were cited by Hooker in the "Flora of British India" (1872-97). They are now being cited again by Rechinger in his "Flora Iranica" (1963-).

During the British period which lasted till 1947, Sind was an appendage of Bombay. It was not a separate province. Bombay botanists considered the plants of Sind to belong in the Bombay Presidency and when Cooke published his "Flora of the Bombay Presidency" (1904-09) he included Sind plants and when Talbot (1855-1917?) published his "Forest Flora of Bombay," 2 vols. 1909 & 1911, he did the same.

As early as 1869 Aitchison, who had been doing a great deal of work on the Punjab, published a catalogue of the plants of the two provinces. Bombay collectors travelled widely in Sind. In 1908 Theodore Cooke (1836-1910) published a Bombay Presidency Flora in two large volumes which were reprinted in three volumes with some corrections in 1958 by the Botanical Survey, Calcutta. This is a standard piece of work but without a proper introduction. Collectors' names and collection numbers are listed and the following collectors who collected in Sind are frequently cited, Theodore Cooke, Dr. David Ritchie, I.M.S. (1808-66), W. A. Talbot I.F.S., Bhola Puran, a native collector for Cooke, Major Nathaniel Vicary, George Marshall Woodrow (1846-1911), Bombay Bot. Survey; Dr. John E. Stocks Bombay, Sind and Baluchistan and Nicholas A. Dalzell (1818-78), collector in both Bombay and Sind.

Following Stocks, a number of officials and officers did some collecting including two Commissioners, Sir Bartle Frere and Sir J. E. M. James, Archdeacon Stead of Bombay and his brother-in-law, Capt. W. S. C. Pinwill, a great collector of plants and animals. He collected many sedges which I saw at Kew but he neglected to note accurate locations and only marked Sind on his tickets which is hardly satisfactory. No one else has found some of his species of sedges in Sind and it looks as though some labels are incorrect.

In 1881 J. A. Murray who was in charge of the Karachi Museum published a most useful book which in some ways has not been equalled. He must have been a field man for his plants are not just names. He knew the kind of places in which his plants grew, what the local people used them for, what animals ate them, which were poisonous and what the medicinal plants were supposed to be good for. He described the mangroves, the riverain forests, the plants of the desert plains and those growing on rocky outcrops. He stated that 90% of Sind plants are African and 50% grow in Egypt.

The next botanical period was also led by people in Bombay and for many years the chief student of the botany of Bombay, Sind, Baluchistan and Waziristan was the Rev. Ethelbert Blatter, S.J. (1877-1934), a Swiss who although he was a

large, heavy man did a great deal of field work. He was on the staff of the St. Xavier's college, Bombay. His botanical interests were wide. He usually, if not always, collected with others and his papers were commonly joint papers with colleagues or friends. Those who usually collected with him were Charles McCann of the Bombay Natural History Society, T. S. Sabnis, Economic botanist, Prof. P. F. Hallberg who was at work on two volumes of Kashmir wild flowers when he died in 1924. Joseph Fernandes was another collaborator. The Flora of the Indus Delta by Blatter, McCann and T. S. Sabnis is an important one (1927-29). In this flora he listed 332 taxa of which he considered 279 to be natives. Of these 40 were grasses, 23 legumes, 18 *Compositae*, 13 *Convolvulaceae*, 11 *Euphorbiaceae, Amaranthaceae* and *Cyperaceae*. He noted a poverty of monocots. He stated that 60 taxa were North African and 39 more, Tropical African. He considered 39 to be Old World Tropical, 29 to be Indian, 16 Indo-Malayan and 22 from most warm countries. He thought that 6 might be endemic and the rest may be considered to be miscellaneous.

At this period there was in addition to Sabnis another Indian plant economist, R. K. Bhide of the Poona Agricultural College who collected in Sind c. 1914 (K, NY).

The modern period in Sind began in 1947 when India was divided and Sind became a province of Pakistan. The colleges in Sind had been affiliated with Bombay University but after partition a new University was built outside of Karachi and fortunately the botanists appointed were interested in systematic botany and started a herbarium and began collecting. The first fruit of their labour was Monograph I entitled "Plants of Karachi and Sind" by S. Z. Hasnain and Obaid-ur Rahman, Karachi, 1957. They list 901 taxa.

After partition two promising young botanists from India and both Ph.D.'s of the Universities of London and Edinburgh, moved to Karachi. Dr. S. I. Ali, who is still in Karachi, and Dr. S. M. H. Jafri, who after being head of several Sind colleges, has migrated to Libya. Ali's speciality has been the *Leguminosae* and he has worked on this very large and very important group for many years. He was born in India in 1930 and came to Pakistan after partition as did his friend Jafri. The two have often collected together and both have done a great deal of work in preparing fascicles for the Flora of Pakistan. Jafri's *magnum opus* is his *Brassicaceae* and in addition he has contributed a number of other families to the Pakistan flora. He is now working on a flora for Libya. Since 1970 Ali has been the Joint Editor of the Flora of Pakistan with Prof. Eugene Nasir of Gordon College, Rawalpindi, now incharge of the National Herbarium, Pakistan Agricultural Research Council, Islamabad. The chief Pakistani collectors with Ali and Jafri were M. Qaiser, Abdul Ghafoor, Saida Qaiser, N. E. Qureshi, Khadija Aziz, Sultanul Abedin, Abrar Hussain and S. A. Faruqi.

Unfortunately for the two editors of the Pakistan flora a number of their collaborators have left Pakistan and are now working in oil rich countries. Among

these are Jafri, M. Qaiser, M. A. Siddiqi, S. M. A. Kazmi, and Abdul Ghafoor.

A good deal of collecting in Sind has been done by collectors from Gordon College. My own collecting has not been extensive but I have been to Sind a number of times on scholarship or other work and took the opportunity of doing a little collecting around Karachi. Once about 1956, Dr. J. J. Norris and Dr. W. A. Dick-Peddie, American botanists who were working for a couple of years, 1955-57, at the Tando Jam Agricultural College invited me to join them for a week of collecting in that area and along the road to Karachi. Once while at Karachi I went on a collecting excursion to the Hub River. I do not know which collectors Prof. Nasir sent to Sind or those from Peshawar and Lahore. Asghar Jalis of Tando Jam was a collector and sent plants to me in Rawalpindi.

In writing about the work of S. M. H. Jafri, I failed to mention his book on the Flora of Karachi published in 1966 by the Book Corporation, Karachi. He deals with 403 taxa from the Karachi and delta area of Sind, with keys, illustrations and descriptions.

The flora of Sind may not be a large one compared with the other three Pakistan provinces but it is nevertheless of great interest and there are enough different habitats to provide a number of different floras. The most dintinctive is the mangrove flora of the coastal tidal zone. The second is the hot, dry desert region with sandy soils and a rainfall of 125 to 175 mm a year. The third main area is the central alluvial plain built up by the annual summer floods. This is the fertile area. The fourth is narrow hilly belt adjacent to Baluchistan. There are some lakes in depressions and wet places where the summer flood waters do not drain away after the summer inundation. In such places there is a distinct flora of aquatic or semiaquatic plants of many genera, *Aponogeton, Naias, Potamogeton indicus, perfoliatus* and *pectinatus, Zannichellia, Lemna, Typha angustata, elephantina* and *latifolia, Trapa, Nymphaea, Scirpus* sp., *Cyperus, Schoenus, Marsilea* etc.

There are common desert types on sand, gravel or alkaline patches where *Acacia nilotica, Aerua, Calatropis, Capparis, Grewia, Indigofera, Leptadenia spartium, Lycium, Prosopis, Salvadora, Tamarix, Ziziphus, Asparagus* sp., *Cenchrus, Farsetia, Zygophyllum* etc. are to be found.

Hasanain and Rahman report the following on rocky places on the Sind border, *Cleome* sp., *Abutilon* sp., *Acacia* sp., *Aerua* sp., *Astragalus stocksii, Capparis* sp., *Commiphora mukul, Cordia rothii, Crotolaria burhia, Daemia extensa, Euphorbia caducifolia, Grewia* sp., *Indigofera* sp., *Lycium barbarum, Mimosa hamata, Pavonia* sp., *Prosopis spicigera, Periploca aphylla, Rhazya stricta, Salvadora oleoides, Senra incana, Sida grewioides, Ziziphus rotundifolia*, etc.

Where did this Sind flora come from? Sind is a continuation of the great desert belt which, south of the Mediterranean, stretches clear across North Africa,

Arabia, and Southern Iran to the foot of the Himalayas and then penetrates the Himalayas along the Indus and its great tributaries. Some of these Saharo-Sindian plants are found in the Kashmir Valley at 1600 m. There are many species at Gilgit and some get as far as Ladak. This North African desert flora is also dominant in the great Indian deserts to the south of the Sind and Punjab deserts. This desert type of flora is also to be found in the Punjab plains and foothills but is absent in the temperate and alpine zones of the Himalayas. In Baluchistan it is found along the coastal plain and up to c. 1400 m. In the N.W.F.P. there is no coastal plain but the Saharo-Sindian flora is dominant in the foothill zone.

Sind is so dry that ferns, liverworts, mosses and lichens are not common. Jafri only reports *Equisetum debile* in his Karachi flora. Hasanain does not report any ferns. Jalis reports *Marsilea minuta* and someone else *M. quadrifolia*. Beddome reports *Athyrium hohenackerianum* Kze. He does not mention the collector. Some work has been done on the Sind seaweeds but I do not know of anyone who has worked on the freshwater algae although they must be abundant. Lady Frere collected algae, probably seaweeds which are Kew. I do not think that anyone has written on the Lichens of Sind but Lady Frere collected some in the 1850's. (K) Sultan Ahmad has written one paper on those of Pakistan as a whole. He has done a great deal of work on the fungi of Pakistan as a whole but has not published any papers with Sind in the title. Kazmi in his Bibliography lists a few papers dealing with the soil and coprophilous fungi of Sind which I have not seen and cannot evaluate but my feeling is that the field has hardly been scratched.

Flora of Baluchistan

Baluchistan is found on the map from c. 23° to 31° North and between 61° and 70° East. The Arabian Sea is to the south. Iran lies to the west and then Afghanistan is both to the west and north. Waziristan is to the northeast and Sind to the east

There are four provinces in Pakistan and Baluchistan is much the largest in area but with the smallest population. This is because of the rugged terrain and the severity of the climate. Most of the country is mountainous and in the northeast toward Waziristan there are a number of mountains attaining a height of c. 3350 m (11,000 ft.) and Mt. Zarghun is nearly c. 3660 m high (12,000 ft.) Much of the country is desert, especially toward the west.

There are extremes of temperature. Near Sibi (150 m) we find the highest summer temperatures in Pakistan. Jacobabad, which is in Sind just outside the Baluchi border, has the reputation of being the hottest place on the sub-continent with temperatures rising to 120 F. or even higher. Above 1500 m. the winters

are cold and ice forms at Kalat (1830 m.) and snow lies at Quetta for two months (c. 1700 m). The precipitation may be as low as 25 mm to 75 mm a year and the only area where it is above 250 mm is in the mountains near Waziristan. Sibi may only have 25 mm and Quetta has an average of 225 mm.

The country is so dry and rugged that there are few roads and few perennial streams. Water supplies are scanty, limiting agriculture. There are few natural resources and it is a country of villages rather than cities. The peasantry is largely dependent on their sheep, goats and camels. The temperate region within a radius of 50 or 60 miles or so ot Quetta is the great fruit bearing region. There are minerals and coal in the western deserts and a most valuable gas field at Sui.

Baluchistan is the part of Pakistan with the least influence from the summer monsoon and the climate is much like that of Iran and Afghanistan. The mountains of the northeast link up with those of Waziristan and shield Sind, the Punjab, and India from winter storms from the north.

The only part of the country which attracts visitors from the outside is that around Quetta which is high enough to have a temperate summer climate, though the temperatures may be high during the day. Ziarat, at 2145 m, would be a comfortable place to take a summer vacation. Most of the plant collecting in Baluchistan has been in this region above 1500 m. Visitors can go to Quetta by air. The first time I went to Quetta by rail. It was a hot journey in May from Lahore to Sukkar and then north to Quetta. The railway follows the Bolan Pass route which was followed by the British Army in 1839 on their way to Afghanistan.

In the British period, the mud village of Shawlkot, now Quetta, was made into a cantonment and a Staff College was built there. Being on the railroad it became a centre of the fruit trade. Water is the limiting factor. There is good, level land and underground water but I was told that the water table was falling because of increased pumping from deep wells. Before Quetta became the centre of trade and government, Kalat was the centre, as the Khan of Kalat was the most powerful chieftain in the area and he leased Quetta to the British.

The town of Kalat was ruined in 1935 as was most of Quetta in an earthquake which killed at least 35,000 people. Kalat was rebuilt near the ruined town. It is an interesting place because of the palace of the Khan and a great spring coming out of limestone. It is limestone country and in such regions the drainage is often underground, finally coming out as large springs making an oasis possible. The fertility of the fields and gardens of Kalat is dependent on this spring. Most of the fruit region lies between 1500 and 2000 m. The fruits raised are grapes, melons, pomegranates, figs, mulberries, peaches, apricots, plums, almonds, pears, cherries, apples and quinces. *Elaeagnus angustifolia* is also reported.

The most interesting and distinctive floral region in Baluchistan is called the 'juniper tracts'. Under this head may be included the vegetation from 2000 to

3000 m. and embraces the country round Ziarat, the Pil Range and the Zarghun range near Quetta. The most important and abundant species is *Juniperus macropoda* (*excelsa*). It forms forests of considerable extent, and is usually pure, being rarely mixed with *Pistacia atlantica* var. *cabulica* or with *Fraxinus xanthoxyloides* and only occasionally attains tree size owing to the unmerciful way in which its branches are lopped for feeding sheep and goats and *Celtis caucasica* is treated in the same way. The shrubs are numerous and of these *Prunus eburnea* is perhaps the most abundant. The best place to see these tracts is Ziarat at 2145 m. This is a mini-hill station where the Quaid-e-Azam,Mohammad Ali Jinnah, stayed for some time fighting against tuberculosis. The best time to see the ephemeral spring flora here is from the end of April to early June. I have visited the area twice, the first time May 2-10, 1957, the second time in the beginning of June 1962 and it was already too late for some plants and much had gone to seed. The climate is like that of Iran and Afghanistan in that there is little if any summer rain. At Quetta the most rain is to be expected in February and March. This means that the summer is a hot dry season and a bad time to collect plants. On the other hand in India and parts of Pakistan the life giving rains are due to a summer monsoon which in the Punjab is expected the first week in July and the greenest season is from July into September.

A large number of collectors have visited the Quetta area and using it as a base have toured this corner of the country, visiting such places as Pishin, Mach, Kalat, Urak, Mashlaq, Ziarat, Chaman and Loralai. At about 2000 m, the juniper tracts begin with small straggly trees. The associated flora is composed of many species and is a distinct assemblage of plants I have not seen anywhere else. It is surprising how many Himalayan trees, shrubs and herbs have migrated so far from the Himalayas. Some of them have not been found between Chitral and Baluchistan. Such species should turn up on the Safed Koh Range. How and when did they migrate toward the southwest? Above the junipers on the mountains from perhaps 2745 m, there are many spiny, hassock shaped plants belonging to the *Plumbaginaceae*, especially *Acantholimons*, *Astragalus* and *Onobrychis* of the *Leguminosae* and *Gypsophila* of the *Caryophyllaceae*. Large *Ferulas* and species of *Iris*, *Allium* and tulip are common in this temperate zone. Here the juniper is almost the only tree to supply timber and fuel.

Some might not think of these areas as forests at all. They are not very beautiful and do not look like a Himalayan forest. The trees are too far apart to make a canopy. There is not enough moisture in the soil to provide for many trees per acre. As Quetta and the other towns grow and the demands of the people increase, the wood cutters and their camels have to go further and further for their loads of wood. How long will it last? Junipers grow very slowly.

The first collector to visit Baluchistan was William Griffith (1810-45), Sup't of the East India Company's Botanical Garden at Calcutta. He was probably the ablest of the British botanists but died prematurely of malaria when only 35, after thirteen years of work. In this time he collected 7000 species from Afghanis-

tan to Bhutan in the Eastern Himalayas. He described many new species and did so while they were fresh. To make a good list of what he found in Baluchistan someone must examine his specimens as in his diary few specimens are named to the species and many of his names are obsolete and not used in the Flora of British India. Of some he gave a short Latin diagnosis. He also studied the fish, birds and animals he found by the way. Not knowing the Latin names of the plants he collected he used the vernacular names he was given. Thinking that these names would be a short cut to naming some species, when I began collecting, I looked for them among those Burkill cites in his check-list but without much success.

Griffith crossed into Afghanistan with the Army in 1839 and travelled clear across to the eastern province of Kafiristan. He visited Peshawar twice and crossed the Punjab before returning to India. He enlisted a number of the Army Officers as collectors who were able to visit places he could not. He collected about 1500 Afghan species but died before he could get his plants named. His friend and successor, Dr. John McClelland, published his posthumous papers (Calcutta 1847).

The second botanist to work in Baluchistan was Dr. J. E. Stocks (1822-1854), a doctor who was first sent to Bambay as a vaccinator. He did a good deal of collecting there and then was sent to Sind in 1848. Unlike Griffith,who entered the Quetta area by the Bolan Pass on the east side of the country, Stocks entered Baluchistan from the southwest. Karachi is on the sea coast of Sind and the Las Bela Coast of Baluchistan is only a few miles away. The boundary is the Hub River. He went as far as Shah Bilawal. I have been told that no one knows just where this place is. This part of the country is low, hot, dry and tropical and the flora is entirely different from that of the Quetta area. In the coastal lagoons there are three species of mangroves at the extreme northern edge of their range.

In 1850 Stocks made a longer trip in Baluchistan entering from Sind at Shikarpur, near Sukkar on the Indus. He went to Kalat by the Gundava Pass. He also visited Quetta and Nushki. It is not certain whether he made a third trip or not. In 1853 he took his personal herbarium to Kew, hoping to work on his own collections, but he died in 1854. Stocks was an excellent collector and a set of his plants was sent to Boissier at Geneva, who named and cited these Baluchi species and they were cited again when Hooker's Flora of British India was published. Stocks in 1850 in Kew Jour. Bot. 2: 303-308 wrote a graphic sketch of the Baluchi flora.

Between 1877 and 1880 Drs. O. T. Duke and Hamilton collected and the specimens were sent to Dr. George King at Calcutta. Many of Duke's plants were marked Shawlkot, the old name of Quetta. In 1884-85,Dr. J. E. T. Aitchison, who had been Civil Surgeon at Jhelum in the Punjab and spent two years collecting in the Kurram Valley during the Second Afghan War, 1879-80, was attached to the Afghan Delimitation Commission and collected between Quetta and the Helmand River in Afghanistan. He published his "Botany of the Afghan Delimitation Commission" in Trans. Linn. Soc. (Bot.) 3(1): 1-139. 1888.

Mr. J. H. Lace (1847-1918), who later became Principal of the Forest School at Dehra Dun had been Deputy Conservator of Forests in Baluchistan from 1884 to 1888 and made a good collection. In 1891, assisted by Mr. W. Botting Hemsley of Kew, he published the results of his work. It was entitled "A sketch of the vegetation of British Baluchistan" (J. Linn. Soc. Bot. (Lond.) 28: 288-327). He collected many of his plants from the 'juniper tracts'. The introduction to this paper is excellent. He listed about 700 species.

Lace reported that in the Harnai region *Dalbergia sissoo*, the *shisham*, is found up to c. 1220 m. *Olea ferruginea*, the wild olive is common. There was *Sida rhombifolia* and *Ruellia patula*. At about 1435 m, there were the two *Pistacias, P. khinjuk* and *P. atlantica*. The fruit of the second is edible but small and the trees do not bear every year. The wood is excellent for fuel and there are occasional open groves of this species with thick trunks and rounded heads. There is also a wild form of *Prunus amygdalus*, the almond. *Prunus eburnea* is striking in early spring between 1375-2440 m , with white branches and pink flowers. There are also *Caragana ambigua, Astragalus stocksii, Rhamnus persicus* and *Sageretia. Populus alba* and Mulberry trees are used as a windbreak in the fruit orchards which are also surrounded by high mud walls.

Most of the weeds in cultivated land are the same as those in Hazara or Rawalpindi Dt. A few are different. For example *Hyoscyamus squarrosus* grows along irrigation channels and *Acroptilon repens* and *Centaurea depressa* grow in wheat fields. In the extensive plains of Northern Baluchistan between 1375 and 1600 m., as in the Pishin Valley near Quetta, there are many miles of shrubby *Artemisia herba-alba* and *Haloxylon griffithii*. The rootstocks of these two plants are used for fuel and the branches as fodder for the sheep and goats. In places there is enough of a peculiar sedge, *Carex physodes*, to form a sod. It is remarkable because of its large brown fruiting utricles. *Stocksia brahuica* is the most interesting large shrub to be found on the Maslakh Range. It is large and is related to *Dodonaea*. It is spiny and may be covered with yellowish red, inflated pods. *Ebenus stellata* is a shrubby pea with stems covered with silky hairs. There are 20 species of the genus in Iran but only one in Pakistan. There are endemics in Baluchistan but very few compared with those in the floras of Iran and Afghanistan.

Baluchistan has had a check-list of plants since 1909. It is now 1980 and still few Pakistan districts have one. That Baluchistan has had one is largely due to two men, I. H. Burkill (1870-1965), of the India Forest Service, and R. Hughes-Buller of the Baluchi Forest Service. Burkill does not seem to have done any collecting in our area but he received the packets of plants sent to the Calcutta Herbarium and named them himself or had them named. In the early 1900's Hughes-Buller and Rai Bahadur Jamiat Rai initiated the scheme of providing a Gazeteer for each of the nine Baluchi Districts. The forest staff in each district was required to collect all the specimens they could find along with their vernacular names and data regarding their uses and importance. The specimens along with this information were used by Mr. Burkill in compiling "A Working List of the Flowering Plants of Balu-

chistan" which was printed by the Sup't of Gov't Printing, Calcutta, 1909. It has been reprinted with change of pagination.

There are no descriptions in this book. No vernacular names were found for many species and for others many names were found. The number of species listed by Burkill is 1130 while Lace only had 700. I have been maintaining a personal check-list for a good many years and at the present time it stands at about 1500 and continues to increase. It is surprising how many species can be found in some desert areas. Most new species are found in the largest genera.

Burkill's introduction to his book is very short. I have used it for the history up to 1909 but he does not discuss the different floras or note the commonest species in the different regions. Lace's account, however, is excellent.

The following remarks summarize those of Lace with some of my own added "The hills and plains, for the greater part of the year look brown and barren but are covered in the Spring, from March to May, with a vast number of flowering plants, small for the most part, but many of them brilliantly coloured, thus totally changing the appearance of the country. This flora is remarkably rich in *Cruciferae* compared with the Himalayas, also in the number of the *Astragali* (about 50), which are chiefly spring plants. A marked feature of the vegetation is is the number of spinous plants. The majority of these belong to the *Compositae*. Eleven and a half % of the species belong to this family." The grasses are very numerous, about 232, but a large proportion of them are ephemeral annuals. Some have been introduced. He states that *Andropogon laniger* (*Cymbopogon parkeri*) is most important, covering a great deal of land. Good fodder grass is, he says, not abundant.

Foothill Baluchistan, both on the eastern side at Sibi and on the side toward the Arabian Sea has a flora like that of Sind. In this zone the flora is Saharo-Sindian. Lace states that at Sibi there is a fairly thick jungle of *Prosopis spicigera, Salvadora oleoides* and *Capparis aphylla*. In low-lying areas, subject to floods, there is *Tamarix articulata, T. gallica* and *Populus euphratica*. Among the common shrubs are *Ziziphus nummularia, Calotropis, Acacia jacquemontii, Calligonum polygonoides, Crotolaria burhia, Leptadenia spartium, Taverniera nummularia* and the huge crucifer, *Physorhynchus brahuicus. Alhagi* is also abundant. In land impregnated with salts there are chenopods, such as *Haloxylon, Suaeda* and *Salsola foetida*. The parasite, *Cistanche tubulosa*, grows on *Salvadora* or *Calotropis*. Lace saw only two cultivated trees here, a *Zizyphus* and *Acacia arabica* (*nilotica*). The poisonous *Nerium odorum* grows along streams up to c. 1800 m. It even kills camels. At higher altitudes camels have died from eating *Iris* leaves and *Hertia* bushes (*Othonnopsis*).

From Harnai, c. 915 m , the palm *Nannorrhops* begins to form dense thickets and large quantities of its leaves are used for making mats or ropes. The floor coverings made from the leaves of this plant are called *chatai* mats. This palm

which is usually small but may develop an ascending trunk, grows all along the Afghan frontier and as far as Margalla in Rawalpindi Dt. on limestone. *Phoenix dactylifera*, the date palm is cultivated.

There are few water plants. *Pteridophyta, Bryophyta*, fungi and lichens are not abundant. The following pteridophytes have been reported: *Cystopteris fragilis, Adiantum capillus-veneris, A. incisum, Asplenium viride, A. ruta-muraria, A. pseudo-fontanum, Cheilanthes persica, C. pteridioides, Pteris vittata* and *Equisetum ramosissimum*.

Only a few families of the monocotyledons are well represented. There are only two aroids and two orchids. *Liliaceae*, including the onions, is well represented as are the sedges and grasses. The *Amaryllidaceae* are only represented by *Ixiolirion*. The irises, however, are well represented by eight species. In the Himalayas *Eremurus* of the *Liliaceae* is only represented by one species but in the temperate hills here there are several. They are gregarious, covering many hillsides. Spring plants with bulbs and corms are numerous.

Several families are much more prominent in the Baluchi flora than they are in the Himalayas. They are the *Chenopodiaceae*, the *Cruciferae*, the *Boraginaceae, Zygophyllaceae, Umbelliferae, Plumbaginaceae* and the *Convolvulaceae*. Thorny and prickly plants are more common and in the upper temperate zone there are more hassock plants.

In the spring there are far more beautiful bulbous and tuberous flowers than there are in the Himalayas and they can be seen better because they spring from bare ground and are not hidden among grasses and other vegetation. The species of *Eremurus, Tulipa, Gagea, Iris, Allium, Ixiolirion, Bellevalia, Hyacinthus, Muscari, Bongardia, Leontice, Glaucium, Roemeria* and finally the poppies are showy for a short season. They may not cover the ground as well as the orange coloured California poppies do in the far west of the U. S. A. but they make a brave show. It should be noted that this fine spring flora is western, not Himalayan in origin. Quite a few of the genera just mentioned are not found in the Himalayas. Many of these species are also found in the Kurram Valley.

The *Chenopodiaceae* and the tamarisks are much more numerous and prominent than they are in the Himalayas. Altogether there seem to be about 60 species of the *Chenopodiaceae*. Usually they are uninteresting and weedy in appearance. They have been neglected and there is not enough material in collections. The members of the tamarisk family also need more attention. I found the group difficult to distinguish as well as undercollected.

In 1919-20, E. Blatter, P. F. Hallberg and C. McCann of Bombay published in parts in the Journal of the Indian Botanical Society a paper entitled "Contribution towards a flora of Baluchistan", based on a collection of plants made by Col. J. F. B. Hotson. Many of the plants were from the Makran coast of Baluchistan.

The paper enumerates the plants with their localities. Once when I visited St. Xavier's College I asked about this collection and was surprised to find that Col. Hotson's specimens were still in envelopes and that they had not been mounted.

Before the partition of India in 1947, Sind and Baluchistan were included in Bombay and there was no University in either province. Soon after 1947, Sind University was erected in a desert area outside of Karachi. Since its foundation it has had an active Department of Botany, eager to do systematic work. Two refugees from India, both Ph. D's from Britain came to Karachi. S. I. Ali from London University has been connected with the Karachi University Department of Botany but S. M. H. Jafri of Edinburgh University has been the Principal of a college. In the past thirty years both of these men have done a great deal of collecting and writing and both have worked on the preparation of a flora for Pakistan. Both have collected in Baluchistan. Jafri has collected with a plant pathologist named Khursheed Akbar. Most of Ali's work has been the preparation of monographs for all of the leguminous genera while Jafri has prepared monographs for the *Cruciferae* and a number of other families. Jafri has prepared one paper involving Baluchistan "Botanizing the Bolan Pass", Pak. Jour. For., 11: 41-47. 1965.

The towns of Baluchistan are oases. The gardens, the shade trees and everything growing in the orchards would soon dry up if it were not for irrigation. All of the Quetta roadside trees have been introduced.

One of the peculiarities of irrigation in Baluchistan is the 'kareze' (Kanat in Iran). This method of obtaining water to irrigate fields is also used in Iran and Afghanistan. In Baluchistan little irrigation is possible from perennial streams as few exist. Due to the lack of a plant cover of grasses and other herbage most of the ground is bare and when there are rains the water quickly flows down the nearest valley in flash floods carrying sand and gravel down to the next valley and forming large alluvial fans. A great deal of water sinks down in these fans which may be both large and deep. Somehow the peasants came to know about this aquifer and beginning at the top of a fan sunk a series of wells connected below ground by a tunnel. The well diggers filled animal skins with the sand and gravel which was hauled to the surface. I cannot figure out how, without modern tools and instruments, these well makers, deep underground in the dark, could keep the wells in line.

The underground water seeped into the tunnel and flowed down to the land to be irrigated. Repairing and keeping these wells and tunnels in working order must take courage as well as skill. As these valleys are largely bare with little vegetation, the heaps of gravel etc. brought up from the wells and tunnels are visible from a long distance in this barren land.

Comparatively few collectors have worked in coastal Baluchistan in the former States of Las Bela and Makran. The coastal strip is narrow, thinly populated and desertic. West of Karachi at Sonmiani Bay the Hub River, the boundary with

Sind, empties into the Arabian Sea. I only know of two workers who have done much work in Las Bela. They are Moh'd Tasnif and Rodman E. Snead, ecologists. Tasnif was from Karachi and Snead from Clark University in Massachusetts in the U.S.A. After several collecting trips they published in 1964 "An Ecological Survey of the Vegetation of Las Bela areas". The Scientist (Pak.) p. 42-48. The list of the trees and shrubs they collected follows. It is not complete.

Trees and shrubs of Las Bela on the Baluchistan Coast

This list should be compared with the list of the trees and shrubs which grow in the temperate region of the juniper tracts. They are all different, except for *Tamarix aphylla*

Rhizophora conjugata
Avicennia alba
Aerua persica
Calligonum polygonoides
Sericostoma pauciflorum
Mimosa hamata
Haloxylon recurvum
H. salicornicum
Salsola foetida
Arthrocnemum fruticosum
Suaeda monoica
S. fruticosa
Atriplex stocksii
Salvadora oleoides
S. persica
*Ricinus communis**
*Phoenix dactylifera**
*Mangifera indica**
*Mangifera indica**
*Syzygium cumini**
*Psidium guajava**
Capparis decidua
Commiphora mukul
Acacia nilotica
Prosopis spicigera
Ziziphus nummularia
Cordia gharaf
Fagonia cretica
Alhagi camelorum
Tamarix aphylla
T. dioica
T. troupii
Euphorbia caducifolia
Nannorrhops ritchieana
Gymnosporia montana
Grewia villosa
G. tenax
Abutilon indicum
A. glaucum
Inula grantioides
Pulicaria crispa
Barleria acanthoides
Calotropis procera

Shrubs and trees reported from the Juniper Tracts

Clematis graveolens
C. orientalis
C. asplenifolia
Berberis lycium vel aff.
B. baltistanica
B. calliobotrys
B. densiflora
Berchemia lineata
Ribes orientale
Viburnum cotinifolium
Abelia triflora
Lonicera hypoleuca
L. quinquelocularis
Rubia infundibularis
Acantholimon fasciculare
A. munroanum

Gypsophila lignosa
Rhamnus prostrata
Sageretia brandrethiana
Vitis persica
Pistacia atlantica ssp. *mutica*
Onobrychis cornuta
Caragana ambigua
Colutea armata
Sophora griffithii
Cotoneaster pruinosa
Prunus eburnea
P. rechingeri (*microcarpa*)
P. brahuica ssp. *affghanica*
Spiraea brahuica
Rosa beggeriana
R. lacerans
Crataegus songarica
C. wattiana
Limonium macrorhabdos
Fraxinus xanthoxyloides
Jasminum humile
J. humile var. *pubigerum*
Buddleia crispa
Salvia cabulica
Plectranthus rugosus
Thymus serpyllum
Perovskia abrotanoides
P. atriplicifolia
Kraschennikovia ceratoides
Daphne mucronata
Ficus carica v. *rupestris*?
Celtis caucasica
Hertia intermedia
Juniperus excelsa
Pinus wallichiana
P. gerardiana

A study of the distribution of these 52 shrubs and trees from Upper Baluchistan indicates that they are hard to place in classes. I find it hard to say which are really Irano-Turanian. It depends on how you define the term. Is a shrub Irano-Turanian if it grows there but its distribution is from the Caucasus to Siberia? Unless a plant is characteristic of this area and does not extend much into surrounding territory I do not think it should be called Irano-Turanian. A plant that is common in the Himalayas and also grown in Nuristan is certainly not Turanian. Similarly plants common in Central Asia to the north of Afghanistan which also grow in Afghanistan and Baluchistan should not be called Irano-Turanian. Take *Clematis asplenifolia* which is found in Central Asia clear down into Baluchistan. The familiar Central Asian *Eurotia* which is a useful fodder plant and fuel in the Trans-Himalaya. Is it Turanian? Unfortunately we must now call this plant (*Kraschenikofia*). I do not like such Russian names.

Eastern Afghanistan complicates the situation and adds many Himalayan plants to the Afghan flora which are found nowhere else in the Persian-Afghan highlands. Taking much of Pakistan into the area of his flora Dr. Rechinger has introduced the Himalayan, the Saharo-Sindian, the Asiatic Russian and some Indian species into his flora.

Of the 52 plants under discussion ten seem to be endemic and 19 Himalayan. This means that more than half are not Irano-Afghan. Of the rest many are Central Asian. I am not a plant geographer and cannot pursue this subject further but the little study which I have given to this subject of where the Baluchi flora came from surprised me, for my attention had not been called to the fact that many Himalayan plants had somehow been able to migrate as far as Baluchistan down a corridor from the Nuristan–Chitral–Swat region.

When I discovered that Dr. Rechinger (1906 –) of Vienna was including the northern half of Pakistan territory in his floral area,I probably incorrectly assumed that he did so because he thought that this part of Pakistan's flora was Irano-Turanian (Persian-Afghan). I therefore began to study the distribution of the plants growing in the major areas of Pakistan which he was including in his flora. He may not have thought of what diverse floras he was including but only of choosing a contiguous geographical area.

I soon found out that there was little in common between the flora of Sind and that of the Iranian-Turanian area. All who discuss the matter agree that the Sind flora is largely African i.e. (Saharo-Sindian) with some elements from tropical India and a number of European and cosmopolitan species. I soon found that the flora of Dir, Swat and Chitral was Sino-Himalayan with more Central Asian species than grow in the Central and Eastern Himalayas. I was surprised to find that the Nuristan Province of Afghanistan was unique in Afghanistan in enjoying the Indian monsoon and that its flora was largely Himalayan with an admixture of Russian plants from further north.

This left Baluchistan, Waziristan, the Kurram Valley, the Peshawar Valley and the area between Peshawar and Swat. Studying the floras of this region, much of which I have collected in, I was surprised by what I found. The range of mountains which has separated historic India from Afghanistan, begins in the tangle of mountains where the Himalayas and the Hindu Kush meet. There are only two important passes across this boundary range; the famous Khyber Pass near Peshawar and the Peiwar Pass where the Kurram River cuts through the Safed Koh Range just after this snowy range, which at first ran east and west, turned south. I expected that this range which runs south-west until it enters Persian Baluchistan would have an Irano-Turanian flora. It does indeed have a flora more like that of the country to the north than anywhere else in Pakistan does but I found out that scores of Himalayan species have migrated southwestward along this range into the temperate mountains of Baluchistan. This is seen most clearly in the trees and shrubs. My feeling is that about half of the trees and shrubs of Baluchistan's 'juniper tracts' are also in the Himalayas and that the next largest element is northern or Eurasian and that the distinctively Afghan influence is not great. There is an important western element like *Pistacia atlantica, Juniperus excelsa, Sageretia brandrethiana, Ficus carica, Celtis caucasica* and *Hertia intermedia* but few, like *Salvia cabulica*, which are distinctly Afghan. Nearly a fifth seem to be endemic. I would not have expected to find the following common Himalayan plants in Baluchistan. *Pinus wallichiana, P. gerardiana, Daphne mucronata, Plectranthus rugosus, Fraxinus xanthoxyloides, Buddleia crispa, Jasminum humile, Viburnum continifolium, Abelia triflora, Clematis graveolens, Rhamnus prostrata, Ribes orientale, Lonicera hypoleuca* and *L. quinqueloculars*. There are many herbs as well which have migrated westwards by the same route. *Vitis persica* may have originated in the Pamiro-Alai region or the Western Himalayas and not in Iran.

In the 1880's J. F. Duthie of the Botanical Survey visited Quetta and ar-

ranged for his collector, Harsukh, to collect in this area, and later he collected in Waziristan and Peshawar. In 1896 there was another Afghan Delimitation Commission led by Surg. Capt. Fred. P. Maynard. He collected along the border west of Quetta. He and David Prain of Calcutta reported on their collection in "A note on the Botany of the Baluch-Afghan Boundary Commission of 1896, Rec. Bot. Surv. Ind. 1(7): 125-137. 1897?.

The Maynard party took the railway to the Afghan Frontier at Gulistan and followed the frontier toward the south as far as Nushki (c. 900 m) where the frontier turns west for more than 500 miles. They were in the field from Jan. 27 to May 20. The fact that the party only found 43 species in this length of time shows how scanty the flora is in some of these deserts. They found only one fern, *Adiantum capillus veneris* and two grasses. The one they call *Cynodon dactylon* must be an error. Was it *Eleusine flagellifera*? *Cynodon* is not a desert grass.

They describe in some detail the country between Robat 1, near Shora, 29.5° North and 63.6° East. There was a small stream at Robat but there was none for the next 270 miles. Water was only found seven times along this road. Sand hills and gravel plains alternated with hardly a trace of vegetation. The road which they followed skirted the bases of low mountains rising to c. 1525 m. The desert was waterless except for a salt lake. The general elevation of the line of march was 900 m. Springs and wells were only found in gorges off the line of march. In February there was 15.5' of frost while in April and May the temperature went up to 115° and the sun temperature to 205°. There were sand and dust storms almost daily. There had been no rain for two years. Travel had to be done at night, making it more difficult to locate the occasional plants. Surg. Capt. Maynard and Lt. Webb-Ware did the collecting. Of the 43 species found, 17 were not in the Flora of British India. Thirteen species were not in the list of Hemsley and Lace. They are

Tamarix macrocarpa
Reaumuria stocksii
Monsonia senegalensis
Trachydium kotschyi
Ferula assafoetida
Phagnalon acuminatum
Senecio decaisnei
Statice macrorhabdos
Hyoscyamus muticus
Mentha arvensis
Rheum ribes
Gagea amblyopetala
Rhagadiolus hedypnois

I think that I first became interested in trying to name Baluchi plants in the 1940's when a new B. Sc. graduate of Gordon College, Ved Parkash Datta, an employee of the N. W. Railroad, was stationed in Quetta and sent me a collection of spring species. I had never seen many of them and found it difficult to get them named. About the same time Dewan Mohindar Nath of our Botany Department began spending summer vacations in Loralai where his father was employed. From time to time others from Rawalpindi visited Baluchistan after partition and made smaller and larger collections which were deposited in our herbarium. I did not

visit the Quetta area until early May 1957 and in 1959 made a small collection from about the Hub River near Karachi. In June 1962 I made a tour in cooperation with the Baluchi Forest Department. With their assistance I was able to visit the most promising localities. I owe thanks to Malik Saeed, Plant Pathologist, Quetta, S. M. Irshad, G. M. Khattak and Moh'd Hamid Ali, all of the Forest Service. Much of my collecting was done at Quetta, Kach, Ziarat, Maslakh, Urak, Hanna, Mastung, Askalku and Kalat.

Since 1947 many Baluchi specimens have been collected by Drs. Mod'd Zahur and Sultan Ahmad of Lahore, Drs. Ali and Jafri of Karachi, Prof. E. Nasir, Yasin Nasir, M. A. Siddiqi and A. R. Beg of Rawalpindi. Dr. Santapau of Bombay told me that he had also made a collection which must be at St. Xavier's College. Dr. Abdul Hamid Khan of Peshawar and Lyallpur, Dr. J. J. Norris and Dr. Dick-Peddie of Tando Jam Agri. College, Dr. Ferdinand Schmid and Dr. J. J. Buetinger of Switzerland all made collections. Dr. Henry and Miss Helen Crookshank made a fine collection in 1952 which I saw at Kew. Dr. Crookshank was head of the Pakistan Geological Survey. Dr. Siro Kitamura of Kyoto University visited Baluchistan in 1955. Mrs. (Dr.) Gertraud Repp of Vienna collected in 1958. I do not know how many more from Karachi University have brought specimens from Baluchistan, besides Sultanul Abedin, M. Qaiser, A. Ghafoor, and Shamim Farooqi, a cytologist.

The most important recent expedition to Baluchistan and the N.W.F.P. was that of Dr. K. H. Rechinger, Director of the Vienna Herbarium, and one of the great botanists of our day. In 1965 with Miss Jennifer Lamond of the Edinburgh Botanical Garden and Dr. S. M. A. Kazmi of Peshawar (now in Somalia), the party entered Baluchistan from Iran, collected in many places, toured in Sind and then the party moved eastward as far as Swat. This expedition was very important and the results are being published gradually. So far 143 fascicles, large and small, have been issued. Most collectors and botanists attempt little and accomplish little. The labour involved in earning a Ph. D. exhausts many students and they never publish again. Dr. Rechinger is of a different breed. In 1954 he published the first fascicle of a projected flora of Afghanistan entitled *Symbolae Afghanicae*. His native tongue is German but he uses Latin and English with equal facility. He had already published a flora of the Aegean Sea region of S. E. Europe. In 1964 with the aid of collaborators he published the flora of Lowland Iraq.

After publishing six large fascicles of his Afghan flora he abandoned the scheme, widened his objectives and began a large flora which will become a replacement for Boissier's great *Flora Orientalis* (1867–1884), now out of date. Rechinger's area begins in Iraq and extends to Chitral in Pakistan. The flora on which he has been engaged since c. 1965 is the *Flora Iranica*. The area he includes is Iran, Afghanistan, part of Pakistan, North Iraq, Azerbaidjan and Turkmenistan. He describes it as the Flora of the Iranian Highlands and the surrounding mountains. This is a vast area with many distinct and diverse floras. I still do not understand why he has included a slice of Pakistan in his flora introducing several

floras which are not Irano-Turanian. By including Eastern Afghanistan, the old Kafiristan, he introduced a Himalayan element,for all the rest of his area lacks the monsoon which is so characteristic of the flora of the Himalayas. Chitral, and Swat are also Sino-Himalayan, not Turanian. Baluchistan has more Irano-Turanian elements than does the rest of Pakistan but has a strong Himalayan colouring and up to c. 1220 m the flora is Sudano-Sindian. In other words the Sind flora is largely African.

In what ways does this flora matter to Pakistani botanists? In many ways it is very helpful for us to have the advantage of the studies of Rechinger and his collaborators. Pakistan has few trained botanists. Each fascicle which comes out may deal with one or many species which are found in Pakistan. As my field has been the flora of the whole of the present Pakistan,I carefully search each new fascicle to see how Rechinger and his helpers deal with our species.Has he changed the name of a familiar species or corrected an error in nomenclature? Sometimes he has taken one of Hooker's varieties and made it into a sub-species. We have to note these changes. Some of his collaborators in preparing their large or small monographs,divide genera and introduce names which we need to evaluate.Whether we approve of the changes or not,we must take note of them in future. In this flora many families and genera we have become familiar with have been divided.

Dr. Rechinger and his party were good collectors and they discovered quite a few species to which they are giving names.

All this has raised various difficulties for me and for anyone doing systematic work on the Pakistan flora. The difficulties are of different kinds. First this new flora is in German and Latin. The descriptions from beginning to end are in Latin. There is not merely a Latin diagnosis. The discussions are in German, except for a few which are in English. There will be many volumes. The exsiccati cited are very numerous; sometimes there are more than a page of them for a single species. The volumes are very expensive and I estimate that the whole will cost some £ 800. Not many Pakistani or Afghan students or libraries will be able to buy this flora. If we can buy a set how many of us can use the Latin and German? If those in Pakistan are to be able to benefit from this flora,we will need to have it abridged as probably nine tenths of the flora does not deal with Pakistan. The collaborators on this venture do not know Pakistan very well and the material they have from Pakistan is very limited. They do not know the vernacular names of our plants, their uses, or their distribution. The keys are hard to use, not only because of language difficulties, but the names we are looking for are hidden among hundreds with which we have nothing to do.

Checking through the list of genera in Burkill's list I was surprised to find that out of 549 no less than 300 are represented by a single species while there are c. 50 species of *Astragalus*. This genus and *Cousinia* together have 400 or more species in Afghanistan. Why?

I also noticed that many familiar north European and Himalayan genera are represented, chiefly in northen Baluchistan, but only by a single species each. The Japanese do not call the flora of Baluchistan *Irano-Turanian* but *North Asiatic*. This is only partially correct for up to c. 1200 m, it is clearly Sudano-Sindian not Central Asian, with a mixture of other elements. If one studies the cool weather spring flora of tuberous, bulbous plants one sees that they are western in origin while many of the trees and shrubs are West Himalayan, while others are Irano-Turanian and Central Asian. I wish that I had time to go into this more thoroughly. The following genera with a single representative each are familiar to Northern Hemisphere botanists : *Anemone, Adonis, Aquilegia, Corydalis, Draba, Arabis, Dianthus, Lychnis, Geranium, Sedum, Ribes, Spiraea, Rubus, Epilobium, Inula, Valeriana, Amaranthus, Viburnum, Gentiana, Verbascum, Scrophularia, Pedicularis, Rheum, Lathyrus, Rhus, Myosotis, Leucas* and *Stachys*. They all grow in Kashmir and Hazara. Some of the northern genera are of course represented by more than a single species.

There are 549 genera and 1130 species in Burkill's list which means that on the average there are only two species for each genus. Why should there usually be so few species per genus? Why should Afghanistan have a high rate of endemism while this is not the case in Baluchistan next door?

THE PUNJAB

There are four provinces in Pakistan, Sind, Baluchistan, the N. W. Frontier Province and Punjab. As every one in Pakistan calls their central province Punjab not West Punjab I shall do the same but those living in other countries when they read any literature about the Punjab should realize that Pakistan's Punjab is much smaller than the one which J. L. Stewart, C. J. Bamber and R. L. Parker wrote about. Another complication is that India has divided their Punjab and created a new province Himachal Pradesh to include the mountainous portions of their Punjab so that Kulu, Simla, Lahul and Spiti are no longer in the Punjab Himalaya.

I was reminded of these facts when a few weeks ago a useful book entitled "Flora of the Punjab Plains" came into my hands, written by N. C. Nair and published by the Botanical Survey of India, Howrah, in 1978. It is a proper flora with keys and an excellent introduction which should be read by all those interested on the flora of Punjab.

It should be noticed that Nair does not call his Indian Punjab East Punjab or mentions the Pakistani Punjab and some one in Europe would not know that he is not reading about the same area which Parker wrote about in 1918. Nevertheless there is not much difference between the flora of the Punjab of this book and the

flora of the Lahore Dt. of Pakistan and it can be used there but would be of little value for one in Pakistan working in the Murree Hills at 2000+ m.

Economically, educationally and politically the Punjab is the most important part of Pakistan. Lahore, would probably have been made the capital but for the fact that it is too close to the frontier with India and so Islamabad, adjacent to Rawalpindi, has been built to serve as the capital. There is no up-to-date check-list of the plants of the Punjab. Aitchison's list, which is more than 100 years old is out of date and T. S. Sabnis' 1940–41 "A contribution to the Flora of Punjab Plains and the associated Hill regions in the Journal of the Bombay Natural History Society deals with the Punjab as it was before 1947. The flora of Pakistan's Punjab is pretty well known and the species are included in my "Annotated Catalogue" of 1972 and in the fascicles of the Pakistan flora which are being published from time to time, and when it is complete, an up-to-date Punjab list can be compiled. This remark also applies to the other three Pakistan provinces. None of them has an up-to-date plant list.

Pakistan's Punjab, lies between the Indus and the Ravi Rivers. Hazara District is to the north. Sind lies to the south and the N. W. F. P. to the west. Most of the Punjab is a vast plain, drained by the Indus, Jhelum, Chenab and Ravi Rivers. The fifth Punjab river, the Beas, is now in India. From the geographical point of view the southwestern part of the Punjab belongs with Sind and is part of the vast flood plain of the Indus River. Its altitude until one comes upstream to Gujrat and Jhelum District, is below 300 m. When we come to the Gjurat and the Jhelum Dts. from the coast we are approaching the foothills of the Himalayas and we find the Pabbi Hills in Gujrat and as soon as we cross the Jhelum River, travelling north, we come to the Salt Range which is much older than the Himalayas and connects the Trans-Indus Hills with the foothills of the Himalayas across the Jhelum in Azad Kashmir. At Khewra in Jhelum Dt. there are enormous salt mines which have been in use for hundreds of years. There are vast caverns from which the salt has been removed with the roof three hundred feet above the floor.

The Salt Range is not very high. There is one mountain called Sakesar which is a mile high and has a few Himalayan species including *Quercus incana* but the next highest, Mt. Tilla, which is near Jhelum City, is only about 1000 metres in height and has a Himalayan foothill flora quite distinct from that of the Indus flood plain in Sind and the South Punjab. Between the Salt Range and the Himalayan foothills in Rawalpindi and Hazara Dts. we find the Potwar plateau where Rawalpindi, Islamabad, Taxila, Wah and Hasan Abdal are located with a milder climate and heavier rainfall than the country south of the Jhelum.

The rainfall of Rawalpindi varies from 425 to 1375 mm per annum with an average of 900 mm. The rainfall of Kahuta has varied from 575 to 1550 mm and Murree from 125 to 2500 mm with an average of 1663 mm. Note how variable the annual rainfall is.

In the past hundred years so much of the land between the rivers of the Punjab has been irrigated that much of the original desert has come under the plow and large cities and hundreds of villages are now located where formerly there was a desert. Creating irrigation systems that will be permanently profitable is not a simple matter. Where soils are sandy or very porous vast amounts of canal water sinks down and raises the water table unless the canals are lined with cement, an expensive process. In many places which were fertile some years ago, there is now waterlogging and the canals have to be turned off and wells have to be dug and the excess water pumped back into the canals to lower the water table. In areas where there are salts in the soil, evaporation brings the salts to the surface along with the water and as this process goes on the land becomes infertile, unless the salts can be flushed out.

The planting of trees along the canals and in the villages along with the greenery introduced by the presence of two crops a year has had a beneficial effect on the climate. The dust storms that removed the surface of the deserts and built up loess deposits in Jhelum and Rawalpjndi districts have been moderated and so have the highest temperatures of the dry season. I could see the effect of many hundreds of years of dust storms on the level of the land at Taxila twenty miles from Rawalpindi. When I first visited Taxila probably in 1911, the farmers were plowing over the unseen broken walls of the city of Alexander's time. When the Archaeological Dep't excavated the area, it was clear that the ruins had been covered by twenty feet or more of wind blown material. I believe that the badlands between Jhelum and Rawalpindi which were formerly a level plateau have been formed by streams carrying away the unconsolidated dust, also due to dust storms as the Himalayan uplift has enabled the streams to carry the soil away, for there is now a gradient.

I was very fortunate, from the botanical point of view, to live in Rawalpindi at c. 520 m. It is only c. 260 m higher than Lahore but there is a good deal of difference in the climate. The winter is longer and cooler and there is a much higher monsoon rainfall. There are not so many very hot nights in the summer as there are in Lahore. Combined with this, many good collecting centres are within easy reach of Rawalpindi by bicycle, bus, car and railroad. The foothills begin about ten miles away and we could take botany classes by bike or bus to Nurpur, Saidpur or Chattar Bagh. Murree (c. 1980–2260 m) was only about 35 miles away and many times we took classes there for the day. Many times we took students to Changla Gali in Hazara only nine miles from Murree at c. 2745 m. We often took them to Haripur in Hazara and Abbottabad for one day trips. Several times we went to Attock by rail coming back in the evening. There was good collecting in Kahuta Tehsil toward the Jhelum River, especially in the Punjar and Karot Valleys of Kahuta Tehsil where there are still good longleaf pine forests. Peshawar was only a little more than 100 miles away by train and Srinagar, Kashmir was only 200 miles by motor road. It was much more difficult for Lahore and Peshawar students to get to good places for the collection of plants.

In Murree tehsil, which is all in the Himalayas, and goes up to 2057 m., the snow lies until April and there is a good temperate flora. The result is that there are more than twice as many species in Rawalpindi Dt. as there are in Lahore or Jhelum Dts.

It should be noted that there are only two seasons when there is good collecting on the plains. The first is in March and April when the flora is western in the pleasant spring weather. Then in April, the ephemeral plants dry up and in the dry hot weather which follows, the ground becomes bare and only a few hardy weeds like pholi, *Carthamus oxyacantha* and *Chrozophora* sp. grow in the harvested fields. The second is at or toward the close of the monsoon when the flora is tropical or semi-tropical and is related to the flora of India or is Indo-Malayan or pan-tropical.

The credit for being the very first to have collected plants in Pakistan and the Punjab has been given to Victor Jacquemont (1801–1832). He is one of the early collectors who went to the East as an explorer and never got back home again. Such journeys as those he made were much more hazardous then than they are today for many reasons which I do not need to detail here. Burkill says that he died "because of his hard life" while someone else said that it was malaria which ended his life. He was probably weakened by his hard life.

Jacquemont was a talented young botanist of good family who was sent to India by the French National Museum to collect what he could find of interest to the Museum. Somehow I had thought that he had gone to India primarily to look for new plants but a recent study I made of his itinerary and the 169 plants which he collected in three years shows clearly that a search for new plants was not a priority with him.

He landed in Pondicherry, South India, a French colony, in May 1829. He slowly moved north, stopping to collect in various places. He made a difficult trip to the Upper Sutlej and crossed into Tibetan territory which he called Chinese Tartary. He visited the regions of Kunawur and Spiti on the borders of Tibet. He made a side trip to Mussoorie and another to Simla. Both of these were then new Hill Stations. He visited Royle at Saharanpur and was shown 100 species of Kashmir plants growing, which Royle had acquired by sending collectors to Kashmir along with shawl merchants. At this period the northern frontier of the British was on the Sutlej and Ludhiana was the frontier post.

Maharaja Ranjit Singh, the Lion of the Punjab, was then at the height of his power, ruling from the Sutlej to Peshawar and controlling Jammu and Kashmir including Ladak. He welcomed Jacquemont, treated him like an ambassador, and met all of his expenses while he was in his territories in 1830 and 31. In 1830 Jacquemont spent much time in Lahore but made a trip to the Salt Range where he did a little collecting and then went to Kashmir the next spring, by the Poonch route, with an escort of 100(?) men.

Burkill did not know that in the 1830's there was a remarkable doctor, a student of *Materia Medica* and a botanist, born in Transylvania who was a physician at the royal court and in charge of the royal gunpowder factory. In his history on p. 189 Burkill states that in 1833 Honigberger "found himself on the Indus at Dera Ismail Khan". Burkill did not know or had forgotten that Honigberger (1795-?) had been living in Lahore and was on his way home to Transylvania via the Kurram Pass and Afghanistan. I found a copy of his Book (1852) at Kew in 1977 and tried to find out from it the year he reached Lahore but I could not find it. I think however, that Honigberger was probably in Lahore in 1830 when Jacquemont arrived there. If so, he and not Jacquemont, should be credited with doing the first modern botanical work in the Punjab. In any case, if Jacquemont was the first to do any collecting, Honigberger was the second and did far more than Jacquemont did, for in 1852 he published "Thirty-five years in the East. Discoveries and sketches relating to the Punjab and Cashmere in connection with medicine, botany etc." 2 vols. London. His book shows that he knew more than 400 species and he illustrated about a quarter of them.

The next person to do a little collecting was Hugh Falconer, who, following Royle, was in charge of the Saharanpur Botanical Garden. When in 1836 the E. I. Co. Gov't decided to send a Trade Mission to Afghanistan he was ordered to accompany it so that he could collect plants and see what useful products were available along the way. In 1837 he collected at Rawalpindi and Hasan Abdal on his way to the frontier. When the Afghans would not receive the Mission, he did not return by the way he came but went to Kashmir by way of Hazara.

During the First Afghan War, 1839–41, although the British Army did not cross Sikh territory, a number of officers did and made small collections as they went through the Khyber Pass or at Attock. Gen. V. Eyre, then a Lt., discovered *Astragalus pyrrotrichus* at Attock, Griffith visited the Khyber and Kafiristan and Vicary published a Peshawar list, which I have not seen, in the Journal of the Royal Asiatic Society of Bengal, 1: 1152 and 25: 40. This travel was possible because the Sikhs were not friendly to the Afghans.

After the British began to administer the Punjab, following the defeat of the Sikhs, c. 1850, they appointed Dr. Andrew Fleming who was a geologist as well as a doctor, to survey the Salt Range to see what else beside salt might be available. He made a collection of Salt Range plants and another from the region about Murree. *Impatiens flemingii* Hk. was named in his honour.

At the same period, in 1850, M. P. Edgeworth was made Deputy Commissioner of Multan. He had been a plant collector in his previous station at Banda in the U. P. and had written on its flora. In 1862 in the Journal of the Linnaean Society he published "Flora Mallica" (Flora of Multan). Multan is mostly desert with some irrigated land and he lists 334 phanerogams, 32 annual weeds of cultivation, 43 trees, shrubs and woody climbers and 78 desert plants. He states that 227 plants were North African and Arabian and 83 were European. He says that

73.3% were also to be found in adjacent India. There were many grasses, *Cenchrus* 6, *Eragrostis* 10, *Aristida* 9, *Panicum* 8 and there were 7 species of *Heliotropium*. There were only three ferns, a *Marsilea,* an *Equisetum* and *Adiantum capillus veneris*. This fern commonly grows on the damp inner walls of wells. *Impatiens edgeworthii* Hk. was named in his honour.

One of the most important names connected with botany in the Punjab and N.W.F.P. was John Lindsay Stewart (1832–73), another Dr. and another Scot. He reached India in 1853 and was assigned to the Punjab Medical Service, but like Edgeworth and Aitchison he promptly began to collect and study plants. Brandis appointed him to be the first Commissioner of Forests for the Punjab which at that time included the present N. W. F.P. He was very energetic and it is said that he traversed all of the Punjab districts on foot, part of the time with Brandis, the Inspector General. He paid special attention to the Peshawar Valley, the Salt Range, Hazara and Ladak. Kazmi (1970) in his Bibliography lists seven works by Stewart and two of them deal with the Punjab. In 1867 he wrote a "Tour in Punjab Salt Range, with some account of its flora" and in 1869 he published "Punjab Plants, comprising botanical and vernacular names and the uses of most of the trees, shrubs and herbs of value growing within the Province." (1869)

The next Punjab District to have a flora was Jhelum. The reason that Jhelum obtained a flora was that Dr. J. E. T. Aitchison, the Civil Surgeon, was a keen amateur botanist and he and some of his friends were interested in the flora of the area. He had already worked on the flora of Hoshiarpur, a district which is now in the Indian Punjab. He published its flora in 1871 and in 1888 in Vol. 8 of the Journal of the Linnaean Society, he wrote up the flora of Jhelum Dt., paying special attention to the economic plants, their habitats etc. In 1869 he had already published a more ambitious work entitled "A catalogue of the plants of the Punjab and Sind" published both in London and in Ludhiana, Punjab. He lists 1500 species.

Contemporary with Aitchison and J. L. Stewart was Dr. George Henderson (1836–1929). He had been serving in Shahpur District, probably as a Civil Surgeon, who had been collecting plants about Mt. Sakesar and in Jhelum District. G. Henderson and A. O. Hume in 1873 published "Lahore to Yarkand. Incidents of the route and natural history of the countries traversed by the expedition of 1870 under T. D. Forsyth", London. On pages 308–346 is a list of 412 vascular plants. They began collecting in the Punjab, continued as they passed through Kashmir and Ladak all the way to Yarkand in Central Asia. I think that they should have found more species.

The third district to have a District Flora is Lahore. It is probably out of print like the other three. The Lahore District Flora was started by Dr. Shiv Ram Kashyap (1882-1934), the first Indian Prof. of Botany at the Punjab University. Most of his research time was given to his beloved *Hepaticae* but in his last years he was accumulating material for a District Flora for use by Lahore students. He died of heart failure in 1934 while in his prime leaving this work incomplete

but his notes and the 200 illustrations which he had drawn himsef were taken over by his colleague, Prof. Amar Nath Joshi (1908-) who I believe became Vice-Chancellor of the new Punjab University in Chandigarh after partition. In 1936 "The Lahore District Flora" was published by the Lahore University with S. R. Kashyap and A. C. Joshi cited as authors. The book was published without the sedges and grasses, two of the largest families in the flora. It was not until 1954 that Dr. Sultan Ahmad (1910-) published a little book "Grasses and Sedges of Lahore", Dep't of Botany, University of Punjab Publ. 17, pp. 1–127. In Kashyap's and Joshi's book there are 450 species and S. Ahmad added 113 grasses and 42 sedges, making 605 taxa for Lahore Dt.

The first systematic work on higher plants prepared by the Punjab University, was this Lahore District flora and the second was a monograph by Sultan Ahmad and R. R. Stewart in two volumes in 1958-1959 on the grasses of West Pakistan describing 375 species. I do not know of any other. There is, however, a monograph on the grasses of the whole of the subcontinent by Dr. N. L. Bor (1893-1972). Dr. Bor was a forest officer who made grasses his hobby. Retiring from India in 1947 he became Ass't Director at Kew and worked there until his death.

Dr. Sultan Ahmad was a student of Prof. Kashyap and I consider him to be his most distinguished student. Most of Kashyap's students were Hindus and they moved to India and did a great deal of work there on liverworts, lichens and mosses but Sultan Ahmad remained in Pakistan and was a Professor in the Government College until his retirement and he continues to edit *Biologia* (Pakistan) as I believe he has done since 1954. He was born at Ladhar in Sheikhupura Dt. in 1910 and has been a great collector, chiefly of fungi but he has been a student of higher plants as well. I saw him collecting in Baluchistan and I have collected with him in Swat and he has collected in many places in between. He is the outstanding authority on the fungi of Pakistan and has discovered at least 200 new species. In his Bibliography Kazmi cites 12 of his papers which he wrote alone and two he shared with another author.

In 1957–1958 in the Pakistan Journal of Forestry I published "The Flora of Rawalpindi District" and reprinted it at the Frontier Exchange Press, probably in 1958, with Introduction and Index, pp. 163, with 1655 taxa. Under a separate account of the flora of Rawalpindi Dt. I will discuss its flora. This flora is 22 years old and out of print and needs to be brought up to date as some name changes need to be made, some additional species have been discovered and keys should be added. It will be noticed that the plain of Lahore district has 605 sp. while there are three times as many in Rawalpindi Dt. which is half mountainous.

The Government of Pakistan has never had a Botanical Survey and neither has the Punjab. The Punjab University has not felt responsible for providing a flora for the province though it did provide one for the Lahore Dt. As a result systematic botany has developed in a haphazard way. Two Government servants, however, have written books on the flora of the Punjab. The first is Dr. C. J. Bam-

ber, Col., I. M. S., who in 1910 published "Plants of the Punjab. A descriptive key to the Flora of the Punjab, N. W. F. P. and Kashmir", Supt' Gov't Printing Pb. It had previously been printed in parts in the J. B. N. H. S., 1908-1912. He divides his plants into trees, shrubs, herbs, climbers, water plants and parasites and then he uses artificial keys to lead the botanical beginner to the right name. Its aim was to help amateurs but is annoying to botanists who are used to dividing plants into families and them keying them out.

There has never been a good book on the herbs of the Punjab but there has been an excellent book on the woody plants. It is "A Forest Flora for the Punjab with Hazara and Delhi, 1924 by R. N. Parker, Commissioner of Forests in Lahore. This is the second edition; the first was issued in 1918. Parker was a forester and an excellent field botanist. He knew his plants in the field and his description and notes are first class. He also knew cultivated shrubs and trees and after dealing with the wild and naturalized species noted a large number of exotics which had been introduced. His book is now 55 years old and has been reprinted without revision. It should be revised because quite a few of his names are obsolete and a good deal of collecting has been done in 50 years. Some species need to be added in order to include the whole of Pakistan and Kashmir. We now know much more about the distribution of trees than he did. Many plants that were thought to be at the western limit of their distribution at the Indus are now known to extend into the Nuristan Province of Afghanistan.

In 1941 T. S. Sabnis, Economist of the U. P., Cawnpore, India, published 'A contribution to the flora of Punjab Plains and Associated Hill regions, J. B. N. H. S., 1940 – 1941, in parts. This list covers East and West Punjab and is not available in book form.

Eugene Nasir (1908–) who is now the Director of the National Herbarium at Islamabad, but was connected with Gordon College, Rawalpindi in the Biology Dept. until retirement, was first a student of mine, went to the Agra University for his M.Sc. and then worked at Gordon College. When I retired in 1960 he became Head of the Biology Department and of the Herbarium which I had started in 1912 and which he and I had built up. Prof. Nasir has done a great deal of collecting with me and after I retired he and his son Yasin became responsible for collecting in many parts of Pakistan. Prof. Nasir has had post graduate training at the University of California in Berkeley and at the Royal Botanic Gardens at Kew. From about 1961 to 1967 he was in charge of collecting useful plants in all parts of Pakistan for the United States Department of Agriculture and since 1970 he has been Joint Editor, with Dr. S. I. Ali of Karachi, of "Flora of Pakistan', sponsored by USDA. He is the author of a monograph on the *Umbelliferae* of Pakistan and a number of smaller families.

A Government servant who did a great deal of collecting, largely through the native collectors he supported, was J. R. Drummond (1851-1921) who was a Dpty. Commissioner at Sargodha. He collected in a number of Punjab districts,

in the N. W. F. P., Salt Range, Punjab and Kashmir. He collected many duplicates which were distributed by Kew.

My own collecting began in 1912 in Kashmir and Ladak and, between 1912 and 1962 I have collected not only in many parts of the Punjab but in all of the main parts of Pakistan except Waziristan. My largest collection has been turned over to the Pakistan Agricultural Research Council. Until about 1940 my second went to the New York Botanical Garden where I had my Herbarium training but realizing that they would be more useful at the Royal Botanical Gardens at Kew in England, I began to send my second set there. The value of this is that large numbers of botanists use the collections at Kew, all the year round, and can take advantage of your collections and can cite them, and if there is a mistake the mistake is likely to be corrected. Monographers are not likely to look for Indian and Pakistan plants in New York but at Kew or the British Museum of Natural History. I have not prepared a check-list of the Punjab but one could be prepared from my 'Annotated Catalogue of the Plants of Pakistan and Kashmir'. My Flora of Rawalpindi Dt. serves as a Rawalpindi check-list.

As my herbarium was not a project of Gordon College, since an institution only teaching up to the B. Sc. standard has no need for a big herbarium, it was at first kept in my home and then in my office at the college. Gradually it became a joint project with Prof. Nasir. When I retired to the U.S.A. I gave Prof. Nasir a statement to the effect that I turned over to him any rights that I had in the herbarium. When the time came for him to retire, it, became necessary to decide what to do with the herbarium in order that it might continue to be useful, for it had become *de facto* a research herbarium because Government had not provided one. Foreign botanists came to see specimens, people who needed to have some one name plants correctly came to consult us and a set of the plants which Prof. Nasir had collected at U. S. expenses had been deposited in it. A herbarium, especially one in a warm country, requires constant care to prevent damp and instects from destroying valuable specimens. We were afraid to leave it in Gordon College, though the Principal at the time, wanted us to do so. He felt, I suppose, that having it gave him some prestige even though the college did not need it in its teaching. He knew its value but we were afraid that there might be a time when no one would care for it. It is well that we decided to offer it to the Pakistan Government for in a couple of years this Principal was transferred. Since 1976 my herbarium has been part of the National Herbarium in Islamabad and Prof. Nasir is now there as the Director.

An ambitious old student of mine, Mohammad Nazeer Chaudhri, is Prof. of Botany at the new Quaid-i-Azam University, Islamabad and he is working hard to build up a large herbarium there and has started a new magazine, *Pakistan Systematics*, as the botanical bulletin of his university. The first issue, Volume 1, No.1 bears the date 1977 and he has since put out another two issues. The main part of the first issue is the beginning of a book on "Flora of Potohar and the adjoining areas". The name is an unfamiliar one and he does not explain the bounds of the area, nor

what adjoining areas he will cover. He is providing keys and descriptions and some good illustrations. Pothohar is the plateau area between the Salt Range in the Punjab and the Himalayan foothills. Rawalpindi City, Islamabad, Taxila, Wah and Hasan Abdal would all be in his area but how Chitral, Gilgit, Multan, Waziristan, Peshawar, Swat and the Kaghan Valley can be adjacent is more than I can see.

The Punjab with its great irrigation system used to be called the bread-basket of India. Since Pakistan was founded, two great dams have added greatly to the electric power generated and to the supply of water. First the Jhelum River was dammed at Mangla, a few miles upstream from Jhelum City and more recently the Indus itself a few miles above Attock. A flood in the main Indus does not harm the Punjab but the Punjab suffers from recurrent floods from the Jhelum and Chenab watersheds. The severity of these floods is in part due to man and his activities. First over-grazing and destroying forests has reduced the ability of the mountainous areas to delay the flow of water to the plains. When the forests are cut down, the humus and dead leaves on the forest floor which act like a great sponge and a rapid run off of the water, are not there to delay the flood waters and erosion is unhindered.

When there is heavy rain on the hills, the streams carry it rapidly to the plains because the hills are steep. When this water reaches the plains, where the gradient is low, the flood water slackens speed but spreads out. Three obstacles on the plains interfere with nature's channels of run off. The Northwestern Railroad and the Grand Trunk Road cross these waterways at right angles and the flood-waters have to flow under bridges and through culverts which slow the rushing waters or are destroyed by them. A number of times I have seen both the G. T. Road and the Railroad breached in many places by these floods. Village houses are usually of unburned brick and as the flood waters spread far and wide the mud houses melt down. Thirdly branches of the canal are obstacles in the way of flood waters as they occasionally have to pass under or over stream beds. A big flood may destroy such engineering works.

In some areas the canals raise the water table so high that damp and alkaline salts in the waterlogged soil eat away the brick foundations of buildings and walls. In some places salty water evaporates leaving the salts behind on the surface and when the salts accumulate to a certain point most crops and trees will not grow. Curing such ills is very expensive and sometimes too expensive.

No one as yet has written anything about most of the Punjab districts. If there is a District Gazetteer facts about common trees and crops must have been entered by a forest officer but it is clear that there is still much to do, not only in working out the flowering plants but the cryptogams as well. Due to the outstanding work of Dr. Sultan Ahmad, a great deal of work has been done on many groups of fungi. Something has been done on soil and coprophilous fungi. Little has been done on freshwater algae. The liverworts and mosses are pretty well known because of the work of Prof. Kashyap and his students but

these groups have been neglected in recent years. The pteridophytes have been collected by many collectors and there are good collections in Islamabad, Dehra Dun, Chandigarh, Kew, the BM and elsewhere. Several of my fern papers are listed by Kazmi and the latest check-list is to be found in my Annotated Catalogue of 1972.

I have not made a list of the Punjab endemics but I do not think that there are very many while there are hundreds in Afghanistan.

The Punjab has been occupied by farmers and herdsmen for at least 5000 years and Mohenjo Daru was a well developed city of the Indus Valley civilization. The animals portrayed on the seals of the people of this period show that the climate was damper and more tropical than it is today. Long before this civilization, stone age man on a terrace above the Soan River below Rawalpindi, where there are conglomerate beds, chipped out stone axes, hammers and scrappers so that hunters have occupied the Punjab for many thousands of years and must to a certain extent have affected the original Punjab vegetation.

Peshawar, Taxila and Lahore were important centres when Alexander the Great entered India from the north c. 2400 years ago and at the height of this Gandhara civilization there must have been quite a large population to have furnished the skilled labour required to build stupas, monasteries and cities with beautiful sculptures, glass, gold ornaments and the many artifacts such as those on exhibit in the Peshawar and Taxila museums.

In Sind and the Punjab there is a great shortage of both fuel and fodder. Often village and roadside trees are lopped for fodder and mutilated by the axes of those in search of fuel. At Gordon College after every storm which broke off dead or living branches, the servant's children rushed to gather the windfalls and put them on the roofs of their huts to dry. Women and children also gathered and dried horse manure and cattle dung to dry for fuel.

Village and city carpenters find it difficult to obtain enough wood for tools, door and window frames, bedsteads and other necessities. The shisham tree, *Dalbergia sissoo*, one of the common road and riverside trees, makes excellent furniture and *Acacia modesta* and *nilotica* are hardwoods much used by the carpentars. The carpenters in Rawalpindi were very fond of deodar wood (*Cedrus lebani* var. *deodara*) because it was easy to work and was not troubled as much by termites as most woods. They also used fir, the long-leaved pine and the five needle pine.

RAWALPINDI DISTRICT

Rawalpindi District occupies the northeast corner of the Punjab and has a

much more varied flora than any other district, becuase part of the district is on the Potwar Plateau and Murree tehsil extends north into the Himalayas to 2075 m. In the Murree Hills there are fine temperate forests and there is an average of 66 inches of rain. Snow sometimes falls as low as 1000 m. and Murree itself has heavy winter snows which do not melt until April. Murree is the only one of the large and popular summer resorts of "Hill Stations" which was inherited by Pakistan.

Rawalpindi District is bounded by Attock and Campbellpur on the west, Hazara to the north, Poonch tehsil of Azad Kashmir to the east and Jhelum to the south. The altitudes range from c. 460 m to c. 2286 m and the area is 2051 sq. miles. Much of the original plain consisted of wind blown loess, the result of thousands of years of dust storms which in less than two thousand years buried the ruins of Taxila, the capital at the time of Alexander the Great which is about twenty miles northwest of Rawalpindi. When I first visited the area the ruins were so well covered that the farmers were plowing the fields which covered the ruins until the archaeologists brought them to light.

Much of the loess plateau is being eroded and has been turned into 'bad lands' which must impress everyone going to or from Rawalpindi by air. Gullies have been cut into the unconsolidated loess leaving cliffs of yellowish earth. Every heavy rain carries many tons of liquid mud down stream. These bad lands are only good for grazing sheep and goats and for producing fuel. The commonest tree in this area is *Acacia modesta*, the *phulahi*. Occasionally there are fields which can be irrigated by Persian wheels.

The Potwar plateau where Rawalpindi, Islamabad, Taxila and Wah are located has a flora similar to that of most of Jhelum, Attock, Campbellpur and the adjacent low-lying parts of Hazara. It belongs to the Saharo-Sindhian (North African) floral belt but because of the better rainfall during the monsoon there are more subtropical and tropical South Indian and Indo-Malayan elements, especially in the foothills of the Himalayas up to c. 1500 m.

The spring flora is largely Saharo-Sindhian and apparently come in from the west, while it is the monsoon flora which is tropical and has come in from India and from the southeast. In fact there are plants like *Mallotus philippinensis* which range much further than Malaysia and China. The spring flora flourishes for only six or seven weeks and by the middle of April it dies down and the ground is mostly bare until the monsoon begins, about the first of July, when almost over-night the countryside turns green again. In the spring flora there are a number of perennials with bulbs, corms or rhizomes. One of the prettiest is the star tulip, *Tulipa stellata*. Other interesting spring flowers are *Merendera aitchisonii, Scilla hohenackeriana, Dipcadi serotina, Gagea reticulata, Allium griffithianum, A. jacquemontii* and *Iris aitchisonii*. There is also an ephermeral spring flora of annuals, borages, crucifers, buttercups, *Adonis*, poppies, *Fumaria, Veronica*, labiates and many more. There are also perennials like *Salvia moorcroftiana* and *Eremostachys vicaryi*. Some of the perennial grasses which flower in April flower again during the monsoon.

The sub-Himalayan or foothill zone flora is much the same as that of Azad Kashmir to the east and Hazara to the west but as the monsoon gradually tapers off towards the northwest there are foothilll species which drop out and do not reach the Indus. The state of our knowledge of the distribution of individual species has not yet reached the point where one can say with confidence what the boundaries of the range of the individual species are. Hundreds of species which were supposed to have a westward range to Rawalpindi or Hazara District are now known to grow several hundred miles further west. Many species which were thought to stop before the Indus are found growing in Swat and Dir and even further west in Afghan Nuristan. Much more collecting and local check-lists are needed. There do not seem to be many endemics in this area.

Although there have been collectors in the Rawalpindi-Hazara area since the visit of Hugh Falconer in 1837, while the Sikhs were still in power, I do not feel that we know all of the plants of the district. Between 1911 and 1962 I covered much of the area on foot and so have some other members of the botanical staff of Gordon College, Prof. E. Nasir, Prof. Mohindar Nath, Prof. M. A. Siddiqi, Yasin Nasir and many students, some, who are now professors or professional botanists like Dr. A. R. Beg, Dr. Shauqat Ali Chaudhary, Dr. F. G. Dickason, Dr. M. Nazeer Chaudhri, K. M. Vaid of Dehra Dun and B. L. Burtt of Edinburgh, and yet from time to time, names are being added to our check-list. The Punjar and Karot Valleys running down to the Jhelum below Kahuta in Rawalpindi District have yielded the most rarities.

This Punjar Valley is unique and quite a few species are found in it not found elsewhere in Rawalpindi or Hazara. It should be kept in perpetuity as a park to protect its present flora. The botanists of the world in the last few years have awakened to the fact that with the current increase of population in most parts of the world, the forests are being cut down and, with loss of suitable habitat, species of plants and animals are becoming extinct. Botanists are being asked to provide lists of endangered species and these lists of threatened plants and animals are being published and bits of land here and there are being bought up and protected by Nature Conservancy Boards. In the olden days rajas, who loved to hunt, set aside areas where the hunting was good and kept the general public out. Often these 'reserves' were the only areas where the natural vegetation of the region could survive. Now that the rajas have gone, the State should set aside a number of these areas as parks.

Some of the rarities here in the Punjar or Karot Valleys between c. 450 and 820 m are *Pittosporum napaulensis* var. *rawalpindense* Gowda, *Begonia picta*, *Cassia absus*, *Curculigo orchioides*, *Desmodium laxiflorum*, *Embelia robusta*, *Engelhardtia colebrookeana*, *Ficus cunia*, *Eulophia graminea*, *Flemingia lineata*, *F. semialata*, *Habenaria griffithii*, *Nervilea gammieana*, *Ophioglossum vulgatum*, *Polygala tatarinowii*, *Shuteria involucrata*, *Thysanolaena maxima* and *Uraria picta*. Some of these may turn up further west but as for as my experience goes these plants have reached their western limit.

Why are there so many rare species in these two little valleys? I think that the reason is that the valleys are off the beaten track. They are still forested. *Pinus roxburghii* is the dominant species and the valleys are sloping steeply northward toward the Jhelum River so that the ground under the pine trees does not dry out as much as it does elsewhere on other exposures and the tree canopy is more effective than elsewhere in Rawalpindi Dt.

Rawalpindi is one of the few districts which have had a local flora. In 1957-1958 the Pakistan Journal of Forestry published in two parts my flora of Rawalpindi District and it was reprinted by the Frontier Exchange Press, Rawalpindi, probably in 1958, but unfortunately it is out of print and needs to be revised in order to list additional species and make some changes made necessary by later work. Parker's Forest Flora is most valuable for anyone working on Rawalpindi plants and there are notes in an old Rawalpindi Gazetteer.

The ferns of the district are listed both in the Rawalpindi District flora and in my 1972 Annotated Catalogue of Pakistan. There is nothing in print about the fungi, algae and lichens, not that none of these have found their way into collections but that the Rawalpindi material has not been sorted out from the Punjabi and Himalayan. A great deal of Rawalpindi material must be in the collections of Dr. Sultan Ahmad and among Kashyap's liverworts and listed in some of their publications. There are two papers on bryophytes listed by Kazmi, Asghar Ali's list of W. Pakistan mosses and his father, Abdul Hameed's 1942 'Notes on the Liverworts of Murree Hills'. Abdul Hameed taught at Ghora Gali. There are still opportunities for pioneer botanical work on the Rawalpindi cryptogams.

When I last counted the number of taxa in my Rawalpindi Dt. list there were 1689 seed-bearing plants and 53 pteridophytes but since that time a few more should have been added. The list does not include a lot of introduced plants though it does include the common crop plants and the more common introduced trees and shrubs. To beautify the new capital at Islamabad a number of additional plants have been introduced. The largest families are the following. The totals for each family would differ a little if counted today.

Gramineae	189	*Scrophulariaceae*	36
Leguminosae	169	*Ranunculaceae*	35
Compositae	134	*Euphorbiaceae*	34
Cruciferae	67	*Caryophyllaceae*	29
Labiatae	56	*Boraginaceae*	26
Umbelliferae	51	*Malvaceae*	25
Cyperaceae	49	*Orchidaceae*	23
Rosaceae	41		

The largest genera are as follows: *Euphorbia* 18; *Astragalus* 12; *Indigofera, Bupleurum, Solanum, Veronica, Polygonum* and *Carex*, 11; *Crotolaria, Ipomoea, Ficus* 10; *Ranunculus, Galium* and *Digitaria* 9.

NORTHWEST FRONTIER PROVINCE

Peshawar District and Khyber Agency

Peshawar District may be found on the map astride the 34th parallel, North latitude and between 71′ and 72′ East longitude. Peshawar is the most important city in the Province and its capital. It is located near the foot of the Khyber Pass, the most important gateway to Pakistan from the north. It has been a trading centre from time immemorial and most of the invaders of India from the north have entered by the Khyber. In the Buddhist period, Peshawar was a centre of Gandhara culture and the ruins of stupas, monasteries and other stone buildings reveal artistic and architectural abilities which have not appeared since.

The Khyber Agency is still a little world of its own. The pass itself is occupied by the Afridi Pathans who are responsible for the safety of travellers through the pass. The tribes living in the Agency are under the general supervision of the Political Department of Pakistan but are largely autonomous. When I was in Pakistan, each man carried a gun and each village was a small fort. The largest part of the Agency, south of the Khyber and west of Peshawar Dt. is called Tirah and is occupied by several Pathan tribes. This region is little known botanically. It was first visited for plant collection by Inayat Khan c. 1899 and recently Naseeb Khan, a worker in the Forest Institute, Peshawar.

Peshawar Dt. is on the whole level and extends from c. 300 m to Tartara Mt. at c. 2130 m. The winters are cold and the summers are very hot, sometimes up to 120° F. The rainfall varies from less than 250 mm to 475 mm. There is much semi-desert and there are few wild trees. With irrigation there are fine crops in many places. Unusually fine peaches and plums are grown in gardens near Peshawar.

It is hard to say who was the first to do any collecting in the Peshawar-Khyber area. Was it Griffith, Vicary or Falconer? If Falconer got as far as Peshawar in 1836, he probably did some collecting as he was not the kind of person to miss opportunities. He was the Sup't of the Saharanpur Botanical Garden, following Royle. The East India Company in that year decided to send a Trade Mission to Kabul and he was ordered to accompany it. There were no telephones in those days and only when the Commission got near the Afghan border did they find out that the Afghans would not receive them. The Commission went home but Falconer obtained permission to collect in the Himalayas. It is known that he did some collecting in the Punjab south of the Indus but I do not know whether or not he collected anything in the Peshawar area. If he did, he proceeded Griffith who reached Peshawar on Nov. 7th, 1839 with a portion of the British Army and they were welcomed and entertained by Gen. Avitabile, the French Commander of the Sikh garrison. It was late in the season for botanical work but Griffith collected what he could find. He noticed, *Ziziphus, Capparis decidua, Calotropis, Aerua* and maize in the Khyber. In Peshawar he found a few specimens in a marshy spot

and reported a *Veronica, Ranunculus sceleratus, Typha angustifolia, Arundo donax, Sparganium, Sium, Butomus, Epilobium,* a *Chara* and a *Nitella, Marsilea, Azolla* and three *Lemnas* (he thought that one was new), a floating liverwort (probably *Riccia fluitans*), and a cultivated *Nelumbium*. Either this year or the following,he collected *Abelmoschos ficulneus*, his No. 1272.

Griffith was expected to return to Calcutta at this time but hearing that the E. I. Company was sending a surveying party with escort into the Kunar (Kooner) Region of E. Afghanistan,he begged permission to accompany it. It nearly cost him his life for he was ambushed while ahead of the troops collecting. His collector lost two fingers in a struggle and he had a narrow escape. Because of continual danger and the unwillingness of the locals to collect plants for him, he was not able to make a very good collection in the Kaffiristan forests, which he found to be much richer than any others he had found in Afghanistan.

On October 14, 1840 he was back in Peshawar again but this time he did not linger and hurried on toward Lahore. The account of his trip from Peshawar to Lahore and what he saw by the way is to be found in a posthumous book entitled "Journals of Travels in Assam, Bootan, Afghanistan and the neighbouring countries". It was arranged by John McClelland and published at Calcutta in 1847. It is a mine of information provided by an ususual man whose interests and what he observed and collected were manifold. His interests were meteorological, geological, zoological and economic as well as botanical. He knew and collected both birds and fishes.

Another officer who did important collecting in Peshawar was Major Nathaniel Vicary (fl. 1833-59). He was sent to Sind with his regiment in 1838 and was a pioneer collector in Sind and Baluchistan and also in the N.W.F.P. He stayed long enough in Peshawar to make a collection and unlike most of the military collectors he published a paper on what he found in the Journal of the Asiatic Society of Bengal 16: 1152. 1840 and 25: 410. 1849. (I cannot check or use these references as we do not have the series.)

The only check list of the plants of Peshawar Dt. is that of Dr. J. L. Stewart (1832-74) though in 1965 one was started by workers at the Forest Research Institute which was left incomplete. Stewart's list was published before the Flora of British India by Hooker and the nomenclature is much out of date. He was the first Conservator of Punjab Forests which at that time included the N. W. F. P. which was much smaller than it is today. He was a real botanist and did not omit the grasses and sedges. His list includes 437 taxa and is not swollen by a large number of cultivated plants. He mentions the common cultivated and roadside trees separately. Some of his plants are only named to the genus. In 1864 he published "Memoranda on the Peshawar Valley, chiefly regarding its flora", Journ. As. Soc. Bengal 32: 219-66. I found a copy of his list at Kew and copied it. There were 430 Angiosperms, six pteridophytes and a liverwort, *Marchantia*. He reported that the average annual rainfall was 14–17 inches and remarked that the paucity of wild

trees was due to the low rainfall. He said that there were a few bananas and mangoes but that they survived with difficulty. He said that the grapes and peaches were very good and the quinces, pomegranates, plums, figs and oranges did well. There were a few jamans (*Eugenia cumini*). There was *Diospyros lotus*, plenty of drek (*Melia azadirachta*) but no nim (*Azadirachta indica*) and the wayside trees were *Albizia lebbek, Morus laevigata, Tamarix gallica, Ziziphus*, and *Salix babylonica*? Less common were *Moringa, Populus alba, Cassia fistula, Bauhinia variegata, Sesbania, Parkinsonia, Ficus benghalensis, F. religiosa, Salix aegyptiaca* (cult for '*bedmushk*' a scent), *Cupressus sempervirens, Populus nigra* and a few specimens of *Platanus orientalis* and *Juglans regia*. I do not remember seeing any *Juglans* but think that all of the others are still there plus more adventives.

As I went through the list I found that the majority of the species are also to be found in the Punjab and are in my Rawalpindi District check-list. The majority belongs to the Saharo-Sindian flora. There are a number of species which are not found in the Rawalpindi list. There is a *Haplophyllum, Trapa bispinosa, Medicago maculata* (not in F.B.I.), *Prosopis stephaniana* (*farcta*), *Reptonia buxifolia, Eremostachys loasifolia, Haloxylon multiflorum* (*Anabasis*), *Halocharis hispida, Abelmoschus ficulneus, Hibiscus hirtus, Eryngium dichotomum, Butomus umbellatus* and *Lemna trisulca* are examples. *Pterachenia stewartii* named in his honour which is also found in Rawalpindi, may be the only endemic species in Stewart's list. Some of these species, which I did not find in Rawalpindi are found in the Himalayan foothills further east.

At Kew I also found a list of 162 numbers gathered in the Khyber Pass in 1896 by a Col. Henry Halcro Johnson (1856-1939). His collections are at Kew and Edinburgh. Quite a few of his species are additions to J. L. Stewart's List. Like Stewart he was a Surgeon. His list contains only one tree, *Quercus baloot* and only a few shrubs. The shrubs are *Prunus prostrata, Sageretia brandrethiana, Argyrolobium* sp., *Fagonia bruguieri* (*cretica*?), *Rhazya stricta, Withania coagulans* and *Viscum album* (probably *V. cruciatum*). He lists one lichen, two mosses, a *Chara* and three ferns, *Cheilanthes szovitsii* (*persica*), *Notholaena vellea* and *Adiantum capillus-veneris*. There is no aroid and no orchid in the list but there is an *Allium*, a *Gagea*, a tulip and a *Scilla*.

At about the same time as Col. Johnston several others did some collecting. Gen. Wingate (c. 1895) collected grasses on the frontier and he had sketches made of these grasses which I saw at Kew. Geo. Watt (1851-1930), author of 'Dictionary of the Economic Products of India" (1889-96) collected in many places, including Baluchistan and Peshawar, and his plants are at Edinburgh. Harsukh and Inayat were collecting for Duthie at this period. Harsukh collected from Baluchistan to Peshawar, 1894-99. Inayat Khan seems to have been the first to collect in Tirah, tribal country in 1899, just west of the Khyber Valley. He probably collected more in Hazara than anyone else.

In 1926–27, the Rev. A. G. Lester-Garland, an Army Chaplain, collected

in Waziristan and Peshawar. At the turn of the century, the same three British Officers who collected in Hazara collected in the Peshawar area, Sir Harold Deane, the High Commissioner, M. Douie of the I. C. S. and Col. A. A. Barrett.

I cannot remember when I first visited the Peshawar area, probably in 1912 or 1913. From that date until 1962, I occasionally visited Peshawar usually going with athletic teams and stayed at Edwardes College or the Islamia College. Twice I collected from Peshawar to the Kurram Valley and once went to Landi Kotal in the Khyber Pass. We also sent staff and student collectors at various times. Prof. Mohindar Nath collected in the Khyber c. 1940 and A. R. Beg, M. A. Siddiqui, Sh. Ali Chaudhary and others so that the area is well represented in the Stewart Herbarium at Islamabad. Prof. E. Nasir also collected and probably Y. Nasir as well.

The first professors at the Islamia College to collect in the 1930's were N. A. Qazilbash and Hassan ud Din. Both kept personal herbaria of their N.W.F.P. and Chitral collections. They were followed by M. A. F. Faridi (fl. 1950–80). He is about the only Professor in Pakistan to collect and write about the fresh-water algae. In the 1950's and 1960's Peshawar became an important botanical centre although much of the emphasis has been economic. The Forest Research Institute was removed from Abbottabad to Peshawar and most of the attention of the staff has been on forest problems and *Materia Medica* so that the only publications of taxonomic importance have been two. M.A. Quraishi and S. A. Khan in 1965 published in the Pakistan Journal of Forestry 15: 364–393, the first fascicle of what was to be a 'Flora of Peshawar Dt. and Khyber Agency. The second portion was published in the same Journal in April 1967, pp. 203–254. Seventy species are illustrated. *Ranunculaceae* through *Tamaricaceae* have been published. I do not know whether or not the scheme has been abandoned. I have only received these two portions of a flora.

In 1952, Dr. Robert Rodin of the Forman Christian College, collected in the Peshawar area. Dr. S. M. A. Kazmi began to work in Peshawar from c. 1958. He worked in the North Regional Laboratories and had a herbarium there. He did a good deal of collecting but has not published a list of his findings. While at Harvard on a fellowship he monographed the *Boraginaceae* of Pakistan and Kashmir. This monograph was printed in parts in the Journal of the Arnold Arboretum in 1970 and '71 without an index. At present he is in Somalia.

While at Harvard, Kazmi became interested in Bibliography and prepared "Bibliography of the Botany of West Pakistan and Kashmir and adjacent regions" which was published by Field Research Projects, Miami, Florida, 1970. This is a most useful book of 136 double pages and he has divided the book into sections, *Spermatophyta, Pteridophyta, Bryophyta, Fungi* etc. I use this book constantly. There are of course omissions and misplacements but it is an excellent piece of work. Most of his work while in Peshawar was on *Materia Medica*.

In 1965 Dr. K. H. Rechinger of Vienna, formerly Director of the Botanical

Garden there, with Miss Jennifer Lamond of the Edinburgh Botanical Garden entered Baluchistan from Iran on a most important collecting trip which included Sind, Waziristan, the Kurram, Peshawar and Swat. While in Pakistan Dr. S. M. A. Kazmi of Peshawar accompanied the expedition and made a collection of his own which should be in Peshawar. I have seen Miss Lamond's collection in Edinburgh. This expedition is of great importance for Pakistani botany as Dr. Rechinger is including a slice of Pakistan clear across to Swat and Chitral from the Arabian Sea. He includes this area in his *Flora Iranica* and is citing not only the specimens collected on his 1965 expedition but some other collections as well which he or his numerous collaborators happen to have been able to see. In this work they have revised or are revising all the families included and as a result many names,we have become familiar with,have been changed. For example, G. Tuisl has revised the *Lactuca* we have been familiar with since Hooker's Flora was published, dividing it into six genera, *Scariola, Streptoramphus, Cephalorhynchus, Cicerbita, Mulgedium* and *Lactuca*. This means that henceforward,no serious systematic work in Pakistan can be done without taking account of what is being published in this great work. It should be noted that this work is not complete but sections are coming out each year and the whole work may take many more years to complete. It should also be kept in mind that Dr. Rechinger is a 'splitter' rather than a 'lumper' and that many of his 'new' species of recent years have not stood the test of time.

A few years ago while I was at Kew, c. 1970, a parcel of plants arrived from Peshawar and Dir collected by Prof. K. M. Salim and Bashir Ahmad Suhail (probably a student) which I named. I do not seem to have brought a copy of the list here.

There should be a large collection of Peshawar and Khyber plants at the Forest Research Institute, for Dr. Abdul Hamid Khan who has done a good deal of work on *Salix*, has collected in many places before he went to Faisalabad (Lyallpur). Dr. I. I. Chaudhri, the ecologist who went to the Karachi University and then to the U.S.A., Dr. M. B. Zaman, specialist in *Materia Medica* at the Forest Institute and Dr. Shaukat Ali Chaudhary formerly of Gordon, then at Faisalabad and now in Saudi Arabia have all done a good deal of collecting.

In 1958, Mr. B. L. Burtt of the Edinburgh Botanical Garden spent a year in Peshawar collecting in various places in the N.W.F.P. and Rawalpindi Dt. studying the possibility for a National Herbarium. His specimens are in Peshawar and Edinburgh. At the same time a Viennese ecologist Dr. Gertraud Repp, made a collection, also Dr. Monse, a Japanese.

The only book on the market to guide those interested in the N.W.F.P. flora has already been mentioned several times. It was first published in 1918 by the Lahore Commissoner of Forests, R. N. Parker, and revised in 1924. It has recently been reprinted without bringing it up to date. It is entitled "A Forest Flora for the Punjab" with Hazara and Delhi, Gov't Printers, Lahore. It only deals with shrubs and trees.

NORTHWEST FRONTIER PROVINCE

The Kurram Agency

The Kurram Valley is easy to find on the map, as Parachinar, the chief town of the valley, is close to the spot where the 34th parallel of latitude crosses the 70th parallel. There are only two passes which have been used commonly by travellers entering the Indian sub-continent from the north. The most famous is the Khyber Pass through which the Kabul River flows and the other is the Peiwar Pass through which the Kurram River enters Pakistan. This valley is west and a little south of the Khyber and is much more beautiful as it is not so dry and bare and at the head of the valley is the beautiful Mt. Sika Ram, the highest peak of the snowy Safed Koh Range, a branch of the Hindu Kush Mts.,which here runs east and west. At the present time very little traffic passes by this route between Pakistan and Afghanistan for when I visited it the only caravans I saw consisted of camels laden with deodar sleepers entering Pakistan.

The British began administering the Kurram as an 'Agency' in 1892 and after Pakistan took over it was still administered by the Political Dept. and when I twice visited the valley, once with the Foreign Minister of Pakistan, Mr. Manzur Qadir, I had to have a permit. The Valley is 100 miles long and the area is 1300 sq. miles. The Kurram River rises in Afghanistan and enters the Indus plain near Thal at c. 760 m. As Mt. Sika Ram is about 4752 m. high,there is enough range of altitude to permit foothill, temperate and alpine plants to grow.

Because of this snowy range the Kurram Valley is well watered and the flora is much different from the xerophytic flora of the Khyber. There is also some summer monsoon rain. The slopes of the Safed Koh are forested and the forests are Himalayan in nature and are mesophytic enough tq contain at least 27 ferns. The summer climate of Parachinar is much milder than that in the Khyber. Its altitude is c. 1500 m. Temperate fruits do well. When I visited the valley in April 1954 and May 1959 there was a good motor road for cars and buses as far as Parachinar, from Thal, where the road leaves the plains. The upper part of the valley, above c. 1830 m., is in the Hariab Dt. of Afghanistan.

It is a curious fact that the first botanist to use the Kurram route was John Martin Honigberger (1795-?) who was born in Kronstadt, Transylvania, U.S.S.R. He seems to have been an Austrian who after supporting himself as a doctor in Turkey, Egypt and elsewhere finally found his way to Lahore and became a physician at the court of Maharaja Ranjit Singh. In 1833 he decided to visit his homeland and did so via the Kurram and Kabul. He went through the pass in the heat of summer. Because of great heat and a swarm of locusts he did not collect much but he did do a good deal of collecting about Kabul and his specimens are in Vienna. Honigberger was a most interesting character and anyone interested in the conditions in this part of the world should read his book "Thirty five years in the East. Discoveries and sketches relating to the Punjab and Cashmere in connection

with medicine, botany etc." 2 vols., London, 1852.

Thanks to Dr. J. E. T. Aitchison (1836-98), Civil Surgeon and botanist, the Kurram Valley has been fairly well known botanically for a hundred years. The occasion for his being able to collect in this valley in 1879-80 was the Second Afghan War. One of the British generals was a keen amateur botanist, Gen. Sir Henry Collett, and he made it possible for Aitchison to collect for two years. The first year he was able to collect both in the Hariab and the lower valley but the second year only in the lower valley.

Aitchison made extensive collections but he made the mistake of numbering his specimens, beginning with number one both years, so that in citing his collections one has to cite the year as well as a number. The Hariab collections strictly speaking are Afghan and do not belong in the Pakistan flora but as there are no barriers they are likely to turn up in Pakistan with further collecting. He wrote up the results of his collecting in the Journal of the Linnaean Society (Bot.) 18: 1-113. 1880 and in 19: 139-200. 1882, with map and illustrations of new species. Some of his determinations were tentative and some only to the genus.

These two publications were published before most of the volumes of Hooker's Flora of British India so that the nomenclature is sometimes different from that used today. During the time Aitchison was at work in the valley, General Collett also did some collecting.

After I had become interested in the flora of the Kurram and in naming the specimens I had collected, I found that Aitchison's list would be much easier to use if his two lists were merged into one and the names brought up to date. I therefore published in Biologia 13(2): 47-124. 1967, a revised list of the plants of the Kurram. It is already out of date as a good deal of collecting has been done in the valley since my visits and as Dr. Rechinger's fascicles of the *Flora Iranica* are coming out he is citing his own, those of Miss Lamond and other collections from the valley.

As far as I know only Aitchison and I have written anything about the Kurram flora. Aitchison worked in the valley for two years and his Introduction to the flora is very useful. A few others have done some collecting. Harsukh, Duthie's collector, collected in the valley in 1894 and his plants went to Kew and Dehra. A Captain Hare collected in 1898. In 1937, Dr. Walter N. Koelz of Michigan, U.S.A., visited the Kurram and a school teacher named Afendi, who taught in Parachinar, made some collections which have been cited in Rechinger's flora. No doubt there are Kurram collections elsewhere, effectively hidden.

I had expected the Kurram flora to be largely Afghan but was surprised to find that at least on the Pakistan side (I did not see the other) the temperate and alpine flora of the Safed Koh is Himalayan and the foothill flora is, as might be

expected, Saharo-Sindian.

Some families are more Himalayan than others but a study of the *Ranunculaceae* shows how Himalayan the Kurram flora can be. Out of 35 taxa, *Aquilegia afghanica, Clematis robertiana, Oxygraphis* (*Ranunculus*) *shaftoana*, and *Ranunculus afghanicus* seem to be endemic. *Ranunculus aucheri* and *R. demissus* are the only species which are not found in the Himalayas. Out of seven *Berberidaceae* all are in my Pakistan list. One of these is a Kurram endemic. Out of six *Papaveraceae* three are common in Pakistan and the other three are Central Asian. The only conifer which is not Himalayan is *Pinus halepensis* and this was found at a shrine and is not native. Of the seven orchids, all grow in the Himalayas as well. There are more than 450 sp. of the genus *Astragalus* in Afghanistan and only 37 are in my Kurram list but ten of the 37 seem to be endemic in the Pakistani Kurram and a couple more in the Hariab Dt. of Afghanistan. The three wild oaks and the walnuts, the white birth and *Celtis caucasica* are Himalayan also. The Kurram willows are almost all to be found in the Himalayas. Twenty three out of 26 of the *Polygonaceae* seem to be wild in Pakistan and almost all of the trees. The more I have studied the situation, the more I am convinced that the Kurram flora is not Turanian but Himalayan.

A comparison of the Kurram flora with that of Afghanistan will show the extent to which that of the Kurram differs. All who have worked on the flora of Afghanistan have noted the surprising amount of endemism in certain families and the fact that there are two enormous genera which account for 10% of the flora. In Afghanistan, using Kitamuras figures, there are some 354 legumes and 187 belong to one genus, *Astragalus*. In the *Compositae* there are 102 species of *Cousinia* while there are only 10 in the Kurram and 34 of *Astragalus* and in both cases most of them are not Afghan species but are endemics or Central Asian.

Using the figures from Rechinger's *Flora Iranica* which are later than Kitamura's there are some 353 species of *Cousinia* in the *Flora Iranica* and he says that there are still more species of *Astragalus*. The reason that Rechinger cites so many more than Kitamura is that the Japanese are giving figures only for Afghanistan not for the whole of the *Flora Iranica. Astragalus* is the largest genus in his entire flora.

Omitting varieties, Kitamura lists about 2750 species in Afghanistan. The area is about 245,000 sq. miles while the Kurram is hardly 5% of that in area yet it has about 1100 species in its flora. I have listed only 7 *Chenopodiaceae* in the Kurram Vy. while there are 82 in Afghanistan.

Families with the most representatives

	Kurram	Afghan		Kurram	Afghan
Compositae	113	426	Boraginaceae	34	64

Gramineae	108	174	Caryophyllaceae	31	107
Leguminosae	88	354	Cyperaceae	31	65
Labiatae	55	158	Liliaceae	30	110
Rosaceae	51	60	Umbelliferae	30	65
Cruciferae	41	190	Scrophulariaceae	28	78
Ranunculaceae	35	73	Polygonaceae	27	49

Genera with the most representatives

	Kurram	Afghan		Kurram	Afghan
Astragalus	34	187	Cousinia	10	102
Polygonum	17	28	Rosa	10	10
Nepeta	13	41	Prunus	9	16
Potentilla	8	10	Lonicera	9	14
Salix	8	11	Veronica	9	15
Poa	8	6	Oryzopsis	8	6
Carex	12	27	Ranunculus	7	14
Euphorbia	10	22	Solanum	7	9

After comparing the floras of the Kurram and of Afghanistan, my conclusion is that the flora of the Kurram Valley is of temperate and alpine zones and is like that of the Nuristan Province of Afghanistan, an attenuated Himalayan and not a Turanian flora, while the foothill flora has tropical Indian elements in the hot summers while the spring flora is largely North African. Many species which grow in Afghanistan are not typically Afghan but have presumably come from Central Asia or the Himalayas or even further afield in Europe.

Among the 30 pteridophytes there is no endemic and all but one, *Adiantum aethiopicum*, is to be found in the Himalayas. This fern has a very wide disjunct distribution in the Nilgiri and Pulney Hills of S. India, in Ceylon, Australia, Africa and even in America. Only a few have collected in the Kurram,so it is very possible that more Himalayan species will turn up.

As far as I know nothing has been published on the mosses, liverworts, algae, lichens or fungi of the Kurram though specimens may be hidden away in collections.

NORTHWEST FRONTIER PROVINCE

Waziristan

The southernmost section of the N. W. Frontier Province is north and a little east of Baluchistan. The Sulaiman Range of Mts., the backbone of Waziristan, is

a continuation of the high range of northeastern Baluchistan.

The climate of Waziristan and Baluchistan is also similar and so is the flora, as might be expected. The climate is harsh and the whole country is dry, rocky and barren with only 250 mm or less of rain a year. There is a little snow in winter at the higher levels which soon evaporates. There is not enough rain to make perennial streams possible and there is so little soil and vegetation that when there is a good rain it runs off rapidly, producing flash floods, so characteristic of these barren mountains. Instead of the ground being shaded by the leaves of trees, it is so dry that when there is a forest of *Juniperus polycarpos* (*J. excelsa*) or *Quercus baloot* there is no canopy as the trees are not close together. The same is the case lower down where there may be mixed forests of *Olea cuspidata, Reptonia buxifolia* and *Sophora mollis*. There is not enough soil water to permit many trees per acre. The mountains rise to 3659 and 3900 m.

In these barren hills the climate improves with altitude and the most severe conditions are in the foothill zone below 1500 m. In the upper temperate zone it is surprising how many species are Himalayan. The species growing in Waziristan belong to so many floras that it is simplistic to say that the flora of the Suleiman range is Irano-Turanian or Turanian (Afghan). The climate seems to be much like that of adjacent Afghanistan but the flora is so different from that of Afghanistan that there must be ecological factors which have been overlooked which account for the Himalayan nature of the plants of the temperate uplands of this great spur of the Hindu Kush Mts. There may be enough influence of the summer monsoon to make a difference. Unfortunately I do not know of any meteorological data from Waziristan.

The foothill flora of Waziristan is Saharo-Sindian with some Indian and tropical admixture. There do not seem to be many endemics and those we do have do not seem to be common. One of the most prominent characteristics of the Turanian flora is the high rate of endemism in certain families and genera. In Afghanistan there are more than 360 species of *Astragalus* in the legumes and more than 350 of *Cousinia* in the *Compositae*. Both genera have large numbers of spiny species. The genera which have a high rate of endemism in Afghanistan are found on the Pakistan side of the line but do not have much endemism and do not have many species which are the same as those found in Afghanistan.

I have found that the following floras are well represented in the Waziristan flora, the Saharo-Sindian, Central Asian, Mediterranean, north of the Sahara, cosmopolitan, tropical Indian, and Himalayan, with a scattering of plants like *Samolus valerandi, Andrachne telephioides*, and *Dodonaea viscosa* with a very wide distribution. The *Dodonaea* has a surprising distribution in all warm countries in mineral soil. Blatter, who has probably done more work in Waziristan than any one else, lists a typical assemblage at E. Miramshah, *Reptonia, Acacia modesta, Nannorhops, Periploca aphylla*, and *Tecomella undulata*. These are foothill trees. The trees which are found at higher altitudes are Himalayan. The largest trees are

said to grow above c. 2700 m. The trees are *Juglans regia, Alnus nitida, Quercus dilatata, Q. semecarpifolia, Q. incana, Q. baloot, Q. glauca, Abies pindrow, Picea morinda, Pinus wallichiana, P. roxburghiana, P. gerardiana, Cedrus deodara* and *Juniperus polycarpos*. The *deodar* and *Q. glauca* may have been planted.

Waziristan is off the beaten path. It is hard to reach and there are no important towns, products or architectural remains. It is the only N.W.F.P. Agency I have not visited. It is, however, pretty well known botanically chiefly through the work of Dr. J. L. Stewart and Father Ethelbert Blatter, S. J. The tribes are the Southern and Northern Waziris. It is all thinly populated by migratory shepherd farmers. It is all rugged, dry and inhospitable as is Baluchistan and so much of the border country between Pakistan and Afghanistan.

The first to collect in Waziristan and report on its flora was Dr. J. L. Stewart who accompanied the First Mahsood Expedition of 1860 while he was a new Asst. Surgeon. The Expedition assembled at Tank and he made a collection of 400 species between Tank and Bannu before he got into the mountains. In 1862 he published an account of his work in the British Geographical Journal 32: 316-334. It was entitled "Notes on the Flora of the country passed through by the expeditionary force under Brig. Gen. Chamberlain,"

In 1888 and 1891 Rev. Dr. J. Williams, no doubt a chaplain, collected in Tank and S. Waziristan. (DD). In 1895 Duthie's collecter Harsukh, collected 200 sp. and the list is in manuscript in the Record Room at Kew. It has not been published and the specimens were placed in the Kew Herbarium without completing the list (K, DD). I was surprised to see how many Himalayan plants he had collected. In 1927 Joseph Fernandez, who had collected in Oman, gathered 9000 specimens which are in the Blatter Herbarium in Bombay. In 1927, Capt. W. R. Hay, Political Agent, climbed the highest mountain in the Agency, Pre Ghal (c. 3400 m.). See Geogr. Journ. 1928: 305-24. His small collection is at the B M.

The foundation of our knowledge of the Waziri flora was laid by J. L. Stewart and the second man to do a great deal of work in the area was Father E. Blatter of St. Xavier's College in Bombay who had previously done a great deal toward laying a foundation for a Sind flora. Blatter was not a man to work alone and he always took other workers from Bombay with him along with members of the St. Xavier's staff. He was often accompanied by Charles McCann, Secretary of the Bombay Nat. Hist. Society, P. F. Hallberg and Joseph Fernandes of St. Xavier's. In 1930 Blatter and Fr. F. Palacios, Prof. of Zoology at St. Xavier's and Fernandes made an extensive trip in the Agency. H. N. Dixon named the mosses. Several papers on Waziristan plants are listed in Kazmi p. 9. In 1930 we find *Plantae novae Waziristanensis* describing 13 new species; in 1932, a new gentian from N. Waziristan. In 1933 we find "New Plants from Waziristan" in which 12 additional species are described and from 1933 to 1935, in parts, in the Bombay Nat. Hist. Soc.,Blatter and Fernandes published "The Flora of Waziristan". A Lt. Meynell collected in Waziristan and gave his collection to Father Blatter.

In 1965 Dr. K. H. Rechinger and Miss Jennifer Lamond of Edinburgh,on their long trip through Iran and from Sind and Baluchistan,across Pakistan to Swat, collected in Waziristan and the results of their work in this area are gradually appearing in the fascicles of the *Flora Iranica.*

The list of plants reported by Harsukh from altitudes of from c. 2500 to 3800 m is surprisingly like a list from sub-alpine Kashmir. I would never have expected these to grow in these mountains. I note a few: *Euphorbia cognata, Thalictrum vaginatum, Podophyllum hexandrum, Polygonum sibirica, Valeriana jatamansi, Ainsliaea aptera, Ranunculus hirtellus, Arenaria neelgherrensis, Bergenia stracheyi, Rosa webbiana, Fragaria vesca* var. *nubicola, Kobresia capillifolia, Jasminum humile* etc.

Some Sindian species from the foothills are *Prosopis, Acacia, Cucumis prophetarum, Citrullus colocynthis, Salvadora oleoides, Rhazya stricta, Periploca aphylla, Calotropis procera, Chrozophora* sp., *Withania coagulans, Alhagi camelorum, Taverniera cuneifolia, Capparis decidua*, etc.

In Rawalpindi I found that the Spring flora was largely Saharo-Sindian while the monsoon flora was tropical and was largely Indian or had come from the Malayan direction along the base of the Himalayas or other parts of the tropics. Similarly in Waziristan the foothill flora is largely Saharo-Sindian but the temperate flora is largely Himalayan with smaller numbers from Central Asia or from Afghanistan. The rainfall increased with altitude and at Ft. Munro at c. 2000 m the average rainfall was given as 250 mm.

Some genera and families had evidently come in from the west and others from the Himalayas and in some large genera,some species had their closest relatives in the east and others in the west. Take *Clematis montana, C. barbellata, C. grata* and *C. connata* are all Himalayan while *C. orientalis* is found from Iran to Manchuria and is the only species in Ladak. Most Waziri *Ranunculaceae* are Himalayan, including *Callianthemum cachemirianum.* Five out of six species of *Berberis* are Himalayan while most of the *Papaveraceae* seem to be Mediterranean or Turanian. This is also the case with the *Cruciferae*. They are western, Saharo-Sindian or Iranian. The capers are western as are the tamarisks and *Zygophyllaceae. Dodonaea* grows in all warm countries. *Pistacia* and *Argyrolobium* are western as is *Caragana. Rhynchosia* and *Dalbergia* are tropical.

Bergenia, Sedum adenotrichum, S. ewersii, Hedera, Jasminum, and *Lonicera* are Himalayan while *Cucumis prophetarum, Citrullus colocynthis, Trianthema, Orygia, Rhazya, Calatropis, Periploca* and *Chrozophora* are Saharo-Sindian.

The mountains of Baluchistan and Waziristan are high but are not high enough to develop an alpine flora while the next area toward the northeast, the Kurram Valley with the Safed Koh reaching above 4570 m does. The highest mountain in Waziristan, the Takht i Sulaiman is 3444 m high. Being out of the

way, with no large or important towns and without good roads the visitors to Waziristan have not been numerous. There are probably Waziristan collections in Peshawar I have not heard about.

NORTHWEST FRONTIER PROVINCE

Hazara District

Hazara is the only district in the N. W. F. P. which is not Trans-Indus. The Indus river separates Hazara from Swat on the west. Gilgit lies to the north. Muzaffarabad Tehsil of Azad Kashmir and Murree Tehsil lie to the east and Rawalpindi and a corner of Attock Dt. lie to the south.

Hazara has the most varied terrain of any section of the N. W. F.P. as it begins on the Potwar Plateau at c. 610 m and the range of mountains which separates Hazara from Gilgit rises to c. 4570 m. Most of Hazara is in the watershed of the Jhelum River. The gorges of the Indus to the west are so steep and difficult that until recently, when the Chinese brought the Pakistani end of their great road from Sinkiang Province of Central Asia into Gilgit and then into Hazara, the people of Hazara had little access to the Indus.

From the plains, Hazara is reached by a motor road from Taxila, which is on the N. W. Railway and by a branch railway line to Havelian at the foot of the hills below Abbottabad. Extensions of this motor road lead to the most important parts of the district and to adjacent regions. One road ascends up to Nathia Gali, the summer capital of the N. W. F. P., and then leads eastward to Murree. At Murree it connects with the motor road to Rawalpindi and with the old motor road to Muzaffarabad and to the Kashmir Valley via Domel and Uri.

A second and most important road leads to the Siran Valley, then to the Kaghan and to Muzaffarabad. When I was collecting in this area there was only a mule track north to Baltistan and Gilgit by way of the Neelam Valley but I am told that there is now a road which can be used in the summer by motor transport to Gilgit. The road via Mansera to the Kaghan Valley has been used in recent years by thousands of tourists who visit this beautiful alpine valley every summer. It has also been used as a jeep road to Gilgit by way of the Babusar Pass (c. 4260 m). From the pass, the road drops down to the Indus and follows it up until it meets the Gilgit River.

The road from Abbottabad to Nathia Gali and then across to Murree via Dunga Gali and Changla Gali is a difficult high level road and in every monsoon it suffers from land slips and rock falls. In the British days, several small summer resorts were built along this road. Nathia Gali, the summer headquarters of the N. W. F. P. is the largest with a good many bungalows for officers and a good hotel. The next 'Gali' is Dunga Gali, the place from which Murree gets much of

its water. There is an interesting 'catchment' area on the mountain above Dunga Gali which I have visited many times for plant collecting because it is fenced in and grazing animals are not allowed. As a result the native vegetation is unspoiled and grows luxuriantly both in the temperate forest and on the grassy hillside between about 2700 and 3000 m.

The next Gali which is nine miles from Murree is Changla Gali at about 2745 m. This has recently been 'developed' as a summer resort. Changla Gali is only about 44 miles from Rawalpindi and many times we took our botany students there for the day to collect in the forest along the 'Pipe Line' and on the mountain above the Gali. This trip enabled our students to see a subalpine forest and the mountain spring time flowers which were completely different from the plants they saw daily at Rawalpindi.

Hazara is varied in more ways than one. Half of it is 'administered'. This half has a police Dep't, post-offices, schools, hospitals and public roads. The other part is locally called the 'gair ilaqa', literally the outside district. If there are any schools they will be little mosque schools and there are no government amenities. The people are independent like those in the 'no-mans-land' or buffer zone between Pakistan and Afghanistan. Their law is tribal law. Outsiders are not wanted. The rough country along the west side of Hazara in the Black Mt. area and the area in the north toward Gilgit are also 'tribal'. In 1888, probably because of some raiding, there was a Black Mt. Expedition which was accompanied by J. F. Duthie of the Saharanpur Botanical Garden. He collected on this expedition and in the Record Room at Kew, I saw his collection note book. One of his notes on this trek was that a grass called *Stipa sibirica* had sickened the baggage animals. I only know of one other person to collect in the "gair ilaqua". He is Mr. B. L. Burtt of Edinburgh who did some collecting in a rice growing area in 1958 which added some species to my list.

The great road to Central Asia which the Chinese have recently built, has opened up a great deal of difficult unknown country and when it is studied by botanist should add many more species to the Check-list. For a good many years I have kept a list of the Hazara plants which I have collected as well as those which others have reported, and at last count there were 1759 taxa including 79 pteridophytes. In my Rawalpindi Dt. list there are 1651. One reason that the number in the Hazara list is greater is that there is an alpine flora in Hazara while there is none in Rawalpindi because Murree Hill is only c. 2075 m in altitude. I have no reason to think that 1759 is the total number of taxa growing in Hazara for additional names are being added from time to time.

My Rawalpindi list is somewhat inflated as it contains a number of plants from the Galis. I should have called my list, a "Check-list of Rawalpindi District and the Murree Hills" because the Galis are included in the Murree Hills although most of them actually belong to Hazara Civil District. Murree is the shopping centre for both Changla and Dunga Galis. As our Rawalpindi students got to see

the Gali plants, I enumerated them along with the Murree species.

I did a great deal of collecting in Murree and Hazara from 1912 to 1962. Before 1947, we usually spent our summers collecting in Kashmir but after that date they were spent some where in Pakistan. We spent several summers in Murree, two in Thandiani near Abbottabad, two in Nathia Gali and two in Dunga Gali. I only collected once in the Kaghan Valley but have collected a couple of times along the road from Abbottabad to Kashmir and several times along the Rawalpindi road to Abbottabad and we took classes by bus to collect in the Haripur area on the plains and in the Abbottabad area.

The first person to do any collecting in Hazara seems to have been Falconer in 1836. He was a paleontologist in charge of the Saharanpur Botanical Garden after Royle. He was sent on a trade Mission to Kabul but the Afghans refused to meet with the Mission and he was allowed to go exploring in the Himalayas to see what he could find in the way of useful plants. He tried to ascend the Indus, not knowing that there was no road through the gorges. He was stopped by the people at Darband and he turned east and entered Hazara. It is said that he went to Srinagar by a hill route and wintered in Kashmir before going to Baltistan. He took his specimens to London. He did not collect much in Hazara.

The next collector to work in Hazara was Dr. J. L. Stewart (1832-1873), the first Conservator of Forests in the Punjab. After doing a good deal of collecting on the frontier he made a trip to Hazara and in 1867 published "Journal of a botanizing tour in Hazara and Kaghan in April-May 1859". J. Agro. Hort. Soc. Ind. 14: 1–73. His specimens are probably at Edinburgh.

The next worker, J. F. Duthie (1845-1922), added a great deal to our knowledge of Hazara. He worked for the Botanical Survey of India, first at Saharanpur and then moved his herbarium to Dehra Dun when the Forest Research Institute was built there. He also taught botany in the Forester's School. He was a great collector and trained Inayat Khan as a professional plant collector. He collected on the Black Mt. Expedition of 1888 and sent Inayat to collect in Hazara for four collecting seasons, 1894, 6, 7, 9. The specimens went to Dehra Dun and to Kew.

At the turn of the century between c. 1900 and 1910 there were three officers who collected in th . N. W. F. P. and about Nathia Gali. The first was the N.W.F.P. High Commissioner, Sir Harold Deane (1847-1924). He collected in Hazara and Murree. The second was Col. Arthur A. Barrett (fl. 1900-5) and the third was M. Douie of the I. C. S., an economist.

None of the foregoing except J. L. Stewart published any thing botanical. The first and only book on the plants of Hazara was written by R. N. Parker, Commissioner of Forests, Lahore who in 1918 published "A Forest Flora for the Punjab with Hazara and Delhi", Lahore. A second edition was published with a few changes in 1924 and it has since been republished without change. This is a

most useful work but only deals with the trees and shrubs. It is out of date as far as plant nomenclature is concerned and should be revised.

In 1947, due to partition, Pakistan needed to build a Forest School from scratch and train foresters as most of the local forest officers had been Sikhs and Hindus and went to India. Dr. Maclagan Gorrie, a capable British forester was put in charge and at first the only books the new school were his personal library. A herbarium was started. Drs. I. I. Chaudhri, A. H. Khan, M. Zahur and probably others started to collect and a few years later a new Forest Institute was built in Peshawar and the school moved there.

Following partition in 1947, Pakistani lecturers and graduate students began to take an interest in plant collecting and the most attractive places for professors to go themselves or to take graduate students were Swat and the Kaghan Valley. Some went to the Murree Hills especially those of us in Rawalpindi. Among the collectors in Hazara from Lahore were Drs. Sultan Ahmad and M. Zahur; from Karachi, Drs. Ali and Jafri, from Peshawar, Hasan ud Din, Drs.N. A. Qazilbash, M. B. Zaman, S. M. A. Kazmi, I. I. Chaudri, A. R. Beg, A. H. Khan (also of Faisalabad); from Rawalpindi, M. A. Siddiqi, Prof. Nasir and Yasin Nasir, Sh. Ali Chaudhary, who collected for Gordon College while accompanying Dr. W. S. Metz of the Ford Foundation, a plant photographer, M. Dar and others. Before 1947 most collections went to Dehra Dun or Great Britain but almost all of these recent collections are preserved in Karachi, Lahore, Peshawar or Islamabad.

If all of this material were to be brought together there would be enough to prepare a good local flora but for the fact that most of the types have gone abroad. Although the collectors have been so numerous, and probably I have overlooked a good many, I do not know of anything of significance which these collectors have written. Although I have not published my check list, it could be reconstructed from my 1972 Annotated Catalogue.

The mountainous part of Hazara is in the drainage basin of the Jhelum River which is an affluent of the Indus. Azad Kashmir and Kashmir proper are also in the Jhelum watershed and so there is not much difference in the flora except for the fact that Hazara is a little further west than Kashmir and is a little drier and a little less tropical so that as one travels westwards from Jammu, Himalayan species which have been common further east, drop out one by one so that one can say that the Hazara flora is like that of Kashmir but somewhat attenuated. Not only does Hazara have a rich flora of flowering plants but Pteridophyta and fungi are also well represented though no check-list is in print.

During the monsoon the forests of Murree and the Galis are full of fleshy and woody fungi which my wife used to like to paint and which we and some friends used to like to gather for eating. There is a rich field there for some one for it seems to me that the fleshy and woody fungi, except for Dr. Sultan Ali's fine work, have been more neglected than any other important group.

We do not know enough about the distribution of the plants of the N. W. Himalayas to say whether or not any of the species first described from Hazara are only to be found within its bounds. When I recently looked through my check-list I was surprised to find how many species were first found in Hazara and if one counts a species endemic if limited to the N. W. Himalayas, I think that more than 80 species are endemics. Quite a few of them are named after N. W. Himalayan collectors, Falconer, J. L. Stewart, Inayat, Griffith (Nuristan), Duthie, Thomson, Winterbottom, Jacquemont, Hormusji, Huegel, Royle and R. R. Stewart. There are several *hazaricas*.

There are a few unfamiliar genera, each represented by a single species, *Pertya aitchisonii, Dubyaea oligocephala, Tovara virginiana, Stachyopsis oblongata (a Phlomis?), Arcyosperma primulifolium, Pseudostellaria himalaica, Eriocycla stewartii, Scaligeria aitchisonii.*

HAZARA PTERIDOPHYTES

There are not as many pteridophytes reported from Hazara as there are from the whole of the former State of Kashmir and Jammu but the area of Hazara District is much less and it is surprising that there are as many as have been reported. More than 100 taxa have been reported from Kashmir and I have 79 on my Hazara list which I do not think is complete for I have a few on a "to be expected list" as they have been found in adjacent territories such as Swat and Murree. There are a few surprising ferns because they are growing far to the west of their nearest known congeners. The strangest case is *Asplenium pekinense* Hance which Oertal found at Dhamtaur and which several have found near by in the Lower Jhelum Valley near Domel. How did a Chinese fern get here? The second is *Pallaea hastata* (Thunb.) Prantl which I found in pine forest among rocks at Abbottabad which Beddome reports from Almora and Sirmoor. I thought that *Gymnopteris vestita* was a third but Rodin has found it in Swat still further west.

Another thing about Hazara ferns which surprised me is the number which grow in the temperate U.S.A., half way around the world and are described in Britton's Manual of the plants of the Eastern U. S. A. and Canada. I noticed *Cystopteris fragilis, C. montana, Polystichum lonchitis, Asplenium viride, A. trichomanes, A. septentrionale, A. ruta-muraria, Cryptogramma stelleri, Adiantum capillus-veneris, A. pedatum, Pteridium aquilinum, Osmunda claytoniana, O. regalis, Botrychium lunaria, B. virginianum* and *Equisetum arvense*.

Burtt recently discovered *Polystichum neolobatum* Nakai between Oghi and Battal in Hazara Kohistan and Burtt and Kazmi report finding *Diplazium japonicum* in Tribal Hazara in 1958. It had previously been found in the Neelum Vy. (Kishenganga Vy.) of Kashmir.

This is another group of ferns which has reached Hazara from the Far East and a few are found even further afield. I think that it adds a good deal to the interest of studying plants to know something of their distribution. Having just looked up the distribution of many of the Hazara ferns it seems to me that no family of flowering plants has so many species with such a wide distribution. No doubt the reason is that fern spores are distributed more easily by wind than larger and heavier seeds. Examples of Hazara ferns which are also in the Far East in such countries as Taiwan, Korea and Japan are, *Equisetum ramosissimum* (Holland and Japan), *Lygodium japonicum, Woodwardia unigemmata, Crypsinus hastatus, Lepisorus clathratus, Microsorium membranaceum* and many more. *Pteris cretica* is found in the temperate and tropical regions of the whole earth and so are forms of *Pteridium aquilinum* and *Adiantum capillus-veneris. Cystopteris fragilis* is another world citizen and in Tibet ascends to c. 5300 m.

No Hazara ferns seem to be limited to that district. *Athyrium mackinnonii* and *A. macdonellii* seem to be endemic in the western Himalaya.

MALAKAND DIVISION

Swat

The most interesting and beautiful part of the Northwest Frontier Province of Pakistan is Swat. It is bounded on the east by the Indus, on the north by Gilgit, on the west by Dir and Chitral and on the south by Mardan and Nowshera Dts. of the N. W. F. P. Most of Swat is contained within the watershed of the Swat River but Buner, a district on the southeast, drains into the Indus being separated from the rest of Swat by a range of hills.

The lower part of the Swat Valley has been well populated for two thousand years or more. It was a well known centre of Gandharan civilization and the people then were Buddhists. Buddhist stupas and other archaeological remains are still visible, and below Mingora, Pakistani and Italian teams have excavated buildings and statuary similar to the antiquities in Peshawar and Mardan Districts of the N. W. F. P. The area is well watered and green but the original forests vanished long ago. Most trees are cultivated and are not indigenous. We can, however, guess at what the dominant trees of the lower valley were in ancient times, for there is a taboo against cutting graveyard trees and as each village has its cemetry, it has a grove of *Acacia modesta* mixed with *Olea ferruginea. Viscum cruciatum* is a common parasite on the olives.

To see Swat at its best, one should visit it in late March or in April when the fruit trees are in bloom and there is still snow on the surrounding mountains. There are fields of opium poppies with blooms of various pastel shades, reminding me of the tulip fields of Holland. Most, if not all, of the spring flowering trees

have been planted. In fact almost all the trees about Mingora and Saidu Sharif are adventives. There are apples, pears, plums, figs, mulberries, walnuts, apricots, loquats, grapes, the Persian lilac, willows, the Lombardy poplar, the shisham, the silk cotton trees and a *Eucalyptus* or two.

At this season, the mustard fields are a golden yellow and the yellow basant (*Reinwardtia*) is common on banks and in crevices of lime stone rocks. It blooms even though cropped close to the ground. Protected in a garden it becomes 2–3 ft. tall. The young wheat fields are full of poppies. The graveyards are blue with a cultivated *Iris* and some times with a white one. There is a small wild *Iris sisyrinchium* and a large yellow one, *I. aitchisonii*. There is a small, blue *Scilla*, lots of pink and white tulips and blue *Ixiolirion*. There are numerous mints, peas, wild onions and buttercups. There is the beautiful Hazara lily, *Notholirion*, which used to be called *Lilium roseum*. There is also a striking large yellow mint, *Eremostachys superba*, which I have only found here and in the plains below Attock. I think that *Incarvillea emodi*, which used to be called an *Amphicome* and which grows in limestone crevices is the best of all. I nearly forgot the *Narcissus*, probably introduced, which blooms in January.

This Spring flora came in from the west and is North African or Mediterranean. It disappears in the hot weather and when the monsoon breaks, an unrelated tropical flora, Indian or Indo-Malayan takes its place. The Swat spring flora is finer than the one we have in the foothills of the Punjab further east.

When Alexander the Great came through Afghanistan into North India on his great Indian expedition, which took him as far south as Lahore before turning west, he did not enter India through the Khyber Pass but passed through Swat to the Indus. Sir Aurel Stein, the great Central Asian explorer and archaeologist, obtained permission to explore Swat while it was still closed to outsiders, in his hunt for the route Alexander took. For that purpose he was allowed to survey and map the state. In his search for the place the Greeks called *Aornos* in the Greek chronicles, he visited many places on the Indus side of the state that no other outsider had been able to see, and it is too bad that no plant collector was assigned to work with him. He found that the side of Swat toward the Indus is extremely rugged, precipitous and pathless and too steep for cultivation and so has very few inhabitants. Although Sir Aurel was not a plant collector, I saw two or three specimens he had sent to Kew from Swat. *Butea monosperma* which must be at the western edge of its range is one and the other, I think, is *Iris drepanophylla*.

During the period when Swat was closed, someone by the name of T. D. Weatherhead collected a few plants there in 1938 which are at the BM in London.

Swat is not an old state but the creation of Wali Mian Gul who built his little empire by conquest. When we visited Swat in 1952, the original Wali had retired to a rather small white marble palace he had built at Marguzar, a quiet retreat a few miles up the valley from Saidu Sharif, the capital. The retired Wali did

not know English but his son was educated at the Islamia College, Peshawar. The son was an enlightened ruler and the State improved rapidly under his administration. He built roads, schools and hospitals and founded a college in the capital. His little army was used for road buildings. His father had established law and order by building a chain of small, square, stone and timber forts, with a garrison of about 40 men each, and these were all connected with headquarters by telephone. The soldiers had no uniforms but could be recognized by their guns and ammunition bandoliers.

Swat was closed to almost all outside visitors during the British Raj, but after 1947, restrictions were gradually removed and permission to enter was easier to obtain.

Before the modern period, during the Chitral Relief Expedition of 1895, the Commanding Officer, Gen. Gatacre collected a few plants in Lower Swat but for half a century, Swat was a blank on the botanical map. Then in 1949, Prof. Muhammad Salim of the Government College, Lahore, took a group of students to Swat and made a collection of about 300 numbers which they sent to me for naming. So many of them were unfamiliar that when in 1952, another party of Lahore professors and students was organized, I was happy to join them. From that beginning a stream of collectors has gone to Swat.

In 1952 our party went by train to Dargai in Mardan Dt. of the N.W.F.P. This was the end of the line. We then went to Swat by bus. We first climbed to the Malakand Pass (835 m.) and then followed the Swat River to Mingora, the business centre, of the little country and only a few miles from the capital. Our first collecting trip was to Mr. Ilam, site of an old Hindu shrine at c. 2910 m. We were allowed to stay in the Wali's Guest house and the next day his younger son and grandson accompanied us to Mt. Ilam. The route we followed was through his private game preserve so that it was an unspoiled collecting ground for plants. After this trip we hiked up the highway to Kalam at c. 2045 m in Swat Kohistan, using it as a centre for exploring the surrounding mountains.

Swat can be divided into three main areas. In the main valley there is Lower Swat where most of the people live, which extends up to Bahrein where the mountains close in and the river flows through a gorge. These mountains cut off many of the rain-bearing clouds of the monsoon so that Upper Swat, or Swat Kohistan, is drier than Lower Swat and has a flora more like that of Chitral and parts of Gilgit. The summer climate of this area is very pleasant and some day Kalam and the area toward Utror may become a summer resort. This is the second part of Swat. Not only does it have a different flora but the inhabitants are Dards and not Pathans and they have their own language and style of dress.

The third part of Swat is Buner. This a fertile area, mostly below 1000 m , chiefly south of Lower Swat and separated from the valley of the Swat River by a range of hills. The road to Buner from Mingora has to cross this range by the

Karakar Pass. Once, when Prof. Nasir and I visited Swat, we left by this road, visited the shrine of Pir Baba and then went south by a litte used road to Nowshera in the N. W. F. P. Buner is warm and tropical in the summer and is drained by the Indus itself. We made a collection in Buner but I do not know anyone else who has collected there except Sultanul Abedin of Karachi University. There is no doubt there are others.

Just as Nanga Parbat dominates Astor, and Chitral is dominated by Mt. Tirich Mir, Upper Swat is dominated by Mt. Mankial, c. 5800 m. Upper Swat or Swat Kohistan is so mountainous that there is little land level enough for irrigation and the population is scanty. When I was there, Kalam (c. 1900 m) was only a small village where the *tehsildar* has his head-quarters. Kalam once had 1000 houses but was almost wiped out in a war between Ushu and Utror. In 1962 there was a new rest-house on the plateau, high above the river, with fine views of the snows of Mt. Mankial. The river forks at Kalam. One branch turns west toward Dir and the other leads up to a pass which the Japanese in their report on their visit to this area call the Dadarili An (5060 m) leading into Gilgit. Duthie called it the Palosar Pass. The Japanese call Mankial Peak, Mt. Falak Sar. In this region the limit of cultivation was not much above 2100 m and maize and buckwheat were the highest crops.

In Swat Kohistan, at the tree line, as in Kashmir, there is *Betula utilis*, the white birch, in some places, but the most interesting thing for me was the presence of a gregarious oak, *Quercus semecarpifolia*, which might be reduced to shrub size or become good sized trees with rounded tops, which were well separated as in a park. The Japanese in their discussion of the trees of this area do not mention this species. I was also pleased to find *Pinus gerardiana* (which the Japanese call *P. griffithii*) between Kalam and Utror. The first time I went to Kalam the motor road had not reached Kalam but the last time in 1962, it went a few miles further to Gabral on the Utror side of the area. I believe that it now goes north to Ushu.

In 1953 with A. R. Beg, I walked east from Kalam past Ushu to the first glacier on Mt. Mankial. The highest trees were the white birches. At most of the places we visited near Kalam the last trees were *Quercus semecarpifolia*, an oak with a very spotty distribution, something like that of *Pinus gerardiana*, the *chilghoza* pine with edible seeds. I did not find either of these trees in the Jhelum watershed in Kashmir but they appear again on the Upper Chenab.

When we made the trip to Mt. Mankial and Ushu the area was not considered safe and the Tehsildar sent six soldiers with us, charging a rupee a day for their services. The soldiers said that their only salary was 16 maunds of wheat a year (1280 lbs.) so we were not surprised to hear about their looting the shepherds when they had the opportunity.

Accomodations were most primitive. One night calves were turned out of their shed and we spread maple leaves on the floor and placed our bedding on the

leaves. Another night we slept in a small windowless shop. The soldiers must have had to supply their own guns for no two were alike. Some were flint locks, a few were long-barrelled and many, if not all the guns, were village made copies of Mausers, Enfields, Austrian or even American guns. The dates on the originals were also copied and I noticed 1859, 1881 and 1884. A gun collector could have found most interesting material for a museum. There was no time-piece in the nearby army post and only one man could read. It was evident that they were not overpaid.

There was a good deal of cultivation between Kalam and Ushu. I was interested in the wayside trees between c. 2000 and 2300 m. There was a little *Pinus gerardiana*. *Deodar* was dominant for a mile or two and then for no apparent reason *Quercus baloot*, which was dominant in the gorge above Bahrein appeared again. Then there was *Fraxinus xanthoxyloides* and near a stream *F. excelsior*. In one place there was quite a little *Quercus dilatata*. *Q. incana* does not reach this altitude.

The climate of Kalam must suit the deodar to perfection for I never saw so many deodars anywhere else and it was regenerating naturally. Now that roads reach Kalam I hope that the forests will not be destroyed for quick profit but that modern forestry methods will be used in order to keep the forest healthy and productive for the future. There must have been some magnificent specimens in the past. In a mosque we saw a beam 200 ft. long. The tree must have been 250 ft. tall. We saw some magnificent beams in bridges.

On July 2, the next day, we climbed high to an easy valley above a great fall where the water had cut deep into the cliffs. There was much *Quercus semecarpifolia* here, instead of white birch, and there were trees with rounded outline while many others were dwarfed. The hillsides were too dry to furnish much variety in the herbs. The flowers of *Morina coulteriana* were dry and if there had been spring flowers they too would have been finished.

In 1953, Beg and I walked to Utror from Kalam and were allowed by the police to sleep in the village mosque. We intended to return to Kalam through the forest between Utror and the Dir border. We had been on our way a couple of hours when the police caught up with us and brought us back. Men from Dir had made a raid and stolen 15 cattle. Three men had been captured and there had been firing and they wanted us out of the way. We were told of a Maulvi shepherd village we would have liked to visit, probably on the meadows above the forest. There was *Polemonium coeruleum* growing in openings of this forest. The language of the shepherds is allied to Punjabi.

Anyone visiting Kalam should take a day or two to collect in the Sho Nala, the nearest little valley running down from Mankial to the Ushu stream. We found some interesting things in this nullah, *Cicer macranthum* Popov, a Chitral and Russian species, *Alchemilla trollii*, *Chrysanthemum tibeticum*, *Hyssopus officinalis* and *Dryopteris oreades* Fomin, another Central Asian species. It would be

worth while to ascend to the plateau on the west side of Mankial which can be seen from the Kalam rest-house. There are fields and houses on this plateau and making that a base, it would be possible to search the slopes of Mankial to the snow line. The first half of July should be a good time. We visited the plateau but did not get up into the alpine zone on the west side of the mountain.

In the Swat Kohistan forests there are a good many kinds of trees, both evergreen and broad leaved. There are two pines, *Pinus wallichiana* and *P. gerardiana* and the Himalayan fir, spruce and yew. I did not find the yew common. The blue pines were suffering from the smallest of the mistletoes, *Arceuthobium minutissimum*. There are two kinds of ash, *Fraxinus xanthoxyloides* and *excelsior*, two maples, *Acer cappadocicum* and *caesium*. There are several willows, *Crataegus songarica, Pyrus lanata, Prunus cornuta* and *armeniaca, Malus pumila, Corylus colurna, Populus caspica* (*alba* s.l.) & *P. ciliata, Juglans regia, Euonymus hamiltonianus, Elaeagnus umbellata* etc. These all grow wild or are cultivated in the Western Himalaya. I did not find *Juniperus polycarpos* which is so common in the Trans-Himalaya and high, dry Kashmir valleys. *J. communis*, a shrub, however, is found. Most of the temperate shrubs of the Kohistan are also W. Himalayan. The *tehsildar* told us that there was a wild bitter almond in Kandia which we did not see.

It is difficult to travel anywhere in Swat except by the main roads. In the last 25 years there has been a good deal of collecting along these roads but little in the high temperate and alpine zones. The mountain ranges run north and south, parallel to the Indus, Swat and Panjkora Rivers. There are snowy mountains between the Indus and the Swat River, high enough to have glaciers and glacial lakes and another range, not so high, lies between Swat and Dir. One day, when we were at Bahrein, we travelled up the swift stream which comes in from the west through the village. The steep path led up through rough pasture land and then there was a Kashmir like forest. Ascending through this we were surprised to find that above the forest the slope was gentler and there was a village with extensive fields. We did not get up into the village pastures. The temperate and alpine parts of these ranges were little known when I left Pakistan.

There is a range of high mountains running south from Mt. Mankial into Buner with one peak of 4500 m. This range separates the Swat River Valley from that of the Indus. There is no road along either the east or west bank of the Indus and Sir Aurel Stein says that the eastern slope of this range is almost inaccessible. In 1953, A. R. Beg and I made a short trip from Madian (1280 m.) to a place called Bishigram and up to a glacial lake on this range. I do not know of any name for the lake. I hoped to find some good alpines and we pushed on to the lake. For the first time in 42 years of work in the Himalayas, I needed the help of my guide to ascend the last few hundred feet. The lake was a disappointment for though it was July 11th, most of the lake was still covered with ice. We did, however, find a good many interesting temperate things on this trip and I feel that there are probably interesting plants on the western slopes of this range that have not yet been collected.

There is a place called Miandam at c. 1830 m., south of Bishigram, where there is a rest house. This would be an excellent base for making excursions into this range. When we were in the Bishigram area we met a party of Railway Scouts who had been hiking along this range but I do not know of any botanist who has explored this area.

Until 1949, Swat was practically unknown botanically and its bibliography is very short. The first paper to mention the Swat flora is Duthie's "The Botany of the Chitral Relief Expedition of 1895" in the first volume of the Records of the Botanical Survey of India, 1898. This barely touches on Swat. The second is 'Plants of West Pakistan and Afghanistan' edited by Siro Kitamura, Kyoto Univ., 1964. This book is illustrated by maps and excellent photographs. The work is based on a joint trip, as far as Swat is concerned, of Kyoto and the Punjab University in 1957. There were three Japanese forestry students as collectors, K. Honda, K. Ogino and G. Iwatsubo and my former student Shaukat Ali Chaudhary who is now in Saudi Arabia. This party was in Swat from July 9 to the 24th. They ascended the Swat River to Kalam and then went north via Ushu and the Jaba Lake to the Dadarili Pass which led them into Gilgit. They seem to be the first botanists to have gone to Gilgit by this route. The names of the plants which they collected in Swat are mixed in with those collected on other expeditions in Nuristan, Gilgit, Chitral and Baltistan and so their list is hard to use. They report a few new species and on pages 247 to 268, they discuss the vegetation of Swat Kohistan and the East Hindu Kush. The third is my Check List of the Plants of Swat State, Northwest Pakistan, reprinted from the Pakistan Journal of Forestry 17(4). 457-528. 1967.

In 1965 Dr. Karl Rechinger collected in Swat and he includes Swat and Chitral in his *Flora Iranica*. My 1967 Check-list of the plants of Swat contained 1473 taxa of flowering plants and 55 pteridophytes. Two more have turned up since.

The largest families with numbers of taxa

Gramineae	183	Scrophulariaceae	41
Compositae	132	Cyperaceae	40
Leguminosae	111	Ranunculaceae	40
Labiatae	67	Boraginaceae	37
Cruciferae	60	Liliaceae	31
Umbelliferae	60	Polygonaceae	28
Rosaceae	59	Geraniaceae	24
Caryophyllaceae	43		

I am not under the illusion that these numbers represent all the plants for this was my estimate twelve years ago and much collecting has been done since that time.

In the last 30 years a surprising amount of collecting has been done on Swat higher plants but little has been done on the cryptogams except the vascular crypto-

gams. I have 57 on my published list. Dr. Sultan Ahmad has collected fungi and mosses but if he has published any Swat species I have not run across the publication. I have not estimated the number of endemics. That should be done when Rechinger's work is complete.

The most abundant genera are *Astragalus* 25, *Polygonum* 19, *Nepeta* 18, *Poa* and *Carex* 16, *Potentilla* 14, *Bupleurum* 13, *Veronica* and *Geranium* 12, *Epilobium, Artemisia, Salix* and *Dryopteris* 11, *Euphorbia, Cyperus, Allium* and *Berberis* 10, *Sedum, Ranunculus, Prunus, Galium, Scrophularia* and *Agrostis* 9, *Lonicera, Silene, Impatiens, Medicago, Vicia, Rubus* and *Pedicularis* 8.

The number of grasses is no less that 183 and almost all of them are found elsewhere in Pakistan. *Agrostis stewartii* Bor turns out to be *A. hissaricus* Roshev, a Russian species. *Cleistogenes gatacrei* is so far only known from Chitral and Swat in our area. Wild rye, *Secale afghanicum*, is common in Swat grain fields and on the frontier, but I have not found it in the Punjab. There is thus virtually no endemism in the Swat grasses.

Astragalus is one of the largest genera in Swat. There are 25 species listed while there are more than 400 in Afghanistan in Rechinger's list. Of the 25 in Swat, 12 are also Afghan but many of these were first described by Russian, or Indian botanists or by Dr. Ali of Karachi which means that though some may grow in Afghanistan, they are not really Turanian but Himalayan or North Asian. This is another indication that the plants of Swat do not belong in the *Flora Iranica*. I have gone through a good many families and find that the Swat flora is primarily Himalayan and secondarily Russian Central Asian with of course some cosmopolitan elements. The Japanese call the Swat flora Sino-Japanese.

There seem to be 57 taxa of pteridophytes, a respectable number for a small area. Fraser-Jenkins of the British Museum is studying the N. W. Himalayan *Dryopteris* and *Polystichum* by modern cytological methods and has segregated *Dryopteris stewartii* from what I have been calling *D. ramosa*. He also found a new hybrid among my Swat ferns, *Polystichum lonchitis* x *P. prescottianum*. Only one of these Swat ferns had not been reported from the Himalayas and Alston named it *Dryopteris oreades* Fomin, a Central Asian fern.

Before 1950, Swat was practically unknown and in these 30 years scores of students from Karachi and Punjab Universities and from the Forest Research Institute, Peshawar have collected plants in Swat. Little Swat material has been collected by people from outside Pakistan and so it will be possible for the person who prepares a flora for Swat to assemble enough material in Pakistan to prepare a really good flora. The early collections from the Punjab, Sind, Baluchistan, and in fact, from almost everywhere else are scattered far and wide.

MALAKAND DIVISION

The District of Dir

At the present time the former states of Dir, Chitral and Swat are parts of the Malakand Civil Division of the Northwest Frontier Province of Pakistan. Dir is the least known of these three areas and has a very different history. Although it is much nearer Peshawar, the capital of the N. W. F. P., it is the last of the three states to be administered from Peshawar. When Prof. Nasir and I visited Dir in 1962 the Nawab of Dir was still in complete control of his State as far as internal affairs were concerned and there were no modern hospitals, or schools. There were no post offices and there was no Forest Department. The road to Chitral crossed Dir, entering Chitral by the Lowari Pass and plants growing along the road had been collected by many visitors but Dir itself was closed to outsiders and I do not know of anyone collecting in Dir State until recent years.

The flora of Chitral has been fairly well known since the Chitral Relief Expedition of 1895 and that of Swat since my check-list of the plants of Swat in 1967 but the first substantial contribution to our knowledge of the plants of Dir was Mir Alam Khan's "A contribution to the Flora of Dir State", an M. Sc. thesis submitted to the University of Peshawar. Prof. K. M. Salim was in charge of his work. He collected twice in Dir and listed 272 taxa. This paper is presumably in manuscript only and I have not seen it but in 1972, M. B. Zaman and Mir Alam Khan of the Medicinal Plant Dept. of the Pakistan Forest Institute, Peshawar, published as Bulletin No. 6 "List of Medicinal and other flowering plants of Dir" (pp. 28, with map and index). This bulletin lists 635 flowering plants and more than half are thought to be medicinal.

Dir is the smallest of the three districts with only 1840 sq. miles of territory while Swat has 5263 and Chitral has 5663. Dir is bounded on the west by Afghanistan. Chitral lies to the north, Swat to the east, and the Malakand Agency to the south. Dir is the poorest as well as the smallest of the three districts and has suffered most from destruction of forests and erosion as the forests were not protected until recently. Dir begins at c. 600 m and ascends to c. 4000 m , but unlike the other two districts, does not have a great mountain with glaciers. Each district is drained by a different river. Chitral is drained by the Kunar which flows into Afghanistan and returns to Pakistan after joining the Kabul River. The Panjkora river drains Dir and joins the Swat river. The main Swat Valley is drained by the Swat River but the Buner section of Swat is drained by small branches of the Indus itself.

Dir and Chitral have been off the beaten track and have not had a memorable past. They do not have the remains of ancient monasteries and stupas, as Swat has, and no Chinese pilgrims have written about them. Swat was a part of the old Gandharan Buddhist civilization and was highly civilized two thousand years ago. The people of Dir and most of Swat speak Pushtu while the people of Swat Kohistan are

Dards with a separate language. The people of Chitral speak Khowar. All the inhabitants of the three districts are Muslims except for a few villages of *Kaffiristan* near the Lowari Pass in Chitral.

There is a great difference between the weather of Chitral along with Swat Kohistan and that of Dir and the main Swat Valley plus Buner. The whole of Dir and all of Swat except Swat Kohistan benefit from the summer monsoon. Chitral and Swat Kohistan are drier as the Hindu Raj Range, which the road to Chitral crosses at the Lowari Pass, cuts off most of the monsoon moisture. Winter rains supply much of the moisture available for the plants of Chitral and Swat Kohistan while the dry season is in the summer. The reason why Chitral and Swat Kohistan have so much *deodar* is that it seems to do best under the Mediterranean like conditions of dry summers and snow in the winter.

When I was in Pakistan there was little in the way of meterological data but since I left in 1962, several meterological stations have been established and in the first part of "The flora of the Malakand Division, Part 1", A. R. Beg and Abdus Samad Khan in 1974 in the Pak. Journ. For. 24: 171-185 on p. 177 give useful metereological statistics. They call attention to the fact that these figures do not adequately reveal the climatic differences to be found in the area as the altitudes of the present stations only vary from 668 m. at Chakdara to the station at Chitral Town at 1556 m. while plants are to be found clear to the snow line. There are still no statistics for most of the region.

In the introduction to this flora a great deal of useful information is provided. First there is a good deal of material on the geology, rocks and soils, then on the different climates and then a discussion of the plant associations. Useful lists of common taxa are provided. In Southern Dir there are foothill forests which A. R. Beg and A. S. Khan call dry, subtropical, broad-leaved forests. The major species in this list are also to be found further east in Rawalpindi Dt. They are *Olea cuspidata, Acacia modesta, Grewia oppositifolia, Ehretia aspera, E. laevis, Dodonaea viscosa, Sageretia theezans, Gymnosporia spinosa, Rhamnus pentapomica, Periploca aphylla,* and *Melhania futteyporensis*. Here also are *Chrysopogon* sp., *Cenchrus* sp. and *Panicum antidotale.*

In the western corner of Dir there is one western tree which enters the picture. All the plants so far mentioned are common Himalayan foothill plants but *Reptonia buxifolia* is a common N. W. F.P. species which has come from the west, a Mediterranean type.

Secondly in the southern part of Swat and Dir there are subtropical forests of *Pinus roxburghii*. This tree was no doubt much more common in ancient times but has suffered through the activities of man. The authors call attention to the fact that in western Dir in the Timargarh area, the long-leaf pine grows but is stunted and the individual trees are not close together showing that the trees are at the extreme edge of their range westward and cannot develop properly.

A. R. Beg and A. S. Khan give a good account of the dry temperate forests of Upper Dir, Chitral and Swat Kohistan. "They are formed between 1500 and 3300 m. (3600 on southern slopes) in the inner dry mt. ranges of all three districts. They develop under a low mean annual rainfall of 250-725 mm., mainly or entirely received during the cold period."

"The forests are open, to very open, and even steppic with sparse to rich xerophytic undergrowth. The various forests comprising this forest group are composed of one species dominants such as *Pistacia mutica, Quercus ilex (baloot), Cedrus deodara, Pinus gerardiana* and *Juniperus polycarpos. Cedrus deodra* and *Pinus gerardiana* often form a mixed crop, the former occupying more humid sites while the latter, dry rocky situations. The most important shrubby species is *Artemisia maritima*."

In Dir, the *Quercus baloot* forest replaces the *Olea-Acacia-Reptonia* forest between 1200 and 1800 m. Associates are *Parrotiopsis, Cotoneaster nummularia, Berberis kunawurensis, Indigofera heterantha, Prunus* sp., *Daphne oleoides, Sophora mollis, Plectranthus rugosus* and *Artemisia maritima*.

A. R. Beg collected in Dir in 1967 and Mir Alam Khan in 1964, 1968 and 69. During 1968 and 69, six parties from Peshawar visited Dir at different seasons collecting in most sections of the district. Their primary interest was medicinal plants but they tried to collect everything. Most of these plants were collected by M. Akram, M. Fayaz, Athar Shah and Azim Khan. The research was assisted by a grant from the U. S. Department of Agriculture.

I have gone through the 635 species in this list with great interest, for it fills a gap in our district floras and adds to the range of a number of species. I had thought for example that *Rhododendron abroreum* was only to be found as far west as Swat and these collectors found three stations in Dir. Now it may turn up in Nuristan. *Persea (Machilus) duthiei* in Parker is said to be found from the Indus east. We found it in Swat and now it turns up in Dir. No first check list is ever complete, or nearly so, and it seems to me, comparing this list with the much larger lists of Chitral and Swat, that further collecting will reveal many more species especially among the sedges and grasses. The ferns have not been listed. They should not be overlooked.

MALAKAND DIVISION

Chitral

The former state of Chitral is strategically located at the extreme northern tip of Pakistan. The Wakhan Corridor of Afghanistan lies to the west and north. The U.S.S.R. is north of this corridor. The Sinkiang Province of China lies to the east and the Gilgit area of Pakistan is on the east as well as the south. Swat Kohis-

tan lies to the south as does Dir. Chitral is not very large on the map of Central Asia but it is about the size of Wales, 5727 sq. miles. It is an irregular piece of territory lying between the 35th and 37th parallels and between 71.3° and 73.7° East. It is all mountainous and is thinly populated with no large towns. The population is about 125,000. In the north it has one very high mountain, 7693 m in height, Mt. Tirich Mir.

Chitral has always been hard to reach. There is a branch railway line from Nowshera in the N.W.F.P. which takes passengers as far as Dargai. Buses then take the passengers over the low Malakand Pass. This road takes them either to Dir or to Swat. The road forks near the Chakdara Fort (c. 700 m) and the road to Chitral crosses the whole of Dir to reach the Lowari Pass (3200 m). The road then winds down to a bridge over the Kunhar River at c. 1572 m. When we visited the area in 1962, the road was jeepable but the bridge had been carried away by a flood and we had to turn back. Until the days of aeroplanes, Chitral was snowbound from seven months of the year as the only road was blocked by snow at the Lowari Pass.

Because of the Hindu Raj Range, a branch of the Hindu Kush which can be crossed at the Lowari Pass, few of the monsoon clouds can reach Chitral which is therefore much drier than Dir and Lower Swat. The average annual precipitation is said to about 320 mm. March and April are the wettest months and July and August the driest while in Lower Swat June, October and November are the driest months and July and August the wettest. This is the climate which suits the *deodar* and *Pinus gerardiana*. The *deodar* is much the most important tree in both Chitral and Upper Swat.

H. L. Wright in the Indian Forester in 1939 states that there is a belt of *deodar* 75 miles long from the Afghan frontier to Chitral Town. "From 90–100 % of the forest from 1900 to 3200 m is *deodar* forest."

The Upper Kunhar River is roughly parallel with the Swat River and the boundary between Chitral and Swat is a range of mountains. There are no large towns and the crops are dependent on irrigation. The chief crops are wheat, barley, maize, rice, walnuts, grapes, mulberries and apricots. As in Gilgit, Baltistan and Ladak the national game is polo. There are still a few villages of Kaffirs (unbelievers in Islam). The rest of the population is all Muslim. The Kaffirs are primitive Aryan idolaters and have been well treated by Pakistan but the Kaffirs of adjacent Afghanistan were ruthlessly suppressed by the Afghans and Kaffiristan was then renamed Nuristan (Land of Light, instead of Land of Unbelievers).

Chitral is a region of great floristic variety and interest with a tropical corner toward Dir where rice can be grown and with a temperate and alpine flora which is on the whole like that of Kashmir with a good many endemics and with many Central Asian species. The Japanese botanists consider it to be extension of the Sino-Japanese flora. There are quite a few plants in Chitral not found anywhere else in Pakistan. The endemics are commonest in *Astragalus, Oxytropis, Liliaceae,*

Alliaceae, Labiatae, Boraginaceae and *Scrophulariaceae. Astragalus* is the largest genus as it is in Afghanistan but there are only about 52 in Chitral while there are more than 400 in Afghanistan. The Chitrali species of *Astragalus* are chiefly endemic, Central Asian or Himalayan and few if any seem to have come from Afghanistan.

In my Chitral list there are some 300 species which are not in Duthie's list of Chitral plants published in 1898, based on the collections made by the officers of the Chitral Relief Expedition of 1895. Most of these additions were made by Stainton, Bowes Lyon, Schmid, Wendelbo and the Japanese.

The tree flora of Chitral is much like that of Kashmir except that in the Jhelum watershed there is not much *deodar*, no *Pinus gerardiana* and practically no *Quercus* while in Chitral *Cedrus deodara* is dominant in large areas as it is in Upper Swat. Near the Lowari Pass which receives some monsoon rain, there are some fine forests of the common Himalayan spruce, silver fir, blue pine, yew, and horse-chestnut. In Chitral there is also *Acer caesium, Prunus padus, Pyrus lanata, Quercus baloot, Ulmus wallichiana, Quercus incana, Q. dilatata* and *Pinus gerardiana.*

Most of the trees of Chitral are also found in Kashmir and the Northwest Himalayas and have presumably come into Chitral from the East but the number of tree species is much less than is to be found in Kashmir. The commonest broad-leaved trees are *Aesculus indica, Acer caesium, A. pentapomicum, A. cappadocicum, Rhus punjabensis, Pistacia integerrima, P. mutica, Crataegus songarica, Punica granatum, Reptonia buxifolia, Diospyros lotus, Syringa emodi, Fraxinus excelsior, F. floribunda, F. xanthoxyloides, Olea cuspidata, Platanus orientalis Juglans regia, Alnus nitida, Corylus colurna, Quercus baloot, Q. dilatata, Betula utilis, Celtis australis, Ficus palmata, Morus alba, Salix* sp., *Elaeagnus angustifolia, Pyrus lanata, P. malus, Prunus persica, Parrotiopsis, Populus ciliata*, and *P. nigra* var. (Lombardy Poplar).

The conifers are *Abies pindrow, P. spectabilis, Cedrus deodara, Picea smithiana, Pinus gerardiana, P. wallichiana, Taxus wallichiana, Juniperus polycarpos,* (*J. excelsa*) and *J. turkestanica*. These conifers also grow in the Himalayas but *Juniperus turkestanica* is Trans-Himalayan.

The willows require more study. Some of those in Chitral are from north or northwest such as *S. capusii, S. karelinii, S. illensis, S. schugnanica* and *S. turanica.*

As in most of the frontier areas of Pakistan, most of the first collectors were only able to gather plants because there were military operations. The very first to collect in Chitral seems to have been Surgeon Major G. M. J. Giles who accompanied the Chitral-Kafiristan Expedition of 1884-85 under Col. Wm. Lockhart. The second was Capt. F. E. Younghusband who collected in Chitral in 1894. The

third occasion for collecting was the Chitral Relief Expedition of 1895. Sir Wm. Gatacre commanded the advanced Brigade and among his officers was a keen collector, Surgeon Lt. S. A. Harriss. To aid him, J. F. Duthie, who was Sup't at Saharanpur, in charge of the Botanical Survey of North India, had an experienced collector, Inayat Khan, and he was sent to work under Harris. In July, Harriss took ill and he and Inayat left but Gen. Gatacre himself was a collector as were many of his officers and the collecting was continued. A Lt. Col. Hamilton, made a collection of his own near Drosh and Col Davidson who had commanded at Chitral collected on the Drosh Pass upto 4300 and 4600 m.

All these collections were brought together and sent to Duthie and he either named them himself or sent them to specialists. Surg. Maj. David Prain named the legumes, C. W. Hope the ferns, and Dr. Brotherus the mosses. The total number of taxa was 934. The families with the largest number of taxa were *Compositae* 72, *Gramineae* 61, *Leguminosae* 45, *Rosaceae* 44, *Ranunculaceae* 38, *Musci* 33, *Cruciferae* 29, *Filices* 27, *Caryophyllaceae* 28, *Umbelliferae* 27, *Liliaceae* 25, *Boraginaceae* 24, *Scrophulariaceae* 23, and *Polygonaceae* 21. Duthie states that 82 taxa were new for the flora of India. Hope described two new species of ferns and Gen. Gatacre made a surprising find of two ferns at Ziarat, far west of any of their relatives. Hope called them *Pteris ludens* Wall. and *Lygodium microphyllum* R. Br., a Walking Fern [They are now called *Dryopteris ludens* and *Lygodium scandens* L.]

The strangest thing about Duthie's list of Chitral plants is that he only lists three species of *Astragalus* while it now seems that there may be as many as 52 taxa of the genus in Chitral. A good many have been described as new by Ali. Duthie does not report any *Oxytropis* while there seem to be 13. It is probable that still more species will turn up in other families as well as in the legumes.

Burkill on p. 194 of his botanical history of India lists 18 army officers among the collectors of this period. In addition to those I have already mentioned, the following are among those who collected on this occasion and some of them collected at other times. Lord Roberts, Sir Arthur A. Barrett, who became the first High Commissioner of the N. W. F. P. in 1901, collected in Hazara and the N. W. F. P.; Sir Henry Collett collected in the Kurram and the Simla Hills; Col. H. H. Johnstone collected in the Khyber; Col. H. H. Rich collected in Kashmir; Lt. Toppin and Gen. Wingate collected grasses. Did as many collect on any other campaign? A good many collected during the first Afghan War but Griffith died before he wrote up his work.

Sidney Miles Toppin (1878-1917) of the R. A. M. C. who was killed in the First World War, collected in Chitral, 1900-02, and after his death, a paper of his on the balsams of Chitral and the Kachin Hills was published in the Kew Bull., 1920: 345-67. *Impatiens toppinii* was named for him.

In 1935 Dr. Arnold Scheibe and Gerhard Kerstan were on a German Hindu

Kush Expedition and the plants they collected were worked up and published by Haeckel and Troll in Fedde Repert. Beih. 108: 1-72. 1938.

In 1937 Kerstan published in German a paper on the distribution of forest trees in E. Afghanistan and Chitral in *'Schriften der Deutschen Forschungsgemeinschaft'* N. F. 1.

About this time in the 1930's two professors of the Islamia College, Peshawar made good private collections in Chitral which they never worked up or had published. I saw part of both collections and it is unfortunate that they have not been made available for students of the Chitral flora. After his retirement Hassan Din worked for a time in Rawalpindi with Prof. Nasir and I believe that some or all of his collection has been used by those working on fascicles of the Pakistan flora.

Prof. Nawazish Ali was a pioneer student of the medicinal plants of the Northwest Frontier and succeeded in getting the villagers of the Kurram Valley to cultivate a good strain of *Artemisia maritima* for making *santonin*, a worm medicine. He called it *Artemisia kurramensis*. He published several pharmacological papers which are listed in Kazmi's "Reference", p. 88. One of these is of floristic interest, "Medicinal plants of W. Pakistan", Pharm. J. (G.B.) : 87, July 22, Reprint, 1961. A few of his specimens were from Dir.

In 1949, A. Heen of Norway made a preliminary visit to Chitral and did some collecting and the following year the Norwegians sent out a team to climb Mt. Tirich Mir. Dr. Per Wendelbo was the botanist on this expedition and explored all around the mountain while the others climbed. In 1952 Wendelbo published in Oslo the scientific results of his work entitled "Plants from Tirich Mir, a contribution to the flora of Hindu Kush". In 1954 he published three new species and in 1957 "A study of the *Primula rosea* aggregate". Dr. I. I. Chaudhri who was then at the Peshawar Forest College accompanied Dr. Wendelbo to Tirich Mir and his specimens should be in Peshawar. Per Stormer of Norway named the mosses.

For many years Dr. Wendelbo, formerly of Norway, but in recent years based in Goteborg, Sweden, has specialised on the flora of Iran, Afghanistan and Chitral and his numerous papers on the flora of this area are listed in Kazmi's Bibliography.

In 1955 the Japanese teams from Kyoto University began intensive work on the plants of the western end of the N. W. Himalayas which they call part of the Sino-Japanese flora. They have collected intensively in the Nuristan section of Eastern Afghanistan, in Gilgit, Chitral, Swat and Baltistan and also in Baluchistan. They were in Chitral in 1957. The team consisted of K. Honda, K. Ogino, and G. Iwatsubo and Shaukat Ali Chaudhary, formerly of Gordon College and at that time at Faisalabad. His specimens should be in Lahore and the Japanese in Kyoto. The results of the Japanese work have been published in 1964, edited by Siro Kitamura of Kyoto University entitled "Plants of Pakistan and Afghanistan", Kyoto Univ.,

1964 and in 1966 "Additional Reports" which includes "Freshwater Algae of Karakorum and Swat Himalaya". The Japanese studied the geology and zoology of the area as well as the botany.

In 1958, J. D. A. Stainton, a British lawyer who has spent his life collecting plants for the British Museum and has done a great deal of work in Nepal, with S. A. Bowes Lyon, made large and important collections, including many new species. A list of their collections has not been published but I saw a manuscript list of the determinations at the British Museum and have cited many of their species in my Annotated Catalogue and Rechinger is citing these collections in his *Flora Iranica*. Their specimens are at the B. Museum and Edinburgh.

There have been so many collectors in Chitral that its flora is better known than that of some parts of Pakistan which are much more accessible. Because the country begins at 1372 m, the Saharo-Sindian flora is scanty as is the tropical flora of India. The flora is basically Himalayan but it is an attenuated flora because of the reduced rainfall. I found the same situation in Swat Kohistan. The Turanian (Afghan) flora is not very well represented. There are more than 300 *Cousinias* in the Afghan flora and only six in Chitral. There are more than 400 species of *Astragalus* and very few of these grow in Chitral.

In recent years a good many collectors from Peshawar, Rawalpindi and Islamabad, Lahore and Karachi have collected in Chitral but no lists have yet been published to show what they have found. I happen to know that Prof. Nasir at Rawalpindi, at various times, sent collectors to Chitral, including M. A. Siddiqui, A. R. Beg, Sadiq Masih, and Yasin Nasir and their collections are now in the National Herbarium. About 30 years ago, Prof. M. A. Zahur of Lahore made a collection of Chitral plants which should be at the University there. Stamm and Woehrl collected *Salix* and *Populus* in Chitral but I have not seen any publication. Dr. M. B. Zaman, now in Bangladesh, student of Materia Medica, collected in Chitral, Dir and N. W.F.P.

An effort in 1962 to add my bit to collecting in Chitral was not very successful. Prof. Nasir and I, in a jeep, entered Dir at Chakdara and spent a night in the guest house of the Nawab of Dir. It would have been a comfortable night but for the fact that there were already many small occupants in our beds. We were able to collect some interesting things near the road which we were not allowed to leave as the country was unsafe. We ascended to the Lowari Pass and descended to the Kunhar River at c. 1372 m., only to find that a flood had carried away the bridge. As there was no telling how long it would take to replace it, we spent the night in the shelter of the verandah of a stable along with 2 donkeys and some chickens and retraced our track to Chakdara and collected in Swat instead of Chitral. We did, however, find some interesting things on the Lowari Pass and the mountain above it, adding a few species to the Chitral list.

My Chitral check-list is not up-to-date but the largest genera are as follows,

Astragalus 52, *Nepeta* 20, *Polygonum* 20, *Poa* 17, *Potentilla* 16, *Oxytropis* 13, *Artemisia* 12, *Silene, Salix, Allium* and *Carex* 11, *Ranunculus, Delphinium, Corydalis, Draba, Sedum, Epilobium, Erigeron, Gentiana, Pedicularis* and *Impatiens* 10 each.

The largest families are *Compositae* 165, *Gramineae* 165, *Leguminosae* 120, *Labiatae* 102, *Cruciferae* 84, *Rosaceae* 67. It will be noticed that all of the genera and families are common in the Himalayas. There are also 36 pteridophytes.

AZAD KASHMIR

Azad Kashmir is a new unit carved out of the territories of the former Maharaja of Jammu and Kashmir. It came into existence as an unplanned result of 1947 partition of India. At this time the Maharaja announced that he 'acceded to India'. Since large parts of his dominions were almost, if not, 100% Muslim, the inhabitants did not want to become citizens of a Hindu India and they killed or turned out the largely Hindu officials, police and merchants. These areas were the Gilgit Agency, Baltistan, Muzaffarabad, Poonch, Kotli and Mirpur. All of this region did not become Azad Kashmir, but only the last four mentioned units, which are in the watershed of the Neelam and Jhelum Rivers.

Where are these areas? When most people think of Kashmir they think of the Vale of Kashmir which lies behind the Pir Panjal Range of Mts. They do not realize that the territory between the Punjab and the crests of the Pir Panjal Range had been part of Kashmir or of Jammu, having been conquered, piece by piece, by the Sikhs or the Dogras of Jammu.

Azad Kashmir is not a very large piece of territory on the map but is a most varied bit of terrain stretching from c. 640 m of altitude at Muzaffarabad, the capital, near where the Neelam River joins the Jhelum, to the crests of the Zanskar Range of Himalayas. The watershed of the Neelam stretches clear to the main Himalayan range, but east of Muzaffarabad tehsil, across the Jhelum River, we find the western end of the Pir Panjal Range which separates the Kashmir Valley from the plains of the Punjab. This Pir Panjal rises to more than 4600 m and is the snowy range which can be seen on clear days from the Punjab. Two main routes cross it. The first is the Jammu route which enters the Kashmir Valley by the Banihal Pass and the Pir Panjal Pass route which is the route the Moghuls used. Visitors leaving the plains or Gujrat Dt., entered the hills at Bhimber and then ascended through Poonch. The famous Vale of Kashmir lies between this Pir Panjal Range and the Himalayas. In the Vale, the Jhelum River flows roughly from east to west as far as Baramulla and then turns abruptly south around the western end of the Pir Panjal Range, forming the boundary between Poonch, Kotli and Mirpur to the east and Muzaffarabad tehsil, drained by the Neelam River, toward the west.

Until India was divided in 1947, most of the trade of Kashmir with India went to Rawalpindi, now in Pakistan, by the Jhelum Valley motor road which left the Jhelum at Kohala, climbed the Murree Hill and descended to the railway at Rawalpindi. Following the first war between Pakistan and India over Kashmir the United Nations succeeded in obtaining a Cease Fire in 1949 which froze the situation of the armies as they were at that time and this line cut the Jhelum Valley Road at Uri at c. 1340 m. and a flourishing trade died. This new boundary separated Muzaffarabad, Poonch, Kotli and Mirpur from the Valley and from that date, the trade of Azad Kashmir has been with the Punjab and not with the Kashmir Valley, and the area has been called Azad Kashmir. There is now a motor road into Poonch which supplies the Pakistan army manning the Cease Fire Line and further east there is a motor road to Mirpur up the east bank of the Jhelum River from Jhelum City which I used in 1956 on a collecting trip.

Until about 1890 when a cart road was built via Murree to the Jhelum Valley to Baramulla and on to Srinagar the route usually taken by visitors to the Kashmir Valley from the Punjab left the plains in Gujrat District, entered the hills at Bhimber and then ascending the Pir Panjal Range through Poonch, climbed to the Pir Panjal Pass at about 3505 m. Because of heavy winter snows this pass was closed until June. This was the shortest route to the valley but there was an easier and longer route over the Hajipir Pass (2490 m) which could be crossed most of the year. A steep pony road which I have used two or three times goes down to Uri and then follows the Jhelum to Srinagar. Jacquemont used this route in 1831.

Until 1947 Muzaffarabad, Poonch, Kotli and Mirpur were backwaters of the little Kashmir and Jammu Empire. The Maharaja ruled from Srinagar in the summer and Jammu in the winter. This changed in 1947 when all the Kashmiri officials were expelled and since that date the people of these areas have local autonomy and look toward Islamabad and Pakistan instead of to Srinagar. Muzaffarabad is the local administrative centre and the Forest Dept. had a little herbarium there.

I lived at Gordon College, Rawalpindi beginning in August 1911, but the region, which was most attractive to me as a young botanist was Kashmir. From the summer of 1912 to that of 1947 most of my vacations were spent collecting plants in some part of the Maharaja's territories and I saw far more of them than he did and probably enjoyed them more. In the summers of 1912 and 1913 with small hiking parties my objective was plant collecting in Ladak (Western Tibet). Both summers we started at Rawalpindi and covered the first lap of our journey from Rawalpindi to Srinagar, on our 'push' bikes. I carried my vasculum on a strap across my back and would stop to collect the interesting things on the way and put them in a press at night. My first introduction to the plants of the future Azad Kashmir was made in this way in 1912 and 1913 between Kohala and Uri. This was when the road to Kashmir was in its glory. There was a dak bungalow with a corps of servants every 12-15 miles. It was before the cars and buses hurried through to Kashmir in a day. Passengers in *ekkas, tongas* and phaetons usually took up to eight days to travel this hilly road except those travelling by the mail

tonga which changed horses every four miles and arrived the second day. The tonga could not start until after the arrival of the Bombay Mail train at Rawalpindi

After visiting Kashmir many times and using the Abbottabad and the Jammu-Banihal routes as well as the one along the Jhelum River, my wife and I thought that we should try a new route and in 1939 took a bus to Muzaffarabad where we hoped to be able to hire riding and baggage ponies. We planned to ascend the Neelam Valley to Kunzlwan and then go to the Kashmir Valley via the eastern, Kashmir end of the Gilgit Road. We did this and then after a rest in Srinagar we ascended the Sind Valley a few miles and took the pilgrim route to the Gangabal Lakes at the foot of Mt. Haramukh (5150 m.) Then using a pass of c. 4270 m , unnamed on my map, we entered Tilel, the largely uninhabited upland region between the Haramukh range and the Neelam Valley. Years before, I think it was about 1919, I had visited this largely uninhabited upland area above the tree line, entering by the Nichani Pass, west of Sonamarg on the Upper Sind Valley. *Draba nichanaica* O.E.S. = *D. lanceolata* x *lasiophylla* O.E. Schulz was named for this pass. Several times I have crossed the temperate and alpine parts of the Neelam watershed. In 1940 we crossed the area, entering from Kashmir by the Gilgit Road. We ascended to the Burzil Pass and then crossed the Deosai plains in order to collect in Baltistan. This is the route which Vigne, Falconer and other early collectors used on their way to Baltistan. Again in 1946 we planned to go clear to Gilgit instead of Baltistan. That year Prof. Nasir went with me and Mrs. Stewart. We collected in Astor in the Rupal and Rama nullahs on the slopes of Nanga Parbat (c 8020 m) but never got to Gilgit as we had to turn back as the hillsides were so dry that we could not get fodder for our horses.

In 1939 the Lower Neelam, then called by its Hindu name, the Kishenganga, was isolated from the busy world of the Punjab plains. It was completely rural. The villages were small and the valley was very narrow. The hillsides were steep so that there were few fields. The hillsides were wooded down to the river along most of the length of the river up to c. 2360 m. There was no wheeled traffic and the pony track was in bad repair. Most of the peasants and their animals were on the high hills above the forest as the month was July. We could only hire one riding pony and even the simplest supplies were hard to find. I made the mistake of taking a Sikh servant along, not realizing that the population was 100% Muslim and that he would find it more difficult to obtain food than we did.

The lower valley was very hot and unhealthful and many people were down with malaria. Botanically the valley was however, very satisfactory for I do not suppose any other important valley could have been found more unspoiled by human alteration of the countryside. The forests were almost unspoiled. Loggers were at work in two lateral valleys but we did not see their work. The flora about Muzaffarabad, near the junction of the Neelam with the Jhelum, was Saharo-Sindian, a typical Himalayan foothill flora, gradually improving in quality and variety with every few hundred feet of altitude, gradually adding new species as others are left behind, displaying a cross section of the floras clear up to the high alpine snow

melt species on and near the Himalayan passes.

For the first hundred miles or so the valley is deep and narrow until it reaches Kunzlwan and Gurez where it widens. Here the road was joined by the Kashmir-Gilgit mule track which descended from the Rajdani Pass on the east. This road leaves the Kashmir Valley at Bandipur and goes all the way to the Indus, ascends the Indus to its junction with the Gilgit River and then ascends the Gilgit River to the town. This was not a road for wheeled traffic but was an improved mule track used to supply the Kashmiri troops at Gilgit. Now, since partition, a motor road has been pushed through Muzaffarabad all the way to Gilgit, no doubt badly scarring the previously unspoiled hillsides.

East of the Neelam River to the range which separates the Neelam from the Jhelum watershed, is an extensive upland region called Tilel which is largely above the tree line and might be called *Artemisia* steppe but with more than the usual amount of coarse vegetation. There are a few villages near the Neelam.

It is a curious fact that the first foreign travellers to cross the Upper Neelam did so long before any collectors had worked in the Lower Neelam. The reason for this is historical. After the death of Maharaja Ranjit Singh, and the defeat of the Sikhs in 1848, the British annexed the Punjab but sold the hill country to Raja Gulab Singh, the ruler of Jammu. During the life of Ranjit Singh, the Sikhs had been enlarging their territories. In 1819 they conquered the Kashmir Valley. Between this date and 1840 they, or the Dogras, had conquered Ladak, Baltistan, and Gilgit, remarkable conquests, considering the great distances, and the physical and other difficulties. The Sikhs were feared and hated. It is said that the Baltis were afraid of two things, small-pox and the Sikhs. After visiting most of this region on foot, I wondered why the Sikhs wanted to take it and how they succeeded, considering the difficult terrain, but found out that in the case of Gilgit it was because two parties there were at odds and one of them invited the aid of the Sikhs.

It is now forty years since Mrs. Stewart and I collected in Muzaffarabad Tehsil. Conditions must have changed tremendously because of partition and the closing of the Jhelum Valley Road and the routes from Kashmir to Baltistan and Gilgit. Pakistan had to establish new ways to supply Gilgit and Baltistan and to get personnel in and out. There was one very long and difficult route to Gilgit via the Kagan Valley and the Babusar Pass. This route to Gilgit via the Indus entailed a descent of nearly ten thousand feet from the top of the pass to the river and the pass was only open for about ten weeks in the summer. A second possible route starting at Rawalpindi used the Kashmir road to Domel, then went to Muzaffarabad Town. Then a motor road had to be built through the Neelam Valley to Kunzlwan where it joined the old Gilgit Road from Kashmir. This too is only a summer road so that air strips were built at Gilgit and Skardu and it became possible to fly to these centres in two hours. As there are no landing fields on the way, this air route can only be used with good visibility. When we visited the Neelam in 1939

the only economic activity was logging. Spedding & Co. were logging in two side valleys and floating the timbers down to Jhelum City.

We could not have studied a better cross section of the flora of Kashmir. We began at c. 600 m. with a flora similar to that in the hills nearest to Rawalpindi where we started. It was early July and the weather was hot and humid in the lower foothills. In the lower valley, especially about Titwal (1070 m) where the Karnah Valley joins the Neelam from the east,there was much malaria. As we ascended the valley, it became less tropical. It was cooler at night and we did not notice any more malaria. There were only occasional villages and few cultivated fields. Most places were too steep for fields. There were hardly any slopes and there was only a kind of chard we could buy as a vegetable. Most of the villagers had gone up to the meadows above the forest.

The Neelam valley is narrow for about 125 miles. In several side valleys there was still avalanche snow down to the river as low as c. 1800 m. One thing that impressed me was that the temperate forest came down much lower than anywhere I had visited in the Western Himalayas. The depth and narrowness of the valley must have had a cooling effect as the snow could lie much longer in the forest as it was out of the sun. This not only permitted the temperate trees to descend lower but furnished habitats for ferns in the shady gullies.

Some of the plants we saw at Batteki (900 m) were *Rubus fruticosus*, s.l., *R. lasiocarpus, Clematis grata, Rumex hastatus, Zanthoxylum alatum, Berberis lycium, Debregeasia, Otostegia, Ficus palmata, Rosa brunonii,* wild pomegranate, the long-leaved pine, *Mallotus, Zizıphus oxyphylla* and *Vitis persica*. At Titwal (1070 m.) *Quercus baloot* became gregarious. It is a common frontier species but is not found in the Murree Hills or the Kashmir Valley. Here we found the first *deodar, Fraxinus xanthoxyloides, Deutzia staminea*, a *Celtis, Plectranthus rugosus, Buddleia crispa, Parrotiopsis*, an *Ulmus, Marlea, Hypericum cernuum* and many more.

At Sulkhala (1200 m) we saw *Sorbaria tomentosa, Indigofera heterantha, Vitis lanata, Viburnum nervosum, Elaeagnus umbellata, Daphne oleoides*, a white and a pink *Impatiens, Phytolacca* etc.

At Keran (1500 m) there was both the long leaved and the blue pine, *Fraxinus excelsior*, a very large *Populus ciliata, P. caspica, Morus serrata, Abies, Prunus, Sambucus, Ilex dilatata*, and many more, often right down to the river. At Taobat (2200 m) there was little *deodar* but *Abies webbiana* was now the common tree mixed with *Picea* and a little *Taxus*. There was *Datisca*, two maples, *Acer caesium* and *A. cappadocicum* var. *indicum* (*A. pictum*), *Rhus succedanea, Aralia, Viburnum cotonifolium, Rosa macrophylla*, two *Delphiniums, Pyrus lanata*, much *Juglans, Asplenium adiantum-nigrum, A. septentrionale, A. trichomanes* and many more.

To illustrate how the temperate species grow at levels lower than usual I noted that at Titwal, below 1070 m there was the first deodar, *Parrotiopsis, Rosa webbiana, Populus caspica*, a very large elm and even the horse-chestnut. These were growing among the foothill plants and below *Quercus baloot*. The oak was badly infested with *Korthalsella opuntia*, a mistletoe.

An interesting thing about this valley was that there were hardly any cultivated trees and there were not many introduced weeds. There was little disturbed soil for erosion, a great contrast to what we found in Poonch and Mirpur.

There are no books which are of much use in the study of the plants of Azad Kashmir except for Parker's Second Edition of "A Forest Flora for the Punjab with Hazara and Delhi". Kashmir is not mentioned in the title but most Kashmir woody plants are included. A booklet which I have used a great deal is W.J. Lambert's "List of Trees and Shrubs for the Jammu and Kashmir State", Forest Bulletin No. 80, Calcutta, 1933. It is only a list but he notes the districts where each of the 498 woody species are to be found. I have not found many omissions except for the species from the frontier districts of Gilgit, Baltistan, and Ladak which he intentionally omits.

I am not sure who was the first to do any collecting in the Lower Neelam Valley. It was probably one of the fern hunters, Col. McLeod, or E. W. Trotter, Supt. of Posts and Telegraphs, Punjab, who did a great deal of collecting in Azad Kashmir from 1885-90, or J.C. McDonell of the Forestry Dep't who discovered *Microlepia wilfordii* in the Jhelum Valley in the Buniar Nullah at c. 1500 m in1897. He also collected in the Lower Neelam. Inayat, Duthie's collector, from 1894 to 1912, also collected in the Neelam c. 1897.

In 1954 Dr. Ferdinand Schmid and J. J. Bueitinger of the Swiss Entomological Expedition collected in the Upper and Lower Neelam but I do not have definite knowledge of anyone else, though it is clear from Lambert's list of the trees and shrubs of Kashmir (1933) that Kashmir foresters have explored the valley. Once when I visited Poonch about 1930, I met P. N. Kohli of the Kashmir Forest Service and he showed me a yellow flowered shrubby labiate he got in the Uri hills and wanted to know its name. I had not seen it before and sent it to S. K. Mukerjea at Calcutta, the expert on *Labiatae*. He gave it the name of *Chelonopsis albiflora* var. *cashmeriana*. This was a surprising find,for the species of which this is supposed to be a variety, is Chinese. I think that it is probably a new species and should be called *C. cashmeriana*. He algo gave me specimens of *Cardiocrinum giganteum*, the largest of the lilies which I had never seen before and which he got in the Kamah Valley above Titwal. This Valley should be explored again. I believe that this lily has been reported from the Banihal Pass a couple of hundred miles to the east. Later Jan Mohammad,a collector in the Forest Dept.,found the *Chelonopsis* again and I saw the specimen in 1962 in the little herbarium in Muzaffarabad. Still later, while I was at Kew, I saw another specimen collected by a Hukam Singh who probably worked for the Forest Dept. The only species I collected which

turned out to be new were *Draba aubrietioides* Jafri which grew on cliffs at Sharda and Badwan, between 1800–2500 m and *Euphrasia foliosa* Penn. at Chorwan.

That the nearest relatives to this mint, *Chelonopsis*, should be in China, is remarkable but there are other examples of the same phenomenon and two more were found in this same Jhelum Valley and not far away. The fern collector. J.C. McDonell in 1899 discovered *Microlepia wilfordii* in the Buniar Nullah at c. 1400 m and I rediscovered it in the same nullah in 1927. This is a Chinese species and *Asplenium pekinense* has been collected further down the valley near Chakothi and between Rampur and Uri. This is disjunct distribution on a grand scale.

The first foreign visitor to the Upper Neelam Valley was G. T. Vigne, a well-to-do English traveller and explorer who happened to be in Jullandar on the Sutlej when that was the frontier town of the East India Company. While he was there in 1834 the Political Officer, Col. Wade, received a letter from the Raja of Skardu in Baltistan asking for a visit from a 'Sahib'. He was afraid of the Sikhs and would like help. Anxious to be the first to go where no other outsider had been, Vigne offered to go. Burkill says that Vigne carried a plant press but that he only used it on the border of the Deosai and at Dras. He explored Kashmir for three or four years, c. 1835-9, and in all that time he collected 95 poor specimens which Royle named and he lists them in his book 'Travels in Ladak, Kashmir and Iskardo', 1842. Whether he collected at all in the Upper Neelam I do not know, but he was observant and he mentions that about Gurez,the villagers were cultivating barley, millet, *Amaranthus* and buckwheat and on Aug. 31. 1835,he noticed *Carum*, leeks, *Prangos*, pines, junipers, willows, *Populus ciliata* and *P. alba* (*caspica*), *Artemisia*, *Thymus*, roses, and black currants.

Hugh Falconer (1808-65), the next explorer to visit the Upper Neelam, Astor, Baltistan, etc. was a very different type. He was an excellent botanical collector as well as a good paleontologist. His specimens went to London and were left there for years until rescued by Hooker who used them in his flora. He used native collectors who wrote their labels in the Devanagri and Persian characters and when I saw them at Kew I could not use much of the information, not being able to read the labels. One puzzle has turned up. Some of these labels are dated 1834, three years before he was in this region. Did he send in native collectors before he went himself, the way Royle did?

The next collector was anothr restless Englishman, a doctor who did not practice but spent his life travelling. He was J. E. Winterbottom (1803-54), friend of Richard Strachey, the brother of Henry, who was a member of the Tibetan Boundary Commission and the surveyor of the expedition,who did some collecting on the Upper Indus. Winterbottom made an excellent collection from the Upper Neelam, (Gurez), Astor and Gilgit and left Kashmir by the Banihal Pass. He made a short visit to Nepal and then with Richard Strachey made an important expedition to the sources of the Sutlej.

The next collector was C. B. Clarke (1832-1906) who in 1876 made large and excellent collections in many parts of Kashmir, from Jammu in the east to Gilgit in the west, which went to Kew and after Clarke retired from India he went to Kew and helped Sir Joseph Hooker by monographing families of plants for the Flora of British India. He is the first collector, as far as I know, who worked in Tilel.

J. F. Duthie (1845-1922), Sup't of the Saharanpur Botanical Garden, and then botanist at Dehra Dun, when the herbarium was transferred there, made two long and fruitful collecting trips along the Western Himalayas collecting on the Deosai, in Baltistain, Gilgit etc. which are recorded in Vol. 1 of the Records of the Botanical Survey of India. These trips were made in 1892 and 1893. In 1892 he entered the Neelam watershed from the Astor side by the Kamri Pass. He descended to Gurez and returned to Kashmir by the Rajdani Pass. He had made a large collection for Calcutta, Dehra and Kew and Kew gave me many of his duplicates which I have left at Islamabad.

I may have been the next collector, visiting Gurez, for the first time, from Tragbol, above Bandipur, in Western Kashmir in 1919 where we camped for nearly two months. I probably visited Tilel for the first time when we were spending a summer at Sonamarg in 1921 crossing into an uninhabited part of Tilel by the Nichani Pass with a couple of friends. The last time we visited the Upper Neelam was in 1946 when we intended to go through to Gilgit from Kashmir by the branch of the Gilgit Road which crosses the Himalayas by the Kamri Pass, however we visited the northern slopes of Nanga Parbat and Astor. We found out that beyond Doian there was not enough fodder for our horses and so we returned to the Neelam catchment by the Burzil Pass; descended to Minimarg, the highest village (3200 m) and ascended the Nagai branch of the Neelam on the route to the Deosai Pass and on to the eastern side of the Deosai plains and then went east to Dras on the Ladak-Kashmir Road. We ascended the Nagai from Minimarg to a beautiful amphitheater in the mountains where there were a number of gujars (shepherds) in tents caring for their flocks and herds. Usually they live in log shelters. The children of the shepherds brought us the sour, red berries of *Rubus saxatilis*. The place was called Domel (a joining) as two streams met here and we followed the eastern branch to ascend to the Deosai Pass. Domel would be a wonderful place to camp for a few weeks collecting in the surrounding mountains. Between Minimarg and Domel I found *Moneses uniflora* in fir forest, the only place in the Himalayas where I have found it. It has been found in Gulmarg.

Between 1896 and 1899 R. B. Keshavanand of the Indian Forest School at Dehra Dun collected in the Kazi Nag Range adjacent to Tilel and in the Neelam Valley. He reported *Pedicularis bicornuta* from Tilel.

In 1905 Alfred Meebold (1863-?) a German, crossed the area; then Filippo de Filippi in 1909; Carl Troll of Germany in 1935; G. L. Webster and Eugene Nasir in 1955; Hans Hartmann in 1962; M. A. Siddiqi and Yasin Nasir in 1966. These, and no doubt others, have crossed the Neelam area on their way to collect in other

places but I can give no details for, as far as I know, none of them have listed what they found in the Neelam area.

I do not know what has happened since I visited the Upper Neelam, but when I knew it, it was not overgrazed as most high meadows were in Kashmir. It was ideal territory for collecting. Those visiting the area had to take tents, supplies and transport with them for there were no roads and there was no shelter away from the main Neelam Valley. I know nothing about the geology of the area except that at least part of Eastern Tilel is underlain by limestone as there are 'sink holes' and we saw one large, deep, funnel shaped hole wth a small stream disappearing down it. Most of the area is above the tree line. There was not much bare soil. There was a good deal of herbaceous vegetation along with the Artemisias. Some herbs were quite large.

In Tilel the most striking large umbellifer is the well known *Pragnos pabularia* which the local people were piling up to dry for winter use. *Ferula jaeschkeana* is also large as is *Angelica glauca* and *A. archangelica*. *Eremurus himalaica*, a large gregarious liliaceous plant is used for greens when it is young. There is also a very large crucifer, a *Megacarpaea*, with the broadest siliquas I know, 4–5 cm. across. It is also used for greens. Hooker lists two kinds and Duthie only one. It looks to me as though there is only one variable species. There are also large borages *Arnebias, Hackelia stewartii, Lindelofia, Onosma, Pseudomertensias* and *Solenanthus circinnatus*. There are two species of *Pyrola, P. rotundifolia* and *P. secunda* which I also found in Gilgit. There are two Rhododendrons, *R. lepidotum* grows at Burzil Chowki and *P. hypenanthum* on the Deosai Pass. *Rheum webbianum* is gregarious below passes as are *Senecio jacquemontanus, S. levingei* and *S. tibeticus*. In one avalanche gulley, with white birch near by, I found an abundance of *Potentilla curviseta* and *Paraquilegia* on cliffs.

Muzaffarabad town is only about two miles west of Domel where the Neelam unites with the Jhelum. Domel, in the old days, was a busy little place on the Jhelum Valley Road where visitors to Kashmir had to stop and pay toll and have their baggage inspected. The section of the old Jhelum Valley Road from Kohala to Uri is a part of Muzaffarabad. The road is now in use only for a little local traffic. When I was using it between 1912 and 1947, it was used by hundreds if not thousands of bullock carts which were required to travel at night so that swifter vehicles could travel by day in comfort, for the road was narrow in many places often being cut out of the cliffs with a fence on the outside to save vehicles from falling into the river. Sometimes the road ran on old terraces showing how much the river had cut down in recent centuries. Occasionally the road runs between fertile cultivated fields. There was never much space between the swift river and the hills on each side and so there is not much cultivated land. There is much less forest to be seen than there is in the Neelam. Everything is green in the summer and the vegetation near the road was specially lush during the monsoon. A number of interesting and rare plants grew on the cliffs. Over the years between 1912 and 1947 I have many times, travelled this road by bicycle, tongas, bus and car and spent one or more nights

at each of the dak bungalows, collecting about each of these halting places so that the flora of this part of the road is well represented in my herbarium at Islamabad.

The flora along this route is well known, for with all this collecting, I think I found only three new species, *Pimpinella stewartii, Campanula tenuissima* and *Scorzonera alba*. One of the most interesting plants along this road is *Primula inayatii* which only grows in the spray of waterfalls. I first saw it between Chenari and Uri. The leaves were long and narrow with a golden farina on the lower side. For years I could not identify it for it blooms very early in the spring. It was near Uri that Kohli discovered the new *Chelonopsis*, already mentioned. Another rarity is the Chinese-Japanese climbing fern, *Lygodium japonicum*, which grows beside the river at Domel (McLeod). Inayat discovered his *Primula* c. 1899. In the spring there are many fine flowers on the banks along the road, many of them bulbous or tuberous. Many of them are also found in Swat and they are all western species. There are pink and white tulips, the Domel or Hazara Lily, *Notholirion*, the bluish *Ixiolirion*, violets, blue *Scilla*, and the beautiful pinky *Incarvillea emodi*.

As I travelled to or from Kashmir I noted the woody plants I saw by the way between Kohala and Baramula and there were about 130 taxa between 610 and 1525 m. A list of the more prominent follows.

Woody Plants between Kohala and Baramulla

Reinwardtia trigyna
Zanthoxylum alatum
Cedrela serrata
Berchemia lineata
Sageretia theezans & var. *brandrethiana*
Helinus lanceolatus
Acer pentapomicum
Rhus cotinus & punjabensis
Coriaria nepalensis
Desmodium tiliaefolium, concinnum, podocarpum
Rhynchosia pseudo-cajan
Sophora mollis
Caesalpinia sepiaria
Acacia catechu & A. modesta
Mimosa rubicaulis
Prunus prostrata
Rubus ellipticus, anatolicus & niveus
Rosa webbiana & R. brunonii
Cotoneaster lindleyi & nummularia
Deutzia staminea
Phagnalon niveum
Inula cappa
Fraxinus xanthoxyloides
Jasminum officinale & humile
Periploca aphylla
Buddleia asiatica
Solanum verbascifolium
Barleria cristata
Strobilanthes (2)
Callicarpa macrophylla
Caryopteris wallichiana
Plectranthus rugosus
Otostegia limbata
Achyranthes bidentata
Aerua scandens
Daphne oleoides
Glochidion velutinum
Andrachne cordifolia
Mallotus philippinensis
Baliospermum axillare
Debregeasia hypoleuca
Ficus sarmentosa var. *inducca, palmata & auriculata*

Alnus nitida
Quercus incana & glauca
Phoenix humilis
Pinus roxburghii & wallichiana
Cedrus deodara
Parrotiopsis jacquemontiana
Woodfordia floribunda
Marlea begoniifolia
Leptodermis virgata
Rubia infundibularis

No one has yet written anything about the flora of the Neelam Valley or the flora along the Azad Kashmir part of the Jhelum River. The course of the Jhelum River is peculiar. In the Main Kashmir Valley it flows from east to west, from Srinagar to Baramula, where the river leaves the Kashmir Valley and for a while it runs south separating Hazara and then Rawalpindi Dts. from Poonch, Kotli and Mirpur, the most important part of Azad Kashmir.

Poonch

I have the bad habit of starting more than I can finish and in the years when Prof. Nasir and I were very much interested in Poonch, I prepared a Check-list and started a proper flora with keys and still have the manuscript along with others I will never finish. There are nearly 1500 species on my list with about 67 pteridophytes. The largest families are as follows. There are 162 grasses, 134 legumes, 120 *Compositae*, 60 *Labiatae*, 57 *Rosaceae*, 47 *Scrophulariaceae* and *Umbelliferae*, 45 *Ranunculaceae* and 43 *Cruciferae*. These numbers are not final and under normal circumstances I would have said that the number of species in the area must be larger but with the destruction of habitat and with clear perennial streams becoming seasonal, the number may decrease as the habitat of rare species is destroyed by overgrazing and destroying forests.

Several of our students at Gordon College came from Poonch and a few of them brought in plant specimens. The lowest corner of Poonch is at about 600 m and it formerly extended up to the top of the Pir Panjal Range at c. 4570 m Since partition, I am not quite sure where the Ceasefire Line is but I know that Poonch now includes an alpine zone for I have collected in the Bedori Range which in places is above 3660 m. The southeastern corner of Poonch, including the capital, Poonch City, was occupied by the Indian Army at partition time and it is still in Indian hands. Like the flora of the Neelam watershed, the Poonch flora begins in the tropical foothills and steeply ascends into the alpine zone. The steeper slopes may be a reason why Poonch suffers much more from erosion than the Neelam Valley does. Although the Neelam watershed is so near Poonch, it is surprising how many Poonch-Mirpur plants are at the western edge of their ranges and have not been reported from Rawalpindi Dt. or from the Neelam Valley. Further collecting may of course reduce the length of this list. In my collecting I have found a large number of species extending far west of the limits recorded in Parker or in the Flora of British India. Toward the limit of their distribution the localities where species are found are often far apart. This disjunct distribution may indicate that the environment on the whole has deteriorated but that some favourable locations remain where there is enough water or shade or warmth to keep species

alive.

Cinnamomum tamala is a good example of disjunct distribution. Parker says that it is rare in Kangra and Chamba. Lambert does not list it for Kashmir, yet we found it in the Nawal Nadi. *Chelonpsis* and *Cardiocrinum* are other examples.

The first time I saw small forests of *Buxus sempervirens*, the box tree, was in Poonch. The wood is very valuable but patches of trees are far apart and the trees I saw were not very large. This is another of the trees which is found at distant intervals, far west of the range given in Hooker. Its western boundary was in Udhampur, in Jammu on Lamberts lists but it is now known from Hazara and Chitral. *Rhododendron arboreum*, similarly, is now known to grow in three places in Dir on the Afghan border while Parker says "from the Indus eastwards". I saw it in Swat. Patches of the dwarf bamboo, *ringal*, grow as far west as the Hajipir Pass in Poonch while Parker says "from the Ravi to Nepal" With further collecting more places will be found like the Karot Valley in Rawalpindi Dt., the Nawal Nadi and Serimang in Poonch, Hilal Khurd in Mirpur and the Karnah Valley east of Titwal where Himalayan species are found, far west of their relatives. Ziarat in Chitral where Gatacre found two eastern ferns,is another such place.

The most peculiar finds in the region were made by Rashid Khan and Mohammad Jan at Hilan Khurd in Mirpur. Rashid found *Scandix iberica, Lisaea heterocarpa, Bupleurum rotundifolium*, three S. European umbellifers, and Mohammad Jan found *Sideritis romana*, a labiate. These are apparently new records for the sub-continent. Two less rare foreign weeds came from the same place, *Gypsophila pilosa* (*Saponaria porrigens*) and *Cephalaria syriaca* which is said to be a noxious weed. Another find of Rashid is hard to explain and that is his discovery of *Litsea deccanensis* of the *Lauraceae* at Ghameer. It was named by Kostermanns, the Dutch authority on the family, a plant of the ghats of South India.

A number of the Azad Kashmir rarities are also found across the Jhelum in two narrow, shady valleys in Rawalpindi Dt., running down to the river, the Panjar and Karot Valleys. *Nervillia gammieana*, a rare orchid, far west of its relatives is one example and *Curculigo orchioides* another. I found *Hoya longifolia* of the *Asclepiadaceae* at Nakial in Poonch and Parker gives its range as from the Sutlej eastwards. *Sabia campanulata* in Azad Kashmir, with many more, is at the western edge of its range. Why? It must be becuase of decreasing rainfall that the rich Himalayan foothill flora tapers off as one travels westward. If I have time (I am 91) I will try to prepare an Azad Kashmir Check-list based on my Annotated Catalogue (1972). Someone should write on the Azad Kashmir plants at the western edge of their ranges.

I have collected in Poonch at different seasons. Once during the Easter vacation with Gordon College instructors, I went down to the Jhelum River from Rawalpindi and crossed the Lachman Pattan bridge. We then walked to Poonch

City where we were welcomed by old students. We climbed the Hajipir Pass and descended to the Jhelum at Uri. Once, in the summer, we went to Poonch the reverse way, climbing up to the pass from Uri. It was not until after 1947, however, that Prof. Nasir and I became deeply interested in Poonch, Kotli and Mirpur. It so happened that a young forester M. Rashid Khan, with a fresh degree in Forestry from Wales, needed work. As Gordon College had lost more than half of its staff through partition, we needed lecturers and Rashid Khan taught zoology for a year or two until he was able to obtain the position of D.F.O. (District Forest Officer) in Poonch. He was interested in finding out the names of his forest trees and the other plants as well, and four or five times he invited us to tour with him in his forests which we were delighted to do. He trained his ranger, Jan Mohammad, to collect and press plants and in 1950s, while he was in Poonch, he sent us bundles of plants for naming which were added to our collections and are now in the National Herbarium in Islamabad. Rashid Khan and his ranger collected a number of species, already mentioned, which are new for Pakistan. After Rashid Khan left Poonch, Jan Mohammad did some collecting for the little herbarium of the Forest Dept. in Muzaffarabad, which I visited in 1962.

From 1831, when Jacquemont went to Kashmir via Poonch this route was the route most collectors used but when the Jhelum Valley cart road was built from Murree to Srinagar in 1890, Poonch became a backwater again. After 1890 the only botanists visiting Poonch have been those from Rawalpindi and Frank Ludlow (1885-1972) who collected beautiful plants for the British Museum and Ami Chand of the Kashmir Forest Service at Baramulla, who in 1930 rediscovered *Primula clarkei* Watt at Poosiana, a Poonch endemic.

Botanists were not the first Europeans to visit Kashmir. I shall only mention one of them, the French traveller Bernier, who accompanied the Court of Aurangzeb in 1663 when they went to Kashmir by the Poonch route. In those days it was a major operation. Before the horses and elephants could use the road, it had to be repaired. Bernier wrote that "three thousand stone cutters, mountain miners and splitters of rocks, along with 2000 diggers, were sent off that they might level the ups and downs of the road. The ladies of the court had to ride on female elephants for not to do so would be a great "indecency". Aurangzeb, the last of the great Moguls, is said to have only gone to Kashmir once and after his time the road and *sarais* fell into ruin. The fact that the Moguls needed to do so much repairing to the roads indicates that even in their day these hills were subject to severe erosion. Kotli and Mirpur, two small Azad Kashmir areas south of Poonch suffer even more from erosion than does Poonch.

The first botanist to cross Poonch and go to Kashmir was Victor Jacquemont (1801-31). His papers and collections were sent back to France and were used by his literary executors, Cambessedes and Decaisne. The botanical part of the volumes describing his Indian travels was prepared by Cambessèdes and published in Paris in 1844. His itinerary with the dates he stayed at each place was carefully recorded but because of the French way he spelled the localities

he visited, I do not always know what places he had in mind. His Mirpour is Mirpur, Koteli is Kotli, Ouri is Uri, Tschomok is Chaumunk. Prountche must be Poonch and Petonne, Pattan. He spells Kashmir, Cachemire. We find a number of *cachemirianas* and *jacquemontianas* in the Kashmir flora. He was apparently too early for the Pir Panjal Pass and used the longer Hajipir route. He must have spent a good deal of time collecting other things in Kashmir for he only collected a few plants here and there. The details are carefully recorded. He took a side trip up the Sind Valley along the Ladak Road but did not cross the Zoji Pass. He visited the Vestervonne Mt. (Westerwan) and did not return to the plains by the way he came, but crossed the Pir Panjal Range by an eastern route through the Jammu side of the State. He did not collect very many plants in Kashmir, or anywhere else, and his method of choosing what to collect is obscure. In some places he would only collect a single plant specimen and if he had been a serious plant collector he could easily have collected all the plants he gathered in three years in a single week. As a pioneer, however, he has been given a great deal of credit.

Burkill calls attention to the fact that on his way to the Punjab to meet Ranjit Singh, Jacquemont stopped at Saharanpur to see Royle who was then in charge of an East India Company's Botanical Garden as well as serving as the Civil Surgeon of the District. He could not leave his station to collect in Kashmir, but he had acquired many Kashmir plants through native collectors and had a hundred species of Kashmir plants growing when Jacquemont visited him in 1830. His "Illustrations of the botany and other branches of the natural history of the Himalayan Mts. and the flora of Kashmir", 2 vols., 1833-40, London, was published before the vols. of Cambessèdes and Decaisne.

For the next 60 years the numerous collectors and explorers in Kashmir and Central Asia used the Poonch route to Kashmir but none of them except Jacquemont, took time to write anything about their plant collecting. There were fine forests in Poonch and fine views but supplies, transport and accommodations were scanty as there were only a few poor villages on the route. Among those who used this route were G. T. Vigne, von Huegel, Winterbottom and Richard Strachey, the Schlagintweit brothers, C. B. Clarke, Henderson & Hume, H. C. Levinge, Meebold, Falconer, George Gammie, and Ludlow.

What these botanists collected in Poonch we do not know except that it is probable that von Huegel collected *Gentiana huegelii* in Poonch and Clarke discovered *Primula clarkei* Watt and *Galium ceratophylloides* Hk. f. Von Huegel was an aristocrat and travelled with a retinue of 150. His specimens should be in Vienna. A set of Clarke's and one of Falconer's is at Kew and may also be at Dehra Dun.

The only place I have found *Paris polyphylla* and *Carex lateralis* in the Himalayas is at Taulipir in Poonch. Duthie had found the *Paris* in the Siran Valley in Hazara many years ago and this secluded valley should be searched for more rarities. The *Carex* is not listed in the Flora of British India and is a good find. Not far away at Serimang and Dhuli a fine *Calanthe* was found which may be *C. tricari-*

nata which I have only seen at these two places. Someone should make a study of the rare plants found in Poonch.

The following taxa seen to be near their western boundary in Poonch or Mirpur:–

Triumfetta pilosa
Uraria picta
Ougeinia oogeinensis
Flemingia bracteata
F. congesta
Bauhinia vahlii
Casearia graveolens
Hymenodictyum excelsum
Begonia tenella
Hoya longifolia
Scurrula pulverulenta
Holmskioldia sanguinea
Euonymus echinatus
Sabia parkeri
Ilex excelsa (doniana)
Polygala tatarinowii
Calanthe plantaginea ?
Corallorhiza trifida
Habenaria digitata
Nervilea gammieana
Thysanolaena maxima
Arundinaria falcata
Carex lateralis

The following species seem to be endemics in Azad Kashmir or vicinity:–

Draba aubrietioides
Primula inayatii
P. duthiei
P. clarkei
P. reidii
Potentilla sericophylla
Berberis parkeriana
Spiraea affinis
Eriocycla stewartii
Campanula tenuissima
Androsace duthieana
Chelonopsis albiflora var.
Galium ceratophylloides
Scorzonera alba
Aristolochia punjabensis
Corydalis stewartii
Saxifraga lilacina
Senecio jacquemontianus

GILGIT

Gilgit is an irregularly shaped, strategic piece of teritory, in the far north of Pakistan, pointing toward Central Asia. It is ony separated from Afghanistan by Chitral which is very narrow in the far north. For about 50 miles Chitral lies to the north and then there is the U.S.S.R. The border with Russia, and then further eastward with China, is in extremely rugged, uninhabited country and that with Chinese Sinkiang is undetermined. Baltistan lies to the southeast and Swat, Hazara and Muzaffarabad lie to the south. Part of Gilgit extends a little more than 37° North.

In this treatment of Gilgit, I am excluding the adjacent Baltistan which could be treated here, but which I shall treat separately as one of the three Trans-Hima-

layan provinces of the old Kingdom of Kashmir : Ladak, Baltistan and Gilgit. I am treating Gilgit as divisible into three main regions, Astor, the portion east of the Indus which includes Nanga Parbat (8120 m.) possibly the most striking of the great mountains of the world; Gilgit proper, including the drainage basin of the Gilgit River plus the territory along the Indus from the junction of the Gilgit River with the Indus to c. 1000 m., where the Indus leaves Gilgit, and thirdly the drainage basin of the Hunza River which enters the Indus from the north a little below Gilgit town.

In Gilgit there are many different habitats and floristic areas from low-lying hot deserts with Saharo-Sindian plants to the hardiest alpines along the glaciers and moraines. There is little land which can be farmed. Crops depend on irrigation as in Baltistan and Ladak. Terracing and the making of irrigation channels is often difficult and precarious as there are frequent floods. Land-slips are common. There are pockets of conifer forest above 2500 m. in favourable places, but fuel and fodder are in short supply and hard to transport. These factors limit economic development and the population which can be supported. Where irrigation is possible there are oases and good crops as at the towns of Gilgit and Baltit.

Considering the difficulty of reaching Gilgit, it is surprising how many collectors have visited the region beginning with G. T. Vigne (1801–63) who visited Astor in 1834 while the Sikhs were still in control of the Punjab and Kashmir, but had not yet conquered Astor, Gilgit or Baltistan. He was followed by Hugh Falconer in 1838 (K, DD). He, too, only visited Astor on his way to Baltistan and Ladak. It was the third visitor, Dr. James Edward Winterbottom (1803-54), a well to do English doctor, who never practiced, who was the first to get to Gilgit proper via Astor, and made excellent collections in 1847-8 which I saw at Kew. He also visited Skardo, before moving on to Nepal and his important exploration of the sources of the Sutlej with Sir Richard Strachey.

In 1876 C. B. Clarke (1832-1906), of the Indian Educational Service, who may have been the ablest of the non professional botanists, who was the next to reach Gilgit. He monographed two of the largest and most difficult families of Indian plants, the *Compositae* and *Cyperaceae*, while he was still in India and when he retired, went to Kew and gave more help to Sir Joseph Hooker toward completing the Flora of British India than anyone else. At the end of a long trip clear across Kashmir, from east to west, he collected in Gilgit and his plants were used in the making of Hooker's great flora though he did not write anything about this trip for publication.

Major John Biddulph (later Col.), Indian Army, collected in Gilgit, 1879-81. In 1873 he had visited Yarkand on the second Forsyth Mission, (K, DD).

Col. H. C. B. Tanner collected in Astor and Gilgit in 1880 and Surgeon Major G. M. Giles seems to have been the first collector to be posted to Gilgit. He lived there from 1885 to 1887. He was one of the first to collect in Dir, Chitral,

Astor and Hunza and got as far as the Wakhan Corridor of Afghanistan which points eastward toward China. None of these collectors published anything and there is still no Check-list of Gilgit plants.

The first to write about his visit to Gilgit was J. F. Duthie (1845-1922) of the Botanical Survey, stationed at Saharanpur, and later at Dehra Dun. In 1892 and in 1893 he made two long and fruitful collecting trips in Kashmir and toward the end of the 1892 trip, he visited Gilgit and reported on the conditions there in some detail. This trip is reported in the very first Record of Botanical Survey of India, 1893. He is the first to describe the very interesting Naltar Valley which I visited in 1954. Duthie collected in Tilel and Astor also, and while he was in Gilgit town, a Capt. Roberts, the medical officer there, gave him a bundle of Gilgit plants and Sir Francis Younghusband, the great Central Asian explorer, who had done some collecting in the Pamirs, gave Duthie his specimens (DD).

That same year, 1902, Prof. P. J. Bruehl of the Calcutta Engineering College, a serious student of mosses and *Ranunculaceae*, collected in Gilgit and Sir W. M. Conway (b. 1856) travelled along the great glacier from the Hispar, near Nagar, into Baltistan. Unlike the other collectors he had his plants named. In 1894 he published "Climbing in the Himalayas. Maps and scientific reports" Pp. 126, London. W. Botting Hemsley of Kew named the plants.

In 1895 Surgeon Capt. Alcock (b. 1859) went through Hunza to the Pamirs for a conference with the Russians. In 1897 Capt. H. H. Deasy visited Hunza and the Kilik Pass. In 1924 Prof. Wm. Lillie and the Rev. John Garrett of the Church of Scotland Mission in Sialkot, collected mosses which were named by H. N. Dixon. In 1925, Mr. and Mrs. Visser-Hooft, of the Swiss Consulate at Calcutta, on the second of their surveying expeditions to the Karakorums, visited Hunza. While he surveyed, Mrs. Visser collected plants and had them named.

The most thorough floristic work on the Nanga Parbat Massif was done in 1937 by a German ecologist, Carl Troll (1899-). While his campatriots were trying to climb the highest peak of the range, he noted all of the plant associations and located them on a large map. Nothing like this map has ever been made for a great Himalayan peak. Fine as his work is, it is not complete as a number of his species had only been named to the genus. His discussion and map were published in 1939 under the title *"Das Pflanzenkleid* von Nanga Parbat" [The plant cover of Nanga Parbat]. He listed 22 plant associations.

Nanga Parbat is one of the great mountains of the world. Some say that it is the grandest. It is c. 8128 m high, c. 750 m less than Mt. Everest, but Mt. Everest itself cannot be seen from afar. It is one, in a great complex of mountains, and its base is far higher than that of Nanga Parbat which rises from c. 1000 m on its western side where the Indus is flowing. It is said that from some directions no less than 7000 m of mountain is visible. No great mountains are very near

Nanga Parbat and so it can be seen from Murree in the Punjab, 100 miles away, and I have seen it from Khillanmarg above Gulmarg on the Pir Panjal Range of Kashmir.

Astor and Nanga Parbat have great altitudinal variation, rising from a foothill zone with a Saharo-Sindian flora, very much like that of Rawalpindi, to far above the snow line. As a result there are many different habitats and a rich flora. Few would have heard of Astor if it had not been for Nanga Parbat. Efforts to climb it began as far back as 1895, when a Mr. Mummery and two Gurkha guides lost their lives, probably in an avalanche. The German climbers tried again and again before they succeeded in 1953, but 33 lives were lost before the mountain was conquered by a German and Austrian team.

Most of the plants of Astor and Nanga Parbat, except for the foothill plants, are Himalayan and grow in Kashmir proper or Azad Kashmir. There do not seem to be many endemics. Forests are larger and more common than they are in Gilgit proper and between the Kamri Pass and the Rupal Nullah there are large upland areas of *Artemisia maritima* steppe. It is from this area that wormwood was cut and carried to the Srinagar *santonin* (wormwood) factory. At Rattu our tent was carpeted with *Scabiosa speciosa* in bloom.

In Astor villages, the white hollyhock, *Althaea lavateriflora* has gone wild and white irises are planted on graves as in Hazara. *Berberis orthobotrys* is common, *Ribes nigrum, Prunus jacquemontii, Rosa webbiana, Datisca cannabina, Lonicera orientalis* var., *L. quinqueloculans, L. asperifolia, L. coerulea* var. *altaica*, and var. *edulis, L. discolor, L. obovata, L. purpurascens, Viburnum cotonifolium, Populus caspica, P. ciliata, P. nigra, Salix caesia, capusii, denticulata, karelinii, lindleyana, iliensis, sericocarpa*, and *viminalis, Betula utilis, Ephedra intermedia* var. *tibetica, Pinus wallichiana, P. gerardiana, Abies*, the fir, and *Picea*, the spruce are to be found. It will be noticed that almost all of these are found in Kashmir and only a few are Central Asian. The large number of trees and shrubs show that there is more moisture than in Dras, Ladak or Baltistan. In 1935 Dr. Arnold Scheibe and Gerhard Kerstan, members of a German Hindu Kush Expedition, collected plants and the list was published by Haeckel and Troll in *Fedde Repert. Beih.* 108: 1-72. 1938. In 1939 R. Scott-Russell, of the Indian Army, collected in the Barpu Valley of Nagar and in Baltistan (MICH).

In 1946, the year before India was divided, my wife and I, accompanied by Prof. Eugene Nasir of Gordon Collge, planned to visit Gilgit on a collecting trip, following the usual Gilgit Road from the Valley of Kashmir. We employed a caravan leader and rented horses in the Sind Valley. The route was familiar to us as far as the Kamri Pass. We found that the flora on the west of the pass was very much like that of Tilel and less xerophytic than that of Dras, north of the Zoji La, on the road to Ladak. The transition from the mesophytic forests in the Sind Valley in Kashmir south of the Zoji La to Tibetan conditions to the north is very rapid on the road to Dras, while in Astor and on the slopes of Nanga Parbat there

are pockets of evergreen forest as there are in the Naltar Valley in Gilgit, and in Nagar. Some moisture must ascend the Indus Valley and the snow and glaciers on Nanga Parbat must modify conditions.

The first place of interest on the Nanga Parbat road was Rattu where there was a company of Kashmir soldiers in a little cantonment. These soldiers were trying to prevent 'kuth' smuggling. *Kuth, Saussurea lappa*, is a large, burdock-like forest plant with roots bearing a pleasant scent which had a great reputation in China. The Kashmir authorities tried to keep its collection and sale a State monopoly and there was a good deal of smuggling. At Rattu there is a great, flowery meadow. We appreciated the services of the army washerman.

Our next objective was the Rupal Nullah as we had been told that the best close up views of Nanga Parbat are to be obtained from this valley. We were also told that some visitors had had to wait a week before the peaks, with their icy slopes, came out of their cloud cover. We were fortunate and every day until about 9 A.M. the views were perfect and then wisps of cloud rose from the snowy slopes and glaciers, probably due to evaporation, and soon the peaks disappeared. We camped a few miles below the snout of the Rupal Glacier at c. 2800 m and spent a week collecting in the neighbourhood.

After collecting about the Rupal Glacier we moved to the next valley to the west, the Rama Nullah, with one of the most interesting glaciers I have ever seen. At one time the glacier must have been much larger and extended further down the valley. The terminal moraine of the present glacier is a couple of hundred feet high and is coverd with tall trees. The present glacier seemed to have retreated a little recently because there was a moat between the top of the moraine and the ice at the front of the glacier. On its way downward the river of ice must have come through a narrow gorge, for on the surface of the ice were big chunks of soil with live plants growing in the earth which must have fallen years before on the ice from above. There was a gap in the terminal moraine through which a foaming river poured.

The river of ice did not fill the valley but flowed down majestically, hundreds of yards wide, with a high lateral moraine on each side, and parallel with each lateral moraine was a good sized brook which must have been supplied with water by seepage from the glacier through the base of the lateral moraine. Between the stream and the sides of the valley were meadows with hundreds of acres of willow shrubs, *Salix karelinii* Turcz., a Russian species, which is gregarious at high altitudes. There was only one house in this nullah below the glacier and it had been built by the British resident in Gilgit who used it to get away from the summer heat.

We had intended to go on to Gilgit as no one had warned us that beyond Doian, where the road rapidly descended to the Indus, there would not be enough fodder for our horses. Leaving our camp a day's march below Astor Fort, Prof.

Nasir and I walked down to Doian to collect and study the situation. At Doian we found a grove of the most xerophytic of the Himalayan pines, *Pinus gerardiana*. Both Aitchison and Coventry had reported the rare *Ferula narthex*, the wild assa-foetida, as growing in Doian. Finding that we could not reach Gilgit, using horses, we decided to retrace our steps, but, not wishing to go back to Kashmir by the same route, we decided to follow the Burzil stream up to the Burzil Pass via Gudhai and Chilam. This is a most interesting country, botanically, and scenically. Leaving Astor we descended from the Burzil Pass to Minimarg (3200 m.) the highest village in the Neelam watershed and ascended the Nagai River to the Deosai Pass and travelled eastward by a little used route to Dras by way of the Marpo La.

I did not find another opportunity to visit Gilgit until early July 1954. In the meantime India had been divided and Gilgit had become a part of Pakistan. In 1953 I had lost my wife through cancer. She had helped me collect on many trips. Gordon College was left on the Pakistan side of the Cease Fire Line and the old Gilgit Road from Kashmir, which we had used in 1946, was closed to us. Now the only land route to Gilgit and Skardu was a long and difficult one from Pakistan up the Kagan Valley to the Babusar Pass (c. 4200 m), dropping down to the Indus and following it upward through hot deserts. This road is only open for about ten weeks from early in July, because of snow, kerosine oil and petrol had to be taken to Gilgit by jeep in the short summer or else taken in by plane. To establish year-round contact with Gilgit and Skardo, Pakistan levelled landing strips at both places and in 1954, I took a student photographer, Jameel, with me, as a general helper on a trip to Gilgit by air.

It was during the monsoon and the first day we had travelled perhaps 80 miles into the mountains when the pilot turned back because the monsoon clouds had closed in and he could not see the mountains. There was no landing field between Rawalpindi and Gilgit, so pilots could not take any chances. This trip across the Himalayas, skirting Nanga Parbat, must be one of the most spectacular in the world. The second day we crossed safely.

Mr. Mahboob Wali Khan, Divisional Forest Officer, put us up in his guest room. He had been a pupil of the famous missionary educator, Tyndale-Biscoe of Srinagar, Kashmir, who as a student had been coxswain of the Cambridge crew. He, along with providing a good education, introduced his Kashmiri Brahmins to swimming, boating, football and other games.

Gilgit Town is a fine oasis on a bench above the Gilgit River at c. 1470 m where there is level land which can be irrigated, producing good crops and many kinds of fruits. The climate is marked by dryness of air, and little cloudiness or precipitation. The summers are hot and the winters are cold. The air is so dry that winter snow soon evaporates. There is great altitudinal variation with deep V-shaped valleys. There is plenty of water in the rivers as they are fed by the melting of the deep snows and glaciers of the Karakorums and the Hindu Kush Mts. Occasional landslides dam a river and when this dam breaks, destruction follows clear

down to the plains. Villages cannot be located near the river banks, because of these occasional floods and the annual summer floods due to melting snow and ice.

Except in the occasional oases, most of the plants are xerophytic up to c. 2500 m. Most of the soil is bare. The root systems of the plants are large, compared with the parts above ground. Many plants are spinous. Others are cushion plants and there are tufted, steppe type grasses and Artemisias. Few horses, cattle, sheep or goats could be fed if it were not for the upland pastures and they too are inadequate and the growing season is short.

As there was not much of interest in the Gilgit oasis and surrounding deserts, I decided one day to explore the Jutial Nullah in order to get high enough to find the temperate plants. The meteorologist at the air port, a Punjabi, went with me as a guide. When we were high enough to find some herbaceous vegetation and I had just discovered *Silene schafta* for the first time, and started to cross a patch of large stones, I stepped on one which turned over and threw me headlong, spraining an ankle badly. Only the meteorologist was with me and there was no help within miles. He was a strong fellow and tried to carry me but the path was all stones and he could not. There was nothing for me to do but to hobble along as best I could. I do not know how far it was down to the road, where we were able to beg a ride from a military vehicle. When I got home I was unable to move about for a week.

Duthie was an economic as well as a systematic botanist and he made a list of the grasses and weeds which he found the Gilgit sheep, goats, camels and cattle were eating at c. 1490 m. His list is as follows: *Lepidium draba* and *L. latifolium, Capparis spinosa, Tamarix gallica, Ziziphus vulgaris, Melilotus, Alhagi, Scorzonera divericata, Fraxinus xanthoxyloides, Digera, Amaranthus, Chenopodium album, blitum, botrys* and *hybridum, Atriplex crassifolia, A. rosea, Eurotia, Kochia prostrata, Rumex hastatus, Salix* sp., *Andropogon annulatus, distans, ischaemum* and *laniger, Sorghum halepense, Aristida* sp., *Avena fatua, Calamagrostis, Eragrostis cynosuroides, E. poaeoides, Oryzopsis, Panicum sanguinale, Pappophorum, Pennisetum dichotomum, P. flaccidum, P. lanatum, Phragmites, Poa bulbosa, Saccharum spontaneum* and *Stipa* sp. It is surprising how many of these plants also grow about Rawalpindi and are Sudano-Sindian plants. Note that many of these edible plants are chenopods. Duthie made this study because of the great shortage of fodder in Gilgit and the difficulty and expense of bringing grass from the distant upland meadows. He recommended using spiny inedible weeds by making them into silage.

The hardiest tree in the Gilgit Agency and an important source of fuel in many places is *Juniperus excelsa* M. B. (*J. macropoda* of Hooker). The occasional forests of Himalayan species are found at high altitudes chiefly between 2700 and 3300 m. These trees are the silver fir (*Abies*), the spruce, *Picea smithiana* and the blue pine, *P. wallichiana* (*P. excelsa*). There is also *Pinus gerardiana*, the *chilgoza* pine, but it is very local. *Sorbus tianshanica*, rowan or Mountain Ash and a number

of the high level willows are Central Asian. *Salix iliensis, S. wilhelmsiana, S. capusii* and *S. excelsa*, and *Populus pamirica* are also Central Asian while *Salix julacea* (*S. wallichiana* auct.), *S. pycnostachya, S. sericocarpa* and *S. viminalis* are Himalayan. *Populus ciliata, P. caspica* and the Lombardy Poplar are western in origin. *Cedrus deodara* is found in Astor and Chitral but I do not remember seeing it in Gilgit proper.

Although Gilgit town is c. 1490 m in altitide, summer temperatures rise to more than 110° F. There is so much glacial sediment in the river that settling wells are necessary. At Baltit in Hunza, bathing water had to be left a couple of days to settle, and some one called the water 'glacial milk' becuase of its appearance. There are many gardens and fruit trees of good quality in Gilgit. There are apricots, peaches, quinces, figs, plums, apples, cherries, mulberries, almonds and grapes. Other crops are rice, barley, wheat, maize, lucerne and a variety of vegetables. In wet places in the oasis I noted *Spiranthes lancea* and *Mentha longifolia*.

Outside the irrigated area many of the plants are the same as those in semi-desert areas in Sind and the Punjab. *Capparis spinosa, Heliotropium lasiocarpum, Peganum harmala, Aristida adscensionis, Stipagrostis plumosa*, and many more.

In 1953-54, Dr. Ferdinand Schmid and Dr. J. J. Buetinger of Geneva, on a Swiss Entomological Expedition, collected in Ceylon, Baluchistan, Kashmir, Gilgit, Chitral etc. They not only collected insects but they also made an excellent collection of flowering plants. It so happened that we were in Gilgit with them in 1954 and after their trip to the Upper Gilgit (Yasin) River, they visited us in Rawalpindi and gave us duplicates, and a year or so later their plant collection was sent to me from Geneva by Dr. Baehni and I named the collection for them but foolishly did not keep a list for myslf and Geneva did not publish one. This is a little known, critical area which is as far as one can get, in Pakistan toward Central Asia, where botanical realms as well as political empires meet and it would be very interesting to have a check-list of this high altitude corner of Pakistan where Afghanistan, Chitral, Gilgit, Russia and China come so close together. It would be interesting to know something of the life of the people as well as the conditions for the plants. The only visitors to the area, who have published a list of the plants collected here, are the Japanese.

Between 1955 and 1957 four expeditions from Kyoto University visited Nuristan in Afghanistan, adjacent to Chitral, Swat, Chitral and northwest Gilgit. They also visited Hunza, Nagar and the Karakorums of Baltistan as far east as Askole. They have sent out teams of workers studying geology, zoology and other subjects as well as botany. In botany they studied the cultivated as well as the wild plants. Their stated objective, botanically, was the study of the western end of the Sino-Japanese floral region, which workers in India and Pakistan call the West Himalayan flora. Their work has clearly demonstrated that the Himalayan flora does not end in Dir or Chitral but in the Nuristan District of Afghanistan. My own study shows that the Himalayan flora is also strongly represented in the Safed Koh

Range above the Kurram Valley in Waziristan's Sulaiman Range and on into the high mountains of Baluchistan.

The Japanese have not been mere collectors but have been prompt in working up their results and publishing well illustrated books with an enumeration of the plants collected and the routes followed by the different collectors. In 1955, S. Nakeo collected in Gilgit, Hunza, Nagar and Baltistan. In 1956 K. Honda collected in Gilgit and Chitral. In 1957, K. Ogino, K. Honda and G. Iwatsubo collected in Swat, Gilgit, Chitral and Baltistan. The itineraries of the expeditions are given and also the names of the different collectors and the plants they collected. Eleven species from the Gilgit area are said to be new, a *Glycyrrhiza*, a *Stipa*, two sp. of *Carex*, a *Youngia*, a *Scorzonera*, a *Tricholpis*, a *Kobresia*, a *Lepidium*, a *Ferula* and a *Swertia*. My suspicion is that a number of these are not new. The combined list of the plants they found on four expeditions is to be found in "Plants of West Pakistan and Afghanistan: Results of the Kyoto University Scientific Expeditions" (1955-57), Kyoto Univ., 1964. It is hard to use as the plants are all in one list.

The same year that the Swiss entomologists and I were in Gilgit (1954) there was a German-Austrian expedition in the Hunza Karakorum, consisting of Paffen, K. J.; W. Pillewizer and H. J. Schneider. The results of this expedition of 1954 were published in *Erdkunde, Archiv für wissenschaftliche Geographie*, Band X, Lfg. 1. Bonn. I have not seen this paper. The Japanese state that the Germans found *Quercus baloot* on the lower slopes of Rakaposhi in Nagar. Paffen collected the plants.

In 1961 (?) Donald McVean (1926-) ecologist on the Jhelum River Dam project collected in Gilgit and Hunza, visiting the Naltar Valley. In 1962, Ikram of the Biological Institute, Rawalpindi discovered *Corispermum ikramii* in the desert near Gilgit.

Oleg Polunin, an English schoolmaster and author of books and articles on European alpine plants, collected in Gilgit, Nagar and Kashmir in 1956 and '60 and he was recently in Kashmir photographing the beautiful plants in order to prepare a book. In 1956 Hugh Tyndale-Biscoe, who was then teaching at the Edwardes College, Peshawar, collected and climbed in the Barpu Nullah, Nagar. In the same year, Shaukat Ali Chaudhary, with K. Honda of the Kyoto University visited the Naltar Vy. and many places on the Upper Gilgit River and its branches. His specimens should be in Lahore. He was on the Punjab University team.

There is a chapter in Kitamura's Plants of West Pakistan and Afghanistan (1964) entitled "Vegetation of Upper Swat and East Hindukush" which is well worth study for it is the only such discussion I know of. It was written by K. Ogino, K. Honda and G. Iwatsubo of the Forestry Dept. Kyoto University. The English is often quaint but they list the crops, the trees, the methods of irrigation and the habitats in the oases on the branches of the Upper Gilgit river. The crops,

and the wild and cultivated trees are like those in Baltistan and Ladak. They list barley, buckwheat, potatoes, radishes, pumpkins, flax, peas, corn and tobacco. They also list willows, *Populus caspica, nigra* and *pamirica*, apricots, mulberries, walnuts, pears and apples. The villages must be much like those in Nubra on the Upper Shyok.

As far as I can find out the only persons to have collected on the Upper Gilgit river were the Japanese team; Schmid and Buetinger (Swiss); and Broadhead, a Scot. The Punjabi, Shaukat Ali was probably with the Japanese when they were in this area.

I have tried to give a complete list of the Gilgit collectors but today found two more in a list of those who had collected, a rare *Ferula* at Doian in Astor. They are both very well known men but I had not known that they had ever visited Astor. They are Dr. J. E. T. Aitchison (1836-98) and B. O. Coventry of the Kashmir Forestry Service (d. 1929).

In 1975 Edinburgh University sent an expedition to this region and David J. Broadhead collected 120 plant numbers from the Thui region, 40 miles n.w. of Yasin and 120 miles N.W. of Gilgit near the Chitral border. I saw the collection at Edinburgh and copied the names as they appeared on the sheets but did not have to study them critically. Quite a few of them were from 3500 to 4000 m. A few were only named to the species. Most of them are high level Himalayan species, some are circumpolar, some Central Asian and some are endemic in this corner of Pakistan e.g. *Saussurea gilesii, Polygonum chitralicum, Astragalus barbicalyx* and *Corydalis pakistanica*. There were more Central Asian plants than endemics. A few are familiar alpines like *Polygonum viviparum, Oxyria digyna, Festuca ovina, Epilobium latifolium, Solidago virgaurea, Myricaria germanica, Geranium pratense* (Eurasian), *Poa alpina*, and *Agropyrum repens*. A few are Tibetan.

It is astonishing that the Punjabi Sikhs were able to conquer Kashmir, Ladak, Baltistan and Gilgit and hold on to these territories for about 100 years considering the warlike proclivities of the people of such places as Gilgit, Hunza and Nagar. In the 1840's, the inhabitants of the Gilgit Valley were divided into a number of tiny states such as Gilgit, Yasin, Punial, Hunza and Nagar. In 1842 the people of Yasin drove out the rulers of Gilgit who appealed to the Sikhs for help. Nathu Shah, the Sikh commander in Kashmir, with a few regiments occupied Gilgit and married daughters of three of the little states, Yasin, Hunza and Nagar. In 1847, the Hunzakuts killed Nathu Shah and in 1852 the Yasinis massacred the Sikh garrison of Gilgit. In 1860 Devi Singh reoccupied Gilgit and thereafter the Sikhs held on to the territory. A revolt of the people of Hunza and Nagar was put down in 1891-92 by Col. Durand. In 1947 all traces of Kashmiri rule were quickly removed as Pakistan took over.

HUNZA AND NAGAR (Nagyr)

The third portion of the Gilgit Agency is drained by the Hunza River which joins the Gilgit a little below the town of the same name, coming in from the north while the Gilgit River comes in from the west. Two small principalities have occupied the area, Hunza being on the right bank of the river and Nagar on the left or east bank. The ruler of each was called an Amir or Mir. Both little states are so mountainuous and there are so many great glaciers that there are only a few small villages and when I visited the area there were only about 25,000 people in each principality. Curiously the Hunzakuts are followers of the Aga Khan, leader of a Shiah sect, while the Nagaris are plain Shiahs. In the bad old days both tribes were raiders and brigands, attacking caravans on the Pamirs and raiding Gilgit and Baltistan.

When we were in the area there was an unimproved jeep road from Gilgit town to the Nagar border at Chalt, a distance of about 31 miles. Now there is a jeep road to Baltit in Hunza joining up with a modern road to China built by the Chinese. Seventeen miles from Gilgit there is an oasis and a rest house at Nomal and a fine nullah, the Naltar Valley, comes in from the west joining the Hunza River here. At Nomal (c. 1600 m) there is no indication that the Naltar is a fine, fertile valley rising steeply to 4270 m among snowy mountains. The first few miles, as one ascends, are as dry and desolate as is the road back to Gilgit.

What is happening to the Nomal Nullah is typical. The swift river is steadily clearing its valley of the alluvium which had accumulated in the valley bottom in the last ice age when the glaciers were much larger and extended lower than they do today. For several thousand feet of altitude, the river has cleared its bed except for stones and gravel, leaving a desert with a few xerophytic plants. Pakistan has built a training school for the Gilgit Scouts at c. 2980 m in a beautiful fertile area which has so far escaped erosion.

Duthie gives a good description of the Naltar Valley. He made large collections and wished that he had had more time there. My experience was like his and I wished that I had allowed more time for this valley and also time for the Bagrot Valley, the next one to the north. The richness of vegetation in the upper valley makes one think of Kashmir. The variety of plants seemed greater than any where else in Gilgit or Baltistan. Most of the plants were familiar Kashmir species, mixed in, however with the Kashmir plants, were a number of Central Asian ones. Duthie states that the Naltar village where the Gilgit Scouts have their training school, is at c. 2000 m. I think that it is c. 3000 m. Duthie stated "There is plenty of vegetation here and some good crops were seen of wheat, barley, *kangni* and *chena* (two millets), walnuts, apples and vines."

What little vegetation there was in the lower valley was completely different from that growing higher up. In the lower valley there was *Myricaria germanica*, and *Tamarix gallica*, s.l., two *Pistacias*, *Salix wilhelmsiana*, and a number of borages and

chenopods. Not far above the village there was still some avalanche snow although it was past the middle of July. Above the village the commonest trees were *Juniperus excelsa* M. B. in the driest places, and the blue pine and Himalayan spruce.

We camped at c. 2750 m in a morainal region with small lakes. There were rounded knolls covered with willows, white birch and rowan or Mountain Ash, *Sorbus tianshanica*. Three of the willows were Central Asian *S. capusii* Franch., *S. iliensis* Regel. and *S. karelinii* Turcz. There was *Rosa, Berberis, Ephedra gerardiana, Hippophae* and *Myricaria*. There were many interesting herbs, *Pyrola rotundifolia* and *P. secunda*; two sp. of *Pedicularis*, two of *Lonicera, L. heterophylla* and *obovata, Papaver nudicaule, Cortusa brotheri, Waldheimia tomentosa*, and *Triglochin palustre*. There was *Saxifraga stracheyi* and *odontophylla*, a violet, *Aquilegia fragrans*, mints, borages and pinks. I never saw so much wild rhubarb. Near a waterfall was *Pleopeltis clathrata*, a pinky gentian, *Pleurospermum stylosum* and some sedges. At a higher lake I only found "dhup", *Jurinea macrocephala.*

The day before we left the valley we climbed up toward the snow line which was above us on all sides. Although it was the 24th of July, we were too early and do not think that we found anything of interest. Any one planning to explore this valley thoroughly will have to come in August in order to get the highest alpines.

Additional plants which I find mentioned in my notes as coming from the upper Naltar Valley were *Rosa webbiana, Prunus griffithii*?, *Ribes grossularia, R. nigrum, Trachomitum* (lower valley), *Draba stenocarpa, Saussurea jacea, Juniperus communis, Oxytropis glabra, diffusa, laponica, microphylla, mollis*, and *tatarica, Androsace mucronifolia* and *A. septentrionalis*. Near rivers among stones were two hassock plants, *Acantholimon lycopodioides* and *Statice macrorhabdos. S. griffithii* grew further down the valley. *Myricaria elegans* and *Hippophae rhamnoides* grew beside the river.

Leaving the Naltar Valley we took a jeep but we had to walk a mile or so as the road was completely covered by avalanche debris. We had to walk from Chalt to Baltit, the little capital of the Mir of Hunza. Conditions were primitive and all we could get for our lunch between rest-houses was dried apricots and dried mulberries. Parts of the path onward to Hunza were probably the worst I have encountered. In places the narrow road is cut out of the cliffs with the river hundreds of feet below with no guard rails and in other places there were broad gravel slides, many hundreds of feet high and wide, with the gravel at the angle of repose.

A goat crossing the slide far above, might start an avalanche of stones and gravel that could carry the road down into the river. Travellers have written vivid accounts of such avalanches. It is hard to believe that last year an all weather road had been built by the Chinese from the Pamirs down to Hunza. This road will open up a great deal of here-to-fore unknown territory if botanists are permitted to collect in the wilds between the villages of Baltit and Nagar and the Kilik, Mintaka and Shimshal Passes which lead to Russian and Chinese territories.

In Baltit we stayed in the Mir's Guest House and became acquainted with the son of a friend who was tutor to the nine children of the Mir. The tutor was the son of Prof. Mumby of the Lucknow Christian College. He had snow leopard cubs as pets. The Mir was friendly and had a good use of English and an interesting collection of books about Hunza and mementos of the many prominent people who had visited him. We did not find much in Baltit or Nagar which we had not collected before. Every possible bit of usable land was well terraced and irrigated. The soil was fertile and there were many of the same kinds of fruit trees here that grow in Gilgit some 600 m lower, except for figs. Apricot and mulberry trees were commonest but there were black and red cherries, apples, pears, and grapes as well. The people made a good deal of wine which was playfully called *Hunza pani* (Hunza water).

One day we climbed up a nullah to the uplands where the Baltit cattle were pastured. Cowherds lived there for the summer and made ghi (clarified butter) from the milk. The *ghi* was used in cooking and had a strong taste which we found unpleasant but evidently seemed pleasing to the villagers.

We crossed the river to Nagar by a long suspension bridge high above the river unlike anything I had ever seen. There were four long cables tied together by cross wires, two to hang on to and two to support the foot part of the bridge but instead of completing the foot path there were pieces of wood perhaps three inches wide, about two and a half feet apart, with empty air in between. Some of our coolies were afraid and went across gingerly without their loads and a few bolder spirits went back to get their loads.

We also found the Mir of Nagar friendly and he also entertained us in his rest house. One day we hired horses and rode out to see the Hispar Glacier, one of the great glaciers of the Western Karakorums. It must be smaller than at some time in the past. We approached it from an old lateral moraine and could not walk out onto the ice but could only look down 60 feet or more to its rugged surface. We did not see any safe way down to the ice river.

A few of the plants from this region reported by Visser or Conway are *Colutea nepalensis, Astragalus falconeri, adesmiifolius, confertus, frigidus* and *cicerifolius, Oxytropis lapponica, O. lappoinca* var. *humifusa, O. mollis* and *microphylla, Hedysarum microphylla, Cicer songaricum, Pleurospermum candollei, Trachydium obtusiusculum, Bupleurum falcatum* var., *Carum carui, Heracleum pinnatum, Cynoglossum glochidiatum* and *Lindelofia angustifolium*.

We returned to Gilgit territory by a road on the Nagar side of the Hunza River. There was nothing of much interest on the way back to Gilgit. Both the little countries lack timber, fuel, fodder and land which can be irrigated. I was able to get a ride in a military jeep from Chalt back to Gilgit and was glad that I did not have to walk as the road was very hot and without shade and I was 63 years old. The road consisted of sand, gravel and stones and there was no drinking water.

I did not like to drink the river water because of the sediment.

Hunza has been made famous by a Col. McCarrison, a British doctor, who after visiting Hunza decided that it was ideal from the point of view of the diet and health of the people. He believed that many of the men were hale and hearty at 100 years of age. Due to his writings and to other books and articles, the fame of Hunza has spread. They assert that Hunza is one of the three or four places in the world with many centenarians. The air cannot be purer anywhere, and the climate is bracing and with food in short supply no one is obese. No one can go very far without climbing and all labor in the fields is hand labor. There are no labor saving devices and it is evident that the people are strong and healthy but I wish that someone would make a scientific study of the situation, for with 99%, plus, illiteracy and no birth registration system I do not think that any of the very old know for sure how old they are. One Hunza admirer wrote that she had been to Hunza and talked to a man 145 years old. How did she know? A Dr. Clark, an American explorer, who lived in Hunza several years did not agree with McCarrison's extravagant claims.

The Botany of Ladak and Baltistan

Ladak and Baltistan are two of the three trans-Himalayan provinces of the former State of Jammu and Kashmir. The third, Gilgit, is the westernmost of the three and nearest to Afghanistan. The boundaries of both, toward Tibet, are disputed. In 1962 China defeated India in a frontier war and occupied a section of Eastern Ladak which India claimed. All of the disputed territory is uninhabited.

I started to deal with the botanical history of these two provinces separately, but found that it would involve too much repetition. Although some collectors did work only in Ladak or only in Baltistan many of them collected in both. In both regions botanical work has been haphazard. No one planned the order in which various localities should be botanized. Most of the collectors only represented themselves and collected where their interest led them. Few of the collectors were professional botanists. They came from a variety of countries and the specimens they collected were distributed far and wide. The first collectors in Sind, the N. W. Frontier Province of India (now Pakistan) and Baluchistan were Army officers but the early workers in Ladak and Baltistan were mostly civilians, explorers of various kinds. Moorcroft was a veterinary surgeon, Thomson was a doctor, and the Schlagintweits were geographers, Vigne and Winterbottom were gentlemen travellers, Clarke was an educator, the Duke of Abruzzi was an explorer, Stoliczka was a geologist, Jaeschke and Heyde were missionaries and Henry Strachey was a surveyor.

No one would have expected that the first collecting would have been in Ladak and Kashmir before any one collected in the Punjab. Collectors have worked

in, out of the way places before anyone collected in places much more easy to reach. In the Punjab the first district to have a local flora was Multan, not Lahore.

Ladak and Baltistan lie north of the main Himalayan Range and were part of the territories of Maharaja Ranjit Singh of the Punjab before they became a part of British India. Ladak, often spelled Ladakh, is the easternmost of the three Trans-Himalayan districts and as the Himalayas do not run east and west but toward the northwest, Ladak is partly south as well as east of Baltistan. Ladak is the only district in India which is largely Buddhist and which, now that China has conquered and absorbed Tibet, retains the culture of Tibetan Buddhism with its monasteries, monks and nuns, stupas, mani walls, temples, libraries, and prayer wheels.

Only a few months ago I received a little book on the plants of Ladak from an old friend, M. Rashid Khan, Chief Conservator of Kashmir forests. It is the work of Prof. P. Kachroo (b. 1924) of the new Kashmir University in Srinagar along with Bansi Lal Sapru and Uppeandra Dhar, all of the University Department of Botany. It was published by Bishen Singh Mahendra Pal Singh, Dehra Dun, India. The title is 'Flora of Ladakh, an ecological and taxonomical appraisal'. This book is a landmark in Kashmir botany as the authors are Kashmiris and I have read it with great interest, for I first became interested in Ladak in 1912 and have been interested in the area ever since. In 1911, as a fresh graduate of Columbia University in New York City, I began to lecture in Botany and Zoology in a tiny Presbyterian Mission college in Rawalpindi with only 86 students. I had a three year appointment and not expecting to be in India again I wondered what would be the most interesting way to spend the two summers, I expected to have in the East, on a slender budget. My salary was $600 a year with a room in a dormitory. It was a different dollar in those days and the first year my food cost me the equivalent of $.41 a day and $.50 the second.

In 1911 with four young men, two Americans, a Bengali and a Scot who wanted an adventurous summer vacation, we decided that a good way to utilize the summer of 1912 would be to hike in Kashmir and Western Tibet (Ladak). Two of us worked in Gordon College, Rawalpindi, which is at the beginning of the cart road to Kashmir constructed in 1890 with a good deal of cost and difficulty. It crossed the first Himalayan Range at Jhicca Gali near Murree (c. 2100 m), descended to the Jhelum River at Kohala and then followed the river to Srinagar, a distance of 196 miles. The other three lived in Lahore.

We had nearly three months of vacation and we left Rawalpindi at the beginning of July on our push-bikes. It was still in the horse and buggy age, just before the Model T Fords and the buses began to carry visitors to Kashmir. Our cook and baggage travelled in a one horse, springless vehicle called an *ekka*. I was the only botanist in the party. The others were interested in taking pictures and seeing new country. We spent the summer in Kashmir and Ladak and I enjoyed the trip so much that I helped organize an even longer expedition for the summer of 1913.

We again rode bicycles to the Kashmir Valley and again hiked to Leh, the capital of Ladak. Instead of returning to Kashmir we turned east from Leh, crossed the Rupshu plains and entered Lahul by the Baralacha Pass; left Lahul by the Rotang La, visited Kulu and then walked further east to Simla and returned home from there by train.

I collected industriously both summers and gatherd enough material to work on for a Ph. D. thesis at Columbia University. When my three years at Gordon were complete in the summer of 1914, I returned to New York; was given a Teaching Fellowship and graduated in 1916. My Ph.D. thesis was entitled 'The Flora of Ladak, Western Tibet', Bull. Torrey Bot. Club 43: 1916-17. This little book was the only one available on the plants of Ladak until the book of Kachroo's. When I visited Dehra Dun in India in 1974, I was surprised to find that the firm which has published Kachroo's book, had republished mine and was selling it, although my booklet is long out of date and I would have been glad to make additions and corrections.

Although Kachroo's book could be improved in many ways this is not the place to detail them and I should say here that it is a mine of information and can be built on in later editions. It is largely based on the collections of the professors and students of the Kashmir University, along the road from the Zoji La to Leh and in Suru and Zanskar. Rupshu was apparently not visited. The collections of J. L. Stewart, Kashyap, Koelz and many others are not mentioned. There are no keys but there is a short description of each plant. Usually one or more localities, where the plant has been collected is mentioned but sometimes the area mentioned is too general. 'Ladakh', 'Zanskar' or 'Rupshu' is not definite enough. The collection numbers of only one worker are mentioned, FJKH. Who is he? It would have made the general list more useful if the plants found by previous collectors had been added.

Baltistan is an irregular piece of land and its boundaries are unsettled in largely uninhabited mountainous country with more mountains above 7400 m in altitude than anywhere else and including K 2, the second highest peak in the world, with the largest glaciers outside of the arctic. The mountains are the Karakorums which Baltistan shares with Gilgit. Baltistan is to be found on the map between 34′ and 36′ North and 73.3′ and 80′ East. Almost all of Baltistan is above 2270 m; It is drained by the Indus and three large tributaries. Two enter the Indus from the north and one, the Suru river drains Suru, Zanskar and Dras coming in from the east. The Shyok flows parallel to the Ladak Range and drains the Eastern Karakorums, including K 2, while the Shigar River drains the Central Karakorums.

Baltistan is thinly populated by Shiah Muslims who were formerly Buddhists. They speak a language similar to Ladaki. The people are all shepherd farmers. There is no mining, little trade and no manufacturing. Their clothing, when I visited the country, was largely homespun. The people are poor and thousands have

to migrate to the plains in search of work. Many of the unskilled labourers in Rawalpindi were Baltis. The chief exports from Baltistan were labourers and dried apricots.

The Balti villages are flat-roofed and built of stone on alluvial fans in river valleys. Their source of irrigation is not a main river because the main rivers are subject to an annual summer flood due to the melting of snow in the high mountains. Irrigating from a main river is beyond the engineering abilities of poor farmers. Building irrigation ditches for long distances, sometimes across precipices requires much labour and great skill. Building the retaining walls and keeping them in repair also entails much hard labour. Unusual local storms may undo all of their labour and cover their fields with rocks and gravel.

The rivers often flow in gorges and frequently precipices arise directly from the water, so to avoid these cliffs the traveller may have to climb a thousand feet or more to get past the precipice. To avoid this necessity, the villagers have learned to make 'paris'. These are precarious paths built across the face of a cliff. Crowbars or pegs of wood are driven into crevices of the rock and with retaining walls and poles and flat stones and in some places with ladders, roads are constructed. I first saw these 'paris' on the Upper Chenab and they are common in Gilgit and Hunza as well as in Baltistan.

Baltistan is a maze of glaciers and peaks, for the Karakorum Mts. are not a single range but there is range after range. The roads were at best mule tracks when I visited the area. There was no wheeled traffic of any kind. It took months for visitors from Europe to get to Baltistan in order to start climbing or exploring. The airplane has changed this and now it is possible to go from London to Skardu in two days. This has made it possible for a climbing party to ascend one of highest peaks in the world and get back home the same year. I wonder what tourism will do to Baltistan. I suppose that there will be hotels in Skardo and a motor road up the Shigar Valley, to Askole and Arandu. Food and supplies will have to be flown in from Rawalpindi. I have read that in 1978 there were 48 climbing expeditions in Baltistan as well as hiking parties. We made our two visits before there was an airstrip and visitors were few.

Skardo is a tableland c. twenty by five miles in area, made uneven by ancient sand dunes or possibly by an ancient terminal moraine when the Shigar Valley was occupied by a huge glacier. There are live sand dunes in both the lower Shyok and Shigar valleys and the Skardo hillocks may have had the same origin. There was, in 1940, when we were there, a moving dune between Skardu and Shigar which had buried part of a village. The oases of both Skardo and Shigar, which are only ten or twelve miles apart, are very fertile but all of the fertility depends on irrigation. Willows, poplars, the Oriental plane tree, apricots, mulberries, apples, pears, peaches, plums, *Elaeagnus* and cherries are grown, also many grapes which are allowed to climb into the trees. Many vegetables are raised.

Outside the oases, in favourable places along streams, there are thickets of a thorny rose, *Rosa webbiana*, which are covered with beautiful pink flowers. There are prickly barberries, and gooseberry bushes and in among these shrubs are vines of *Clematis orientalis*. *Myricaria* bushes are beautiful when they are in bloom. *Hippophae rhamnoides* is common and is often used for hedges. Clumps of *Artemisia* are abundant, and also tree junipers. Twenty-two days of marching were usually required for expeditions to cover the 295 miles from Skardo to Askole at 3052 m. near the foot of the Biafo glacier. Here there are good fields of barley, plenty of willows, poplars and a few fruit trees.

There is one area in Baltistan which has no counterpart in Gilgit or Ladak. This region is the Deosai Plains. Before the days of the airplane there were only two routes from Kashmir to Baltistan. One route, which was used by the Duke of Abruzzi in 1909, follows the Ladak route as far as Purig (Dras) and turns west at the Suru River and gradually descends to the Indus and Skardo. The other is a more western route which was used by Vigne and Falconer, the first foreign visitors. They left the Kashmir Valley at Bandipur and followed the Gilgit Road west to the Neelam (Kishenganga) River. They followed this route to the Burzil Pass and then followed a caravan route across the main Himalayan Range which here widens and before descending to Skardo and the Indus, the traveller had to cross both the little and the greater Deosai Plains. These plains are uninhabited and are above the tree line. Travellers must take their firewood with them from below the Burzil Pass. Before the traveller can descend to the Indus a second range with peaks up to c. 17000 ft. (5180 m) has to be crossed by a high pass. The nearest pass is the Burji La (c. 4875 m) and the second, the Satpura La, not quite so high. We crossed these uplands in the second week of July and reaching the Burji La found that it was still closed and we had to go further to the Satpura. In order to descend we had crossed the Deosai, which is like a *pamir* or *tundra*, at the best time to get the wild flowers. The winter snow on the plains is very deep. I have a picture of a postman's hut near the Burzil Pass. It is built on poles twenty feet or more tall with a ladder up to the door so that the postman could use the room in the winter. It is said that the plains can be crossed on the snow until about June 1. Then as it melts the plains become a morass with swamps, melting snow and pools of water which give birth to billions of mosquitos such as are to be found in the arctic. We were warned to take gloves and face nets for the mosquitoes and were glad that we did. Fortunately when it got cold at night the mosquitoes did not bother us. Most of the ground must be under snow for at least eight months a year. Then as soon as the snow melts the valleys and hillsides become an alpine garden which only is beautiful for a month or two, for the soil dries out as there is little summer rain. The vegetation is all dwarf and there is a surprising variety of species, about 600. Naturally the plants are all snow-melt, Himalayan plants and there are few annuals and few ferns and no trees though there are dwarf, shrubby willows and junipers.

I have been much puzzled by the Deosai Plains and wish that I could find something written by a geologist about the area. There is a curving branch of the

main Himalayas which leaves the main range near Dras and curves back near the Burzil Pass. The curving branch range rises to about 5200 m. and the Burji, the Satpura and the Bari are the passes toward the north and the Alampi La toward the west. The bowl between this range and the main range is c. 25 by 35 miles and it drains toward the east by a smaller Shigar River which flows into the Dras. The whole bowl is above the tree line and if ever there were junipers or willows large enough to furnish wood for fuel, they have been removed long ago. All of the plants are Himalayan snow-melt plants and it is not certain that there are any endemics though Fedde described *Corydalis onobrychis* and *onobrychoides* as new species.

By the end of August there is not much in bloom and the mosquitoes have disappeared. In the rest of the Trans-Himalayan region even the non-botanist will notice that the flora can be divided naturally into three. The plants can be divided again in various ways but this is the primary division. The vegetation of the villages is mostly planted, but many are weeds and other herbs which have somehow been introduced and would die out if the supply of water to the oasis should be cut off. Secondly we have the plants which are real natives that grow in the deserts, on the cliffs, in pure sand, below springs and along streams. Thirdly we have the high level plants near the melting snows and glaciers, along the moraines and in or beside the water from the glaciers. These are all alpines and many of them are the same as those found on the Deosai and near the melting snow of the Himalayas. These are of varied origins. Some like *Cystopteris fragilis, Polygonum viviparum* and *Oxyria digyna* are found all around the Arctic. Some are from Northern Europe and North Asia. Some are Central Asian or even Siberian and some are Himalayan. I was interested to find that several of the Balti willows were not Himalayan but Russian Central Asian, e.g. *Salix iliensis* Regel, *S. karelinii* Turcz. and *S. turanica* Nasarov. *Ephedra regeliana* is also Russian. One interesting find of Hartmann was *Nitraria schoberi* L., a salt marsh shrub, which is found from Eastern Europe to Central Asia. The commonest association in the dry areas is the *Artemisia steppe*, a transitional zone which resembles overgrazed pasture land.

The villages are usually small and well shaded. Lombardy poplars and several kinds of large willows are to be found in every village. Most of the willows have been pollarded, the small branches being used to make baskets and the leaves for fodder. In the lower villages up to c. 2700 m there are often huge Oriental plane trees, *Platanus orientalis*, and large walnut trees. The commonest fruit tree is the apricot and some varieties bear large fruits of fine quality. When they are ripe the roofs of houses, the walls, and rocks are orange in colour from the drying fruits. The seeds have been moved. They are cracked and the kernels are crushed for the oil, or they may be sold for almonds. Some are quite sweet and others are bitter. Mulberries are also abundant and some are large, black and juicy. They are also dried, as are some of the grapes. In 1940 we saw caravans of horses laden with bags of apricot seeds on their way to the Kashmir Valley.

A few years ago after reading Burkill's 'Chapters on the History of Botany in India' I was inspired to do the same for Pakistan and Kashmir because that was

the region where I had lived for about half a century. I began to wonder "What kind of men were those, who, in the days of the Sikhs, when travel was slow and often dangerous, did the first exploring, surveying, and collecting?" The more I read about them, the more interested I became and I regret that my interest did not arise earlier for now at 91, I do not have the time to follow this new hobby very far. It took men of enterprise, courage and curiosity and large numbers of people from many backgrounds had the qualities which were necessary. It should be remembered that it was not only botanical plant collectors who had these qualities. There were geographers, geologists, zoologists and plain thrill seekers as well.

William Moorcroft (1765-1825), the first European to do a little collecting in Ladak in 1820-22, was a pioneer of pioneers. He was the first Englishman to become a Veterinary Doctor and had to go to France to get his degree. He was the first veterinarian to be employed by the East India Co. and in 1814 was the first Britisher to penetrate into Tibet in the effort to purchase a flock of the goats which produced the fine *pashmina* wool which was used to make the expensive Kashmir shawls. On this trip he made the first collection of Tibetan plants to be sent back to London.

In 1820 with a companion, named G. Trebeck, at 55 years of age, he started out again, this time to buy stallions in Central Asia, to improve the breeds common in India. This was his avowed objective but my private opinion is that his real purpose was to find out what it was like behind the Himalayas which were still a large white area on the maps of 160 years ago. If he had started on this exploration as an envoy of the E. I. Company there might have been political difficulties, so instead of entering Kashmir by the front gate through Lahore and Kashmir he decided to by-pass the Sikhs, as much as possible, and so avoided the Punjab and the Kashmir Valley by going to Kulu in the Punjab Himalaya. A petty raja held him up for months probably fearing that if he let Moorcroft go through, he might get into trouble. Finally the party was able to proceed and crossed the Rotang Pass into Lahul, then crossed the Baralacha La (c. 4875 m) into Rupshu and finally reached Leh, the little capital of Ladak. Leh is a small place at c. 3300 m. but was an important crossroads. Toward Turkestan and Central Asia there was a 35 day route over some of the worst terrain on earth. Toward the southeast was another long route to Lhassa, the capital city of Tibet, the home of the Dalai Lama, the spiritual leader of the Lamaistic form of Buddhism. The third route led south to the Zoji La, the lowest Pass across the Himalayas and on to Srinagar, the capital of Kashmir.

The trade with Yarkand was in the hands of Kashmiri merchants and it is said that it was their jealousy which prevented Moorcroft from getting permission to move on into Central Asia. Moorcroft was a persistent person and he stayed two years in Ladak hoping to go to Yarkand. He made one trip into the Kashmir Valley, travelling about and asking hundreds of questions. He was frustrated when in the Valley, for he was followed wherever he went. The visit of Moorcroft would not have gotten into the botanical history books if it were not for the fact that before

he left Kashmir on his attempt to go north across Afghanistan to Bokhara, where he died in 1825, he had packed up a little bundle of 23 botanical specimens which he sent to Wallich in Calcutta. If he had had any interest in botany he could easily have sent several hundred specimens. It so happened that a number of his plants were new to science and Wallich described them as new; for example, *Salvia* and *Gentiana moorcroftiana*.

Without planning to do so, Moorcroft was thus the first to collect in both Ladak and Kashmir. The next explorer who got into the botanical history books also did so without much effort on his part. He was G. T. Vigne (1801-63), a well-to-do British wanderer, who went to India by the land route thinking that he would travel a year or two. He was away for seven years. When he reached India, he had no idea that he would explore in Kashmir. He moved north to the British frontier with the little empire of Maharaja Ranjit Singh, "The Lion of the Punjab". Ranjit Singh had employed a number of European adventurers in high positions but no foreigner could enter his territories without his consent. In 1830 Ranjit Singh had given the French botanist, Victor Jacquemont, permission to collect in the Punjab, the Salt Range and Kashmir and in 1834 he allowed Vigne to enter his domain. Vigne did not, however, go to Kashmir proper but to Baltistan. While he was in Ludhiana on the Sutlej, the British frontier post, a letter came to Col. Wade the British Political Officer, from Ahmad Shah, the Raja of Skardo, in Baltistan. In 1819, the Sikhs had conquered Ladak and it seemed likely that they would soon attack Baltistan. They did so in 1840. He had therefore written to ask that the British send a 'sahib' to visit him. I suppose he hoped that the British might help him. Vigne was the kind of man who liked to be the first to do something and he offered to go to Skardo. He was not a botanist but Burkill says that he had a plant press in his kit, but he seems only to have collected specimens in two places, in Astor and in Dras, although he travelled in many different parts of Kashmir for four years. Like Moorcroft, he kept lots of notes and after he went home he wrote two volumes on his travels and in a supplement he lists 90 plants. His specimens are said to have been poor. He had them named by Royle. Vigne visited Baltistan, Ladak and many places in Eastern Kashmir; made rough surveys, visited the passes and if he had been a real collector, could have discovered hundreds of species. He was the first to collect in Dras and Astor. He tried to go to Gilgit but the raja would not let him.

He was followed to Kashmir by a man of a different type, Hugh Falconer (1808-65) a paleontologist, who during his career in India was given important botanical assignments. He followed Royle as Sup't at Saharanpur and while there he was asked to join a Trade Commission going to Afghanistan. The Commission was allowed to pass through Sikh territory and Falconer did some collecting as he travelled north to the Indus. It was before the days of telephones and telegraphs and it was not until after they had crossed the Indus at Attock that the Commission found out that the Afghans would not receive them. There was a struggle at the time between Russia and the E. I. Company. The Russians were supporting one candidate for the throne and the British were supporting another who was

favourable to them but who was not popular in Afghanistan. This led to the First Afghan War in 1839-42 in which the British were defeated. As I write in 1980, 140 years later, Russia is forcibly helping its puppet to control a leaderless Afghanistan with no Great Britain to the south, to fight another Afghan War.

The Trade Commission had to go home but Falconer was allowed to go into the Himalayas to hunt for useful plants. He tried to reach the Himalayas by travelling up the Indus Valley, not knowing that there was no route through the gorges. He got as far as Darband where the people stopped him and he turned east, crossed into Hazara. Burkill says that he went to Srinagar, Kashmir by a hill route and not by the Jhelum Valley. He spent the winter of 1837 in Srinagar and in the spring went west from the Kashmir Valley by the Gilgit Road to the Neelam Valley, ascended to the Burzil Pass, crossed the Deosai Plains and dropped down to the Indus at Skardo and collected in Baltistan, where he met Vigne. Falconer was the first to collect from Tragbol in the Kashmir Valley to Skardo and up the Shigar River to Askole. He took his specimens to London in 1841, along with five tons of fossil bones which he had collected in the Siwaliks. There were 76 bundles of plants which were put in storage and neglected until Sir Joseph Hooker rescued them when they were needed for the preparation of his Flora of British India. Falconer used native collectors and the labels on his plants were written by them in the Persian or Devanagari script and when I tried to use them at Kew I found that they had not been translated so that I could not get full value from them. Often when I could figure out the name of a locality the place name was not on my map. There is another puzzle about the dates on the specimens which are said to be from 1834 to 1838. Falconer was in Baltistan only in 1838. He must have sent in collectors, as Royle did, before he was in the region. Falconer was a good collector but he did not try to name his specimens or write about them. All he wrote was about three plants of economic value, the *Kuth* plant, *Saussurea lappa*, the *asafoetida* plant, *Ferula narthex*, and on *Reptonia buxifolia* which he called *Edgeworthia buxifolia*.

The next collectors were at work in 1847-48. As soon as the British had defeated the Sikhs, they wasted no time but sent a Commission to study the question of the boundary of Kashmir with Tibet, and they called it a Tibetan Boundary Commission although the Tibetans would not cooperate and did not meet them. The Commission was in charge of a Major Alex. Cunningham and the botanist was Dr. Thomas Thomson. The surveyor was Capt. Henry Strachey, the brother of Capt. Richard, an engineer and collector who with J. E. Winterbottom in 1848 explored Kumaon and the sources of the Sutlej.

Dr. Thomas Thomson was the first to have had some botanical training. He was a classmate at Glasgow of Joseph Hooker and pupil of Sir William Hooker who became the first Director at Kew. The Commission went to Leh by a route from Kunawur to Spiti and then westward through Rupshu to Leh, the capital of Ladak. The members then went their separate ways. Henry Strachey surveyed on the Upper Indus, doing a little collecting. Thomson crossed the Ladak Range

westward into Nubra, descended the Shyok River, a difficult route to Skardo, the Baltistan capital, where he had to spend the winter as he did not start for Kashmir soon enough before the passes closed.

Early in 1848 he ascended the Suru River to Dras and returned to Kashmir by the Zoji La. He descended to Srinagar and explored in the Kashmir Valley and then moved toward the east and toured in Jammu and Bhadrawah which Vigne had visited without collecting. He visited Kishtwar and then made his way back into Ladak by way of Zanskar and Rupshu. He returned to Leh, crossed the Ladak Range again into Nurba and visited the northeastern Karakorums. Thomson was in some ways a good collector but his plant labels are not very helpful. Instead of reporting the places where he found his plants he simply wrote "W. Tib:" [western Tibet] on the tickets. He kept a diary of his journeys and in 1852 published "Western Himalaya and Tibet", pp. 501, London. His specimens went to Kew.

While Thomson was doing this exploring another well-to-do British traveller, J. E. Winterbottom (1803-1854) a doctor who never practiced, but spent his life travelling, made excellent collections in Gurez, Skardo, Astor and Gilgit and then in 1848 went to Nepal and with Sir Richard Strachey explored Kumaon and the sources of the Sutlej in Tibet.

The next visitors were the remarkable Schlagintweit brothers, Hermann (1826-82), Adolf (1829-57), and Robert (1833-85). The first brother Hermann, after he and Robert left India published a number of large books in German about their explorations and he was given a title as a reward, allowing him to add Sakünlünski to his name, as if it were not long enough already. The brothers came to India as geographers in 1854, sponsored by the King of Prussia, but the E. I. Company, pleased with their work, employed them. They visited many parts of India, the Himalayas and adjacent Tibet and Adolf even got as far as Kashgar where he was murdered. They collected in Baltistan, Ladak and also in adjacent Tibet. They were the first to collect in the Hushe Valley of Baltistan in July 1856. They employed two plant collectors and sets of their extensive collections were distributed from Kew. At least one set went to Munich. After the revolt of 1857, the British Government in London removed the East India Co. and the two remaining brothers were not re-employed.

The next important collecting trip in Ladak, after that of Thomson was one of J. L. Stewart's in 1859. Stewart was a doctor who must have spent as much time collecting plants as he did on his medicine. He was appointed by Brandis to be the first Conservator of Forests in the Punjab. Stewart did not limit his exploration to the inhabited areas of Ladak but penetrated into the most barren and Tibetan parts of the country. He reported that he had travelled 837 miles, crossed 17 passes over 14,000 ft., and went as high as 19,632 ft. On one pass he found only two lichens and a moss. He noted which plants could be used for fuel, which were edible etc. Sometimes they could not find dung or large roots to burn and had to burn turf. He published in 1869 a plant list in which he includes, along with his

own collections, plants which had been gathered by Dr. Cayley, the Trade Agent at Leh, who had found 175 species of plants.

At this period in the 1860's, there was a Moravian Mission established in Leh, Ladak and in Kyelang, Lahul. The Moravians were a Protestant denomination who began in Moravia and started Missions in out of the way parts of the world such as Labrador and Guyana. They decided to open a Mission in Tibet and as, in the 1850's, they could not get permission to enter they started work in Leh, Ladak; Khelang, Lahul and Poo in Kunawar, all on the borders of Tibet. They learned to speak Tibetan and began to translate the Bible into that language and settled down, waiting for the way into Tibet to open. They built a hospital and a small school in Leh which I visited in 1912 and 1913. They are mentioned here, as among their number, two men were good botanists and plants have been named for them. Both of them lived for years in Lahul but they collected plants in Ladak as well, the next district to the west, with much of the same flora as that of Lahul. Both were Germans. Augustus William Heyde who died in 1900, was in Lahul from about 1857-70. Hooker named *Scutellaria heydei* and *Cynanchum heydei* for him. The second was the Rev. Heinrich Augustus Jaeschke who compiled a Tibetan dictionary and was his colleague in Kyelang. The genus *Jaeschkea* Kurz is named for him. The first account of the flora of Lahul, published by Aitchison in 1865 was based on a report from Jaeschke. When I visited Kyelang in 1913 I was shown a small herbarium of theirs. When Stoliczka passed through Kyelang on the Forsythe Expedition of 1874, he was given a collection by the missionaries but as Stoliczka died before returning to Leh, it is said that these plants were accidentally mixed with those Stoliczka had collected himself.

By the 1860's, a tea industry had been established in Kangra and so the planters were looking around for markets. About 1868 the Yarkandis succeeded in driving out their Chinese overlords who had been supplying Chinese tea to the area. A planter named Shaw, an uncle of Sir Francis Younghusband, visited Yarkand and persuaded the British authorities to send a Trade Commission. As a result in 1870 the First Forsythe Trade Embassy was sent from Leh. Dr. George Henderson (1836-1929), who seems to have been serving as Civil Surgeon in the Punjab, was appointed naturalist and surgeon. He later became Director of the Calcutta Botanical Garden. He was accompanied by A. O. Hume (1829-1912) an ornithologist. Following the expedition, they published a book in 1873, "Lahore to Yarkand". Between Lahore and Yarkand they found 412 plants and 276 are listed as being Ladaki.

The Second Sir Douglas Forsythe Embassy was sent to Yarkand in 1874 with H. W. Bellow (1834-1892) as Surgeon Naturalist and Ferdinand Stoliczka (1838-1874) a geologist, who also looked for plants. He died on the return trip of the party two days before they reached Leh, probably from appendicitis. He had gotten as far as the Wakhan Corridor on a side trip.

Leh was the starting point for a number of expeditions into Tibet and Central

Asia, Deasy and Pike in 1890, Capt., later Gen. Bower and Surgeon Capt. Thorold in 1891, Mr. and Mrs. St. George Littledale, Capt. Welby, Lt. Neill Malcolm, etc.

The collective botanical results of these trips were summarized by W. B. Hemsley and H. H. W. Pearson in the Flora of High Asia. They list 282 flowering plants and one fern, *Cystopteris fragilis*, as growing above 4800m.. Of these there were 53 *Compositae*, 30 *Gramineae*, 23 *Cruciferae*, 19 *Ranunculaceae* and 18 *Leguminosae*. Additional details about the numerous persons who were at work at this period may be found in Burkill and in Pampanini.

In 1889-90, Capt. A. G. Hunter-Weston, Royal Engineers, made a good collection of Baltistan plants which went to Kew. In 1892, J. F. Duthie (1845-1922) of the Botanical Survey, collected on the Deosai. In 1892, Dr. J. Jacot-Guillarmod of Switzerland collected in the Biafo region of Baltistan and a few plants from K 2 which are at Geneva.

In 1909 the Duke of Abruzzi (1873-1935), an Italian nobleman and explorer, son of the Duke of Aosta, visited the Trans-Himalaya in 1909 and 1913-1914. He also explored in South America and Alaska. He was accompanied on his trips by Filippo de Filippi, G. Dainelli and O. Marinelli, collectors. The expedition, in 1909, left the Kashmir Valley by the Zoji La and followed the Ladak Road to the Suru River and went to Baltistan by the Suru River route. The party went as far into the Karakorums as the vicinity of K 2. De Filippi visited the Deosai Plains and published a list of the 39 species he collected. He must have crossed the plains late in the season as I have a list of nearly 600 species from the Deosai area. In 1930 R. Pampanini, an Italian botanist published 'La Flora del Caracorum. Spediz. Ital. de Filippi', in one volume in Bologna. It had been published in parts in 1913-14.

Pampanini's book is an unusual one. Not only does he list all of the plants which de Filippi had collected but he lists all of the collections of earlier visitors to Baltistan with a list of the species which they collected and for good measure he added the names of those who collected in Ladak with the list of species that they collected. Not only did he list species but he provided a map showing the routes taken by each collector. My two expeditions of 1912 and 1913 are among the last he mentions.

Between 1901 and 1914 a great deal of exploring and surveying in the Himalayas was done by W. Hunter and Fanny Bullock-Workman. They were the authors of a number of illustrated books on exploration which were not botanical and were published in London. In 1901 "In the Ice World of the Himalaya", in 1908, "Ice-bound Heights of the Mustagh" [i.e. on the Further Karakorums]. In 1909 they published "Peaks and Glaciers of the Nun Kun" that is the Suru section of Ladak and in 1910 "Call of the Snowy Hispar", that is the Hispar glacier of the Gilgit Karakorums. Mrs. Workman seems to have been the leading spirit on these expeditions and I read somewhere that she was carried in a dandy clear up to 5800 m.

Neither were botanists, nor collectors but in their expeditions of 1908-1909 to Suru and of 1913-1914 to the Karakorams they were accompanied by botanists, Dr. M. Koncza and Dr. C. Calciati. These two men in 1908-1909 collected in the Hushe and Kondus Valleys of Baltistan. Their plants went to Freiburg.

Alfred Karl Meebold (b. 1863) in 1909 published "*Eine botanische Reise durch Kashmir*" in Vol. 43 of Engler's *Bot. Jahrbücher*, 99: 63-172. He collected in Ladak, the Deosai and Skardu in 1905. *Geranium meeboldii* Briq. was named for him.

We have now arrived at modern history for I seem to have been the next to have added a bit to the flora of Ladak, first collecting in 1912 and 1913. Three times in later years I traversed the road from Dras to the Zoji La.

Until it became possible to fly to Pakistan and on to Skardu over the Himalayas, Baltistan was so hard to reach that visitors from abroad were not numerous, as before 1870, those who came by sea had to go around the Cape of Good Hope and before 1860 there was no railroad to Rawalpindi and before 1890 there was no wheeled transport from Rawalpindi to Srinagar. In 1909 it took the Duke of Abruzzi's party eight days by horse drawn carriages to cover the 200-mile hilly road to Srinagar, the capital of Kashmir, and when they had arrived at Srinagar they still had weeks of travel on foot or horseback. Even those who went to India by the land route via Turkey and Persia to the Persian Gulf and then by sea to Bombay or Karachi, had travelled three or four months before they could start on the last lap to Baltistan or Ladak. Moorcroft, Vigne, Falconer, von Huegel, Winterbottom, the Stracheys, Roero and the Schlagintweits all arrived in Kashmir before there were steamboats or railroads; before there was quinine for malaria and before there were doctors with inoculations and vaccinations. There were health dangers and physical dangers and inconveniences which modern travellers do not know.

The next expedition was that of W. Bosshard and Emil Trinker in 1927. I believe that Trinkler was a geologist (1896-1931). They came on a German Central Asia Expedition and many of the 230 species they collected were from Ladak. They were named by E. Schmid and in 1932 a paper was published by Bosshard "Bot. Ergebnisse d. Deutsch. Zentr. As. Exped"., Fedde Repert. 31."

Mr. and Mrs. J. Visser-Hooft of the Calcutta Dutch Consulate made three difficult exploring trips in the most forbidding regions of Inner Baltistan in 1922, 25 and 29. They explored in Hunza and the upper reaches of the Nubra and Shyok Valleys. They also explored the Siachen, the greatest of the Karakorum glaciers. While her husband surveyed, Mrs. Visser collected plants. In 1929, H. E. Dolk of Holland published "Plants collected by Mrs. J. Visser-Hooft during the second expedition to the Kara-Korum Mts. in the year 1925". I have not seen any further publication listing what she collected.

Major R. C. Clifford and Maj. Kenneth Mason of the Survey of India in 1926

surveyed and did some collecting in the Shaksgam Valley and the Aghil Range in the far north east of the Karakorums. The conditions here are the most extreme in Baltistan. It may be difficult to find six species in a day. It is possible to ride up to 5800 m without encountering any snow. There is so little snow-melt water that rock debris cannot be carried downstream. For days on end there was no fodder for transport animals. To illustrate the poverty of the flora, in a trip from this area to Yarkand, they only found eight legumes, five species of *Astragalus* and three of *Oxytropis*, seven composites, seven crucifers, six *Rosaceae* and only four grasses. Sixteen families had only one representative each.

The next important collector in Baltistan and Ladak was Dr. Walter N. Koelz of Grass Lake, Michigan, a student of art and fishes and collector of birds, who was a professional plant collector for many years in India, especially the Himalayas, in Afghanistan and in Iran. In 1930 he collected in the Punjab Himalayas for the Roerich Museum. In 1931 he began in Kulu, collected in Lahul and then entered Rupshu by the Baralacha Pass. He visited Hanle (c. 4000 m) on the Tibetan border, travelled in Ladak and Zanskar and returned to Kulu. In 1934 under the auspices of the University of Michigan, he again collected in Kangra, Kulu and Lahul before crossing into Zanskar by the Tsarichen La. He crossed into Purig (Dras) and then into Ladak by the Namika La. He ascended the Indus to Himis, turned east into Rupshu and then collected in Lahul and Spiti. He has probably collected more than anyone else in this whole region, even more than Thomson.

Duplicates from the Koelz collections are in many herbaria but the largest collections are in Washington, D. C., University of Michigan and N. Y. Botanical Garden. When I was at the N. Y. Botanical Garden, 1940-43, many Koelz specimens were named by me. In 1960, when I came to Michigan, my first task was getting large numbers of Koelz specimens processed so that they could be placed in the herbarium. Some were sent away to experts for naming. Unfortunately Koelz did not write anything botanical about these extensive Himalayan journeys and lists of what he collected have not been published. I have however cited a good many of his plants in my Annotated Catalogue.

My trip to Baltistan was soon after that of Koelz but I did not hear about his collecting until I was in New York. In 1940 with my wife, Dr. Hunsberger, a distinguished surgeon from our Sialkot Hospital, and her companion, a Miss Trimble, we set out for Baltistan. We engaged a caravan leader from Nunner in the Sind Valley, hired 19 horses with a few horsemen and went to Baltistan following the same route used by Vigne and Koelz. I had never had a doctor with me on long trips, though one year I wished that I had, as a blister went septic and I got blood poisoning. This time we took a doctor as the Rani of Shigar was very ill and the Mission doctor at Shigar, Dr. Gilbert, was not allowed to see her as she was a Muslim in 'strict purdah'. Dr. Gilbert persuaded Dr. Hunsberger to go with us to Baltistan to examine the Rani, using this trip as her vacation. When we reached Shigar it turned out that the Rani had incurable cancer.

The Shigar River which drains Central Baltistan enters the Indus opposite Skardu. To get to Shigar, a large fertile village, travellers must first cross the Indus which here is both wide and swift in the summer when the snow on the high mountains is melting. There are only two ways of crossing. One is by means of inflated buffalo skins which can be joined to make a raft. The other by ferry which was a crude barge that could carry eight horses at a time. We had to go up river about a mile to load. The boatmen paddled as hard as they could while the river carried us down a mile or so. Then the boat had to be towed upstream and the process repeated. The three crossing took hours. We then ascended the river to the fine oasis of Shigar village. The lower Shigar Valley is several miles wide and is probably the most populous and fertile valley in Baltistan.

Arriving in Shigar, we had to rent a field where our horses could graze as there was little food for our horses in the desert. It rarely rains in Shigar but it did rain while we were there. We did not think anything about it but when we came to start on the next stage of our journey across the Thalla La (ca. 4875 m) we were told that the pass was closed by heavy snows and that we would have to wait a few days until it melted. Our rain was snow on the mountains.

The first day's ascent was very difficult in the rocky, stony, hot desert zone. With our riding horses we took a short route and the baggage ponies took a longer one which was supposed to be easier. We arrived at the camping site before dark and waited for our camp and our food until about midnight when the horsemen arrived exhausted and with our camp chairs and tables broken. The pony men had to load and unload the baggage again and again in order to pass bad places on the road which had evidently not been used much by caravans.

When we had ascended about 900 m above the valley at c. 3353 m, the climate had improved enough to permit *Artemesia* steppe to develop. There was enough grazing for the horses and cattle of the Shigar villagers on the north facing hills to our right, with a forest of *Juniperus turkestanica* on the opposite slope. *Clematis alpina* ssp. *sibirica* was climbing among the junipers. Above the junipers we found interesting snow-melt alpines almost to the top but unfortunately at the top, c. 4900 m , the ground was still covered with snow and we do not know what interesting rarities we missed.

From the top of the Thalle La there are breath-taking views in all directions, I do not know how far we could see but we must have seen K 2 in the far north. The descent to the Shyok was much easier than the ascent. The Shyok is a large river draining the whole of the Eastern Karakorums and the western slope of the Ladak Range which separates Baltistan from Ladak. After descending a few thousand feet I was surprised to see that there were again fields below us and a village called Kasurmik (Khusomik). The grain in the uppermost fields was unripe and the few stone huts were unoccupied. Descending a thousand feet or so we came to some more houses and a threshing floor and we found the villagers threshing their barley at c. 3660 m. Most of them were complaining about their eyes and Dr.

Hunsberger got out her medicines and gave them eye drops. She was no doubt the first woman doctor and the first doctor of any sort they had ever seen. She found patients at every halt. We did not see any forest on this trip down to the river gorges, and it was a long way down the Shyok to the first village.

The Upper Shyok is occasionally responsible for causing disastrous floods. A glacier will push across the river and form a dam and a lake will form behind it. When the dam finally brusts, the wall of water carries everything before it and havoc is wrought clear down to the plains. About 1840 such a flood is said to have wiped out a Sikh army camped near the river at Attock. There are also annual floods each summer when the alpine snow and ice are melting.

Due to the melting snows of July and August and the occasional floods due to landslides, or glacial dams, the river banks are sandy or rocky and not shady with poplars and willows. There is so much sand along the lower Shigar and Shyok that there are sand dunes and sand storms and one night we had to hold on to our tent poles for hours to prevent our tents from blowing away. It is in the upper valleys that there are thickets of *Myricaria, Hippophae, Rosa webbiana, Loniceras, Ribes, Berberis* and several willows along the stream banks. The lower river valleys are deserts but as climate moderates with altitude there is a great deal of *Artemisia* steppe in the sub-alpine zone below the snow-melt alpine regions where there are good many species of alpines right up to the snow line.

We descended the Shyok which, along this part of its course, is very hot and barren with high cliffs, great talus slopes and a very scanty vegetation. The Shyok joined the Indus and then we descended until we came to Suru River which joins the Indus from the southeast. The Suru River drains the Nun Kun peak region of Suru and also the Dras area of Ladak. We then ascended the Suru River passing some fertile villages until we came to the Kashmir-Ladak Road above Dras and then crossing the Zoji La, the lowest pass on the whole Himalayan chain, c. 3444 m , returned to Srinagar.

In 1946, as I have described in the Gilgit chapter, with my wife and Prof. Nasir of Gordon College, we set out to travel from Kashmir to Gilgit, but only got as far as Doian on the steep slope down to the Indus below Astor, because there was not enough fodder for our horses. We therefore returned to the Burzil Pass, descended to Minimarg, the highest village in the Neelam watershed. Taking an eastern branch of the Neelam, the Nagai, ascended it, camping at Domel and then ascended to the Deosai Pass and on to the Deosai plains. We then followed an old, high, and little used route taken by people from Astor wanting a direct route to the Kashmir-Ladak Road. It is only a summer route as it is almost all above the tree line and the Marpo La, c. 4725 m , has to be crossed. This is high, mostly uninhabited country and we found only a few species to add to our Deosai list. There was a good deal of *Lagotis kunawurensis, Pulsatilla wallichiana, Aconitum rotundifolium* and *Pedicularis albida*. There was *Nepeta kokanica, Chorispora macropoda, Draba pyriformis, Ermannia himalayensis* and a shiny leaved

Ranunculus on top of the Marpo La which I could not name but Riedl has recently described as *Ranunculus stewartii.*

On the Dras side of the Marpo La, we found extensive pastures where a good many people from Dras were encamped with their cattle. There were no juniper forests. If they ever existed, they have been cut down. About a 1000 m lower at Dras, pastures have to be irrigated.

The next collectors in Baltistan were Dr. Grady Webster, then at Harvard, and Prof. Eugene Nasir of Gordon College. They came in 1955, accompanying a team of Harvard mountain climbers, visiting the Ghondokoro Glacier region in the Hushe Valley. The Hushe river is a tributary of the Shyok. The leader of this party, Harry Franchis, also collected some plants while climbing at the higher levels. They entered Baltistan by the same route which I did and while their companions were climbing, Wesbster and Nasir collected in the surrounding mountains. They published an excellent account of their observations and listed their collections in 1965 in the Pakistan Journal of Forestry 15: 201-234. 1965. They listed 250 species of flowering plants, 59 byrophytes, 56 mosses and three liverworts. The area they dealt with is about 400 square miles. It will be noticed that the number of species they list here is less than half of the number I reported from the Deosai. The difference is due to the fact that the Deosai plants, are all Himalayan where the ground was covered with snow all winter and these plants were growing far enough away from the Himalayas to be typical of the main part of Baltistan with a different climate. Conway, Hartmann, Webster and Nasir and the Japanese, who collected in Central Baltistan, did not find large numbers of species. Still further from the Himalayas in the Aghil Range and Shaksgam Valley area where Mason and Clifford collected in 1926, the number of species is much less. Between Leh and Yarkand they only found about 75 species and many of them are from Ladak and not in these barren mountains at all. Here the snow line is above 5500 m and the passes are bare all winter.

There are thickets of shrubs along the streams in the subalpine zone. The common wild shrubs are two *Myricarias, Hippophae rhamnoides, Rosa webbiana*, which is often very large and beautiful, *Ribes orientale*, several Loniceras, a *Berberis* and several willows.

Webster and Nasir report that there are only four species which become trees in the Upper Hushe Valley in the East Central Karakorum, *Juniperus 'polycarpos'* (probably *excelsa*), *Betula utilis, Salix viminalis* and *S. wilhelmsiana*. They found trees growing as high as 3960 m or even 4115 m. The highest shrub they found was *Lonicera semenovii.* Calciati reported a *krumholz* of *Juniperus* at 5000 m at the Masherbrum Glacier. The first tree I found on the descent from the Satpura La toward Skardu, I determined as *J. turkestanica* Kom. (*J. excelsa* M.B.) and the highest and most important tree on the Thalle La seemed to be the same.

The next important worker in Baltistan was a Swiss ecologist, Dr. Hans

Hartmann (1926-) of Küsnacht near Zurich. He visited the Biafo Glacier in 1962 in the heart of the Karakorums which he approached by the Shigar River. First he published Part I, the floristic part, which was published in 1966 and then in 1972 in *Vegetatio* he published an important ecological paper "Uber die Vegetation des Karakorum".

Number of species reported for the largest Baltistan and Ladak families.

	Deosai Plains	Biafo Glacier	Hushe Valley	Ladak
Compositae	71	49	41	119
Gramineae	50	38	18	81
Cruciferae	37	22	14	50
Scrophulariaceae	34	11	7	30
Rosaceae	32	19	13	30
Ranunculaceae	30	10	8	27
Caryophyllaceae	25	11	8	35
Labiatae	25	12	9	31
Cyperaceae	24	14	10	26
Umbelliferae	24	8	6	20
Polygonaceae	24	10	6	30
Leguminosae	20	22	14	59

In looking at the above figures it will be noticed that on the Deosai Plains the number of species is usually much greater than it is about the Biafo Glacier and in the Hushe Valley in the heart of the glacial country. It will also be noticed that on all four lists, the largest family is the *Compositae*. The grasses are second. Usually in the various parts of Pakistan the legumes are one of the first three families in number of taxa but this does not seem to be the case in the Deosai. I do not know why. In the case of the Deosai all of the taxa are snow-melt alpines and in Central Baltistan the snow-melt plants are in the majority but there are also some oasitic and desertic plants. The *Chenopodiaceae* are not in the twelve commonest families but there are 23 sp. in Ladak and only six in the Deosai and Biafo regions and only two in the Hushe Valley. There are more desert plains in Ladak than there are in Baltistan. Including the species on the Deosai, I estimate that 1223 species have been reported from the whole of Baltistan.

Ladak is the most Tibetan of the Indian districts, though nearly half of the population, that in the Dras-Kargil area nearest to the Zoji La, the only practicable pass from the Vale of Kashmir, is Moslem. Most of the area of Ladak, however, is inhabited by Ladakis, a Mongolian race related to the Tibetans and speaking a language allied to Tibetan. The culture and religion of the Ladakis is Tibetan and the picturesque qualities of the Ladaki villages, the monasteries, the monks and nuns, the *mani* walls, pagodas, prayer wheels, prayer water wheels, prayer flags etc. are more like Nepal than anything in India. Much of Ladak is very high and

uninhabitable except for nomads who with their flocks roam the high valleys and plateaus up to 5100 m , the home of the wild ass or *kiang* and the wild yak. Most of Ladak has no permanent inhabitants. The snow line is very high, c. 5800 m and over much of the area, the rainfall is 75 mm or less annually. The snow on the high mountains comes from the north. In the Tsomoriri area of S. E. Rupshu, it is possible to ride up to 6400 m on horseback on bare ground (Rup Chand). Koelz reported a number of plants from this altitude.

Compared with Baltistan, Ladak has few high mountains. The most famous are the Nun Kun peaks in the southeast in an area called Suru adjacent to Zanskar and the Himalayan main range. The area called Zanskar, is all peaks without plains or salt lakes but none of those in Zanskar compares with those of the Karakorums in Baltistan. There is a high snowy range, in Ladak Range, which separates Baltistan and Ladak with passes between 5000 and 5800 m but none of the actual peaks is noteworthy. Baltistan on the other hand has more peaks 7400 m and over than anywhere else on earth and has four great glacier systems with the greatest glaciers outside of the arctic. There are no outstanding glaciers in Ladak which is drier and has much less winter snow.

Ladak is like Tibet with extensive dry, high plains with an arctic and desert climate. Ladak has many lake basins which do not have an outlet and like the Dead Sea and Great Salt Lake in Utah, the lakes are salty due to evaporation, coupled with a lack of an outlet. About these salty lakes and plains, there are many halophytic plants than are to be found in Baltistan. All of Baltistan is well drained and there are no salt lakes and no hot dry desert plateaus. The reason for the difference is that the branches of the Upper Indus have not yet cut back far enough to drain the Ladaki lakes. In Baltistan, the Shigar and Shyok rivers have removed the alluvium from their beds up to roughly 2500 m, leaving the lower valleys deserts.

There are no high, dry plains in Baltistan or Gilgit. There are few villages in Baltistan above 3000 m. The Shigar River which drains the heart of Baltistan has two main branches, the Braldo which comes down from the east and the Basha from the west. The last village on the western branch is Arandu at c. 2900 m and the last village on the eastern branch is Askole at c. 3000 m. Each is at the foot of a glacier. In Ladak many villages are higher than this and good crops of wheat are raised up to 3700 m and barley may give good crops to 4300 m and rarely to 4600 m. At these highest villages, there are no fruit trees but only barley, broad-beans and peas are cultivated. Buckwheat is also cultivated at high altitudes. There is cultivation at high altitudes in Baltistan but not very much. The only place I saw it is on the Shyok side of the Thalle La at Khusomik and there may well be similar high fields across the Shyok above Kharmang. Neve says that there are still some Buddhist villages on the Kharmang-Ladak Road.

The lowest corner of Baltistan is below Skardu along the Indus to Rondu (c. 1700 m ?). Almost all of Baltistan is above 2280 m and almost all of Ladak

above 2850 m. Because of the altitudinal difference, I think that there is a greater variety of cultivated fruits and vegetables in Skardu and Shigar than there is in the lowest Ladaki villages. On the other hand wild and cultivated plants in Ladak can grow at higher altitudes than Balti plants can.

Another difference between the two districts is that there is no area like the Deosai Plains in Ladak. Crossing the Zoji La at only c. 3500 m, the traveller is on his way to Leh, the capital of Ladak. From the foot to the top of the pass is only three miles and only nine miles further is the wind-swept village of Matayan and Dras, an important village, at 3000 m is only twelve miles further. Some call this area Purig, partly settled by Baltis and partly by Dards (Neve). All are Shiah Muslims. The road from the Zoji to the Indus is more than 100 miles long and crosses two passes, the Fotu La and the Namika La before it reaches the Indus. The Tibetan climate begins before the traveller reaches Dras. In contrast to this, crossing the Burzil Pass on the way to Baltistan, one has to cross the alpine Deosai plains before one drops down into a Tibetan type of climate at Skardu.

What are the similarities between the two regions? Firstly there are no crops without irrigation in either province and the villages are all oases. The cultivated crops and the weeds in the oases of both are practically the same. Secondly the snow-melt plants in both districts are largely the same and so are many of the desertic plants which manage to live without irrigation and without melted snow. Both regions are largely without wild trees.

There are indications that Central Asia is becoming drier than it has been. Sir Aurel Stein in the Lop Nor Desert found abandoned towns and fields. In Ladak it is evident from the old shorelines that the lakes are smaller than they used to be. There are fluctuations from year to year and also long term ones. There are signs that glaciers have retreated and at one or more times in the past the terminal moraines extended to much lower altitudes. In Ladak at the present time, here and there, at old monasteries, like one at Himis Shupka, there are very old pencil cedars and no young ones. I have been told that people have tried getting them started again but unsuccessfully. At places I have seen stumps showing where trees stood. In the transition zone near the Himalayas there are white birches in Dras and in Suru but no where else in Ladak. As mentioned elsewhere there are pockets of *Juniperus, Betula utilis* and willow forest in Gilgit and Baltistan which are not found anywhere in Ladak proper.

I made check-lists of both areas and found that there are almost the same number of species in each, c. 1220, but there are quite a few species in Baltistan that are in Lahul to the southeast which seem to have skipped Ladak. I do not know whether this is due to insufficient collecting or not. There are many more salt tolerating plants in Ladak than in Baltistan, mostly *Chenopodiaceae*. There are more wild trees in Baltistan and more snow-melt plants because of the Deosai Plains in Baltistan.

Pteridophytes

The list of pteridophytes collected in Baltistan shows that the climate of Baltistan is not quite as dry as that of Ladak because there are only two ferns and three species of *Equisetum* in Ladak while the following have been reported from Baltistan. *Cystopteris fragilis, Dryopteris blanfordii, Thelypteris remotipinnata, Polystichum thomsonii, Athyrium rupicola, Asplenium trichomanes, Adiantum capillus-veneris, Asplenium ruta-murria, A. varians, A. virida, A. pseudofontanum, Cryptogramme stelleri, C. brunoniana* (ascent to Deosai), *Cheilanthes persica, Botrychium lunaria*, and *Equisetum ramosissimum.*

Ladak

Plants reported by Koelz as growing at 5800 m

Ephedra intermedia
Lloydia serotina
Rheum spiciforme
Eurotia ceratoides
Ranunculus lobatus
R. pulchellus
Corydalis stricta
Draba oreades
Pegaeophyton scapiflorum
Braya oxycarpa
Hedinia tibetica
Sedum tibeticum
Oxytropis densa
Pedicularis oederi
Aster flaccidus
Saussurea bracteata

Plants reported as growing to 5500 m

Poa attenuata
Trisetum spicatum
Polygonum tortuosum
P. sibiricum
Arenaria bryophylla
Stellaria graminea
Thylacospermum rupifragum
Sedum crassipes
Saxifraga flagellaris
S. imbricata
Potentilla sericea
Astragalus heydei
Oxytropis heydei
O. tatarica

In my unpublished check-list of the combined floras of Baltistan and Ladak, at last count there were 1689 taxa. This is to be considered as only an interim report but it gives a good general idea of the Trans-Himalayan flora. In looking at the names of the genera it will be noticed that *Saussurea* is probably the only genus that may be unfamiliar to North American or European botanists.

Largest genera in Baltistan and Ladak

Carex	42	*Saxifraga*	21	*Androsace*	13
Astragalus	40	*Corydalis*	20	*Euphrasia*	13

Polygonum	31	*Allium*	18	*Stellaria*	12
Gentiana	31	*Veronica*	17	*Bromus*	12
Potentilla	30	*Primula*	16	*Sedum*	12
Saussurea	29	*Draba*	16	*Lactuca*	11
Ranunculus	10	*Kobresia*	16	*Tanacetum*	11
Artemisia	27	*Epilobium*	15	*Erigeron*	10
Taraxacum	26	*Agropyron*	15	*Cuscuta*	10
Pedicularis	26	*Lonicera*	14	*Potamogeton*	10
Salix	23	*Stipa*	14		
Nepeta	22				

The largest families

Compositae taxa	250	*Cyperaceae* taxa	67	*Boraginaceae* taxa	52
Gramineae	203	*Ranunculaceae*	64	*Polygonaceae*	45
Cruciferae	97	*Rosaceae*	64	*Gentianaceae*	44
Leguminosae	94	*Caryophyllaceae*	53	*Umbelliferae*	42
Scrophulaciaceae	74	*Labiatae*	53	*Chenopodiaceae*	35

"Who's Who" of Ladak and Baltistan Collectors

Considering the fact that little has been printed about the plants of Ladak and Baltistan, those who did large or small amounts of collecting have been very numerous. The list which follows is a long one and even so I am sure that it is not complete. Far more have collected in these two areas than those who collected in the Vale itself. Many in this list also collected in the Vale.

Abruzzi, Duke of (1873-1935), two expeditions from Italy, 1909 & 1913-1914. De Filippi was his botanist; also Piretta and Cortesi in 1909 and Dainelli & Marinelle in 1913-14.

Aitchison, J. E. T. (1836-1898), Civil Surgeon, author and collector, Punjab, Afghanistan, Astor, Ladak, Trade Commissioner, Leh, 1873.

Alcock, Surg. Capt. A. W., visited Pamirs in 1895.

Ali, Zaffar, collector for Gordon College, Swat, Gilgit, Deosai etc.

Antilli 1914, apparently an Italian.

Arnold, A. E., discovered *Astragalus arnoldii* in Shaksgam Vy., c. 1894-97.

Axt, Wolfgang, Austrian collector, 48 sp. in 1961. Reported by Alex. Gilli in report on Austrian Karakorum Exped.

Bellew, Surg. Maj. H. W. (1834-92), Pamirs in 1895; on Forsyth Mission of 1873 as Surgeon Naturalist.

Bosshard, W. & Emil Trinkler, German Central Asian Exped., 1927. Plants named by Emil Schmid (1891-). Mostly from Ladak.

Bower, Capt. H. & Dr. W. G. Thorold, Ladak & Tibet, 1893.

Brandis, Sir Dietrich (1824-1907), I. G. Forests, author, collector, Ladak.

Bruehl, P. J. (1855-1935), mosses, *Ranunculaceae*. Prof. of Engineering (Calc.) Gilgit collector.

Burkill, Isaac Henry (1870-1965), I.F.S., author, "Chapters on Indian Botany" etc.

Bullock-Workman, Dr. & Mrs., explorers, surveyed in the Karakorums and Nun Kun peaks of Suru. Authors. Employed two botanists. See seq.

Calciati, Dr. C. (fl. 1908-14) & Dr. M. Koncza (Freiburg). See above.

Cayley, Dr., Trade Agent Leh, 1866-67. Collected 175 sp.; accompanied Henderson on 1870 Trade Mission to Yarkand from Leh.

Chand, Thakur Rup (1902–), born in Lahul, Punjab Himalaya. Collector for Walter Koelz, Balti., Ladak, India, Afghanistan, Iran, Assam.

Clarke, C. B. (1832-1906), I.E.S., author, collector, Kashmir, Balti., Gilgit, Kashmir etc.

Clifford, Maj. R. C., I. M. S., explored Shaksgam & Aghil range of the Karakorums with the surveyor Kenneth Mason (1926).

Conway, Sir W. Martin (1856-1937), author, surveyor, collected along Gilgit and Balti glaciers, 207 flowering plants, three mosses.

Cordeaux, 1867.

Dainelli, G. & Marinelli, O., botanists with de Filippi on Duke of Abruzzi Exped., 1913-14 to Karak. Mts., Rupshu and Zanskar.

Deasy, W. H. P. and Arnold Pike, Frontier of Ladak & Tibet, 1896. See Hemsley [BM].

de Filippi, Dr. Filippo (1869-1938), Botanist with the Duke of Abruzzi, 1909; 1913-14 (Italy), Ladak, Balti.

Desio, Ardito, Italian conqueror of K 2, 1953-54, collector [BM].

de Terr, Helmut & G. E. Hutchinson, paleontologists, collected E. Karak. Mts. & Ladak, 1930 [NY].

Douglas, Justice Wm. O., U.S.A., collector Lahul, Rupshu c. 1950, Wash., DC.

Drummond, J. R., I.C.S., Pb. (1851-1921), collector, Pb. Kashmir, Zanskar.

Duthie, J. F. (1845-1922), Bot. Surv. Ind., author, collector, Kashmir, Hazara (1888), Kashmir (1892-93), Balti, Ladak, N.W.F.P. etc. [DD, Calc, K].

Dutreuil du Rhins, Jules Leon (1846-94). Ladak, Chinese Turkestan, 1892-94.

Dyhrenfurth, G. O., collector Baltoro area, Karak, Mts., 1931 [Basel].

Falconer, Hugh (1808-65), paleontologist, collector, Pb., Balti., Ladak [K, DD, Calc. etc.).

Forsyth, Sir T. D., Bengal Civil Service (d. 1886), leader two Exped. Yarkand, 1870, 1873-74.

Francis, Harry, leader Harvard Climbing Exped., Karak. Mts. (Hushe Vy.) 1955.

Fuller, Joseph Bamfylde (1827-1910), Sup't Saharanpur Bot. Gard., Kashmir, Gilgit, Balti.

Gammie, George A. (1864-1935). Bot. Surv. Ind., collector, Son of James of Sikkim, Dras, Kashmir etc.

Grenard, Fernand, frontier of Ladak teste Pampanini.

Haeckel, I. & W. Troll, authors bot. results German Hindu Kush Exped., 1935

Hartmann, Hans (1926-), Swiss ecologist, author, collector, Biafo Glacier region, Balti., Ladak, Suru.

Hay, Lord Wm. E. (fl. 1857-72), Supt. Simla Hill States, Zanskar, Balti., Ladak collector [Calc.].

Hedin, Sven A., (1865-?) Swedish Central Asia explorer, Tibet, Ladak. Author "Trans-Himalaya".

Heyde, Rev. A. W. (fl. 1860-70), Moravian missionary, collector, Ladak, Rupshu, Lahul. *Cynanchium heydei* Hk.f.

Hemsley, W. B. & Pearson, H. H. W. See 1902 report on the Tibetan trips of Deasy, Thorold etc.

Henderson, George (1836-1929), surgeon and naturalist on 1870 Forsythe Mission to Yarkand with O. A. Hume, authors, Lahore to Yarkand, 1873. Includes list of plants collected along the whole way. Not a complete list.

Honda, K., K. Ogino, C. Iwatsubo, Japanese collectors on Kyoto and Pb. Univ. Exped. to Karak. Mts. in 1957.

Huegel, Baron Carl von (1794-1870), German born; Austrian by adoption, Kashmir & Ladak, 1835-37.

Hume, Allan Octavian (1827-1912), ornithologist with Henderson on 1870 Forsyth Mission to Yarkand.

Hunter-Weston, Capt. A. G. R. E.; collector in Balti., 1889-90.

Hurley, James J., American Consul, Lahore c. 1960, collector Balti,[RAW].

Inayat Khan, Duthie's Muslim collector (fl. 1894-1912), N.W.F.P., Pb., Kashmir, Dras etc. [D D , K].

Iwatsubo, Goro, Kyoto student and collector on E. Hindu Kush Exped. 1957.

Jaeschke, Rev. Heinrich A. (fl. 1860-80?), Moravian missionary in Lahul, Tibetan scholar, collector, Lahul, Rupshu, Ladak. *Jaeschkea* [B, K, W].

Kashyap, Prof. Siv Ram (1882–1934), Gov't College, Lahore, liverwort expert, collector Pb., Ladak, Tibet [LAH].

Kerstan, Gerhard, German Hindu Kush Exped. of 1935 [Halle].

Koelz, Walter N. (1895–), Michigan, U.S.A., professional collector, India, Ladak, Rupshu, Balti., Iran, Afghan etc. [US, NY, MICH, Harv. etc]

Koncza, Dr. M. with Calciati on Bullock-Workman Exped. to the Karak. Mts., 1908; Hushe & Cundos Vys.

Lacoste, Commander, in 1906 collected in Sassir La, Baltistan and only found six species. *Delphinium lacostei* Danguy.

Lance, John Henry (1793–1878), Bengal Civil Service, collected in Kashmir, Dras, Ladak, Spiti in 1849. *Lancea* H.& T.

Littledale, Mrs. and Mrs. St. George R. explorers, Tibet etc. 1895. See Hemsley. *Littledalea* Hemsl.

Lloyd, P. S. & S. Megan collected in Nagar & Baltistan [BM].

Lobblicher, F. was on German Karak. Mts. Exped. of 1959.

Ludlow, Frank (1885-1972), Ind. Ed. & Political Service, collector along length India-Tibetan border, Balti., Ladak etc., often with Maj. Sherriff. Specialized on beautiful alpines, *Primula, Corydalis* [BM].

Malcolm, Lt. Neill & Capt. M. S. Welby, from Leh across Tibet [1896]. See Hemsley.

Mason, Major Kenneth (1887-), Trig. Survey of India, collected on Ladak-Balti. frontier; Shaksgam & Aghil Range with Clifford in 1926. Prof. Oxford.

Maxwell, Janet, Southampton Univ., collector at Stok, Ladak in 1976 [E].

Meebold, A. K. (1864-1952), German collector India, Kashmir, Ladak, Deosai etc., 1905 [Breslau]. *Meeboldia selinoides* Wolff.

Meinertzhagen, Col. R. (1878–1967), ornithologist, collector Ladak and Balti.? c. 1925 [BM].

Moorcroft, Wm. (c. 1765-1825), first to collect in Kashmir and Ladak, zoologist, 1820-22. Plants to Wallich in Calc. *Salvia moorcroftiana* Wall. ex Bth.

Nakeo, Dr. Sasuke, member Jap. Karak. team. 1956-57 [Kyoto].

Nasir, Eugene (1908-), Prof. Gordon College, Rawalpindi; author, specialist *Umbelliferae & Silene*; collector many places. With Webster in Hushe Vy., Balti., 1954. [RAW]. Director, National Herbarium, Islamabad.

Nasir, Yasin (1943-), lecturer Gordon College, taxonomist, National Herbarium. Contributor Fl. Pakistan, collector, Deosai, Balti., etc.

Neve, Dr. Arthur, C. M. S. Med. Mission, Srinagar, mt. climber, explorer, (fl. 1885-1929) collector Nubra, Balti., Ladak, Kashmir. [K]

Nowitsky, W. Th., collector on Ladak Frontier in 1898, Kardong, Karak. Pass etc. Author "De l'Inde a la Fergana." *Braya nowitskyii* Lipsky.

Ogino, Kazuihiko, of the Kyoto Univ. team visited Swat and E. Hindu Kush Exped. 1957 [Kyoto].

Osmaston, B. B., (1867-1961), I. F. S., collected in Suru, Balti. & Ladak [K]. *Berberis osmastonii* Dunn.

Pampanini, Renato (1875-1949), author of "La flora del Caracorum", 1930, which contains scientific results of the Abruzzi Expeds.; list of Ladak & Balti. plants and collectors; maps of routes etc. 1930.

Pennell, Dr. Francis W. (1886-1952), author *"Scrophulariaceae* of W. Himalayas". Describes new Himalayan sp. incl. Balti. sp., 1943. Phila., Pa.

Picot, H. P., 1892. A Frenchman reported 26 sp. from the Kuen Lun plateau.

Pike, Arnold. See Deasy & Pike.

Pirotta, Pietro (1853-1936) & Ronaldo Cortesi (1879-1949), Italian botanists named plants of Duke of Abruzzi Exped. to Karak. Mts. of 1912[13?].

Polunin, Oleg, English school master, author of books on horticultural plants esp. alpines. Collector Gilgit, Kashmir, Balti. [BM].

Roero, Osvaldo di (Marchese), (1817-1896), Central Asian Explorer, lived in Kashmir in 1853, travelled from Leh to Yarkand in 1854, visiting Central Tibet and Turkestan several times between 1853 & 1875.

Sack, John, Harvard Univ. Exped. to Baltistan with Webster & Nasir in 1955; did some collecting at high levels.

Sahni, Birbal (1891-1949), Punjabi paleontologist, collector Kashmir & Ladak.

Schlagintweit brothers, Hermann (1826-1882), Adolf von (1829-1857), Robert (1835-85), German explorers in all parts of India including Baltistan and Ladak, 1854-58. Hermann an author. Collectors, geographers.

Schiebe, Arnold, & Gerhard Kerstan, members German Hindu Kush Exped. 1935. Plants named by Haeckel & Troll W.

Scott-Russel, R., Ind. Army, collected in Balti,and Gilgit in 1939 [BM, K].

Sherriff, Maj. George (1898-1967), former Political Officer, Kashgar, often collected beautiful alpines in the Himalayas with Ludlow. Garden in Scotland

[E, BM].

Siddiqi, M. A. (1924-) formerly lecturer Gordon College; at present in Libya; preparing flora; has collected widely in Pakistan including Baltistan [RAW].

Stewart, Isabelle Darrow (1888-1953), w.o. seq., collected with her husband in many places including Kashmir, Dras, Baltistan.

Stewart, Ralph Randles (1890-), Principal Emeritus Gordon College, Rawalpindi. Collector in most parts of Kashmir and Pakistan (1911-1962), author "The Flora of the Deosai Plains". 1964 and of Annotated Catalogue Kashmir & Pakistan plants (1972),[RAW, NY, K etc.].

Stewart, Dr. James Lindsay (1832-73), first Conservator Forests, Pb., Civil Surgeon, collector Pb., N.W.F.P., Hazara, Ladak etc. Author,[E].

Stoliczka, Ferdinand (1838-74), geologist and bot. collector. II Forsyth Exped. Died on way back to Leh of appendicitis?.

Strachey, Sir Henry (1816-1912), Member Tib. Boundary Commission of 1847-48; surveyor and collector Upper Indus in Ladak.

Strachey, Sir Richard (1817-1908), bro. praec., engineer, friend of Winterbottom with whom he visited the sources of the Sutlej and made an excellent collection of the plants of Kumaon, 1848-49. [Oxf. K].

Takamura Yasuo, member Kyoto Univ. Karakorum team in Balti. 1957.

Thomson, Thomas (1817-1878), E. I. Co. Surgeon, member Tib. Boundary Commission, 1847-48; collector Balti., Nubra, Ladak, Kashmir [K, Calc. etc.].

Thorold, Dr. W. G. with Capt. H. Bower (later Gen.) went from Leh into Tibet in 1891-92. See Hemsley.

Trinkler, Emil (1896-1931), German geologist in Central Asia. Collected in Ladak with W. Bosshard (1927-28), [*Braya trinkleri* Schmid].

Troll, Karl (1899-), botanist German-Austrian Nanga Parbat Exped. of 1937. Prepared floristic map of Nanga Parbat; collector.

Vigne, G. T., first foreigner to enter Deosai and Balti. in 1835, collected in Astor and Dras. Explorer. Only collected 90 sp. Named by Royle.

Visser-Hooft, Ph. C. & Mrs. J., Dutch Consulate, Calcutta, explorers and collector (Mrs.) in Karak. Mts. 1922, 1925, 1929. Plants named by Dolk in Holland.

Ward, Col. A. E., in charge game preservation, Kashmir, did some collecting in Sassir La in 1895.

Watt, Sir George (1851-1930), Gov't economic botanist, collected in Zanskar and Karak. Mts., 1878.

Webster, Grady L. (1927-), Harvard botanist on Climbing Exped. of 1955 with E. Nasir, now Univ. of Calif., Davis. Calif. Collector and author.

Weiler, Dr. G., collector in the Baltoro region, Balti. on the Austrian Exped. of 1956.

THE VALE OF KASHMIR

There is no place in the Himalayas equal to the Kashmir Valley. It is indeed the Switzerland of the Himalayas with a climate and a variety of scenery which is

unequalled. It is not surprising that one of the great Moghul Emperors exclaimed "If there is a paradise on earth, it is here". I have loved the valley since 1912 and must have visited it at least thirty times.

The Valley of Kashmir is a great elliptical bowl, about 80 miles long from east to west and c. 25 miles from the crest of the Pir Panjal Range in the south to the crest of the Himalayas in the north. The capital, Srinagar, is 34.1° North and 74.8° East. The floor of the valley at the capital is c. 1600 m in altitude and a number of snowy peaks, some of them higher than 4275 m , from the rim of the bowl.

The river Jhelum meanders through the valley from east to west and there are large lakes, canals and waterways. The alluvial soil is fertile, especially in the neighbourhood of Srinagar where there are miles of gardens and orchards supplying the capital with a great variety of vegetables and fruits. These gardens on land are supplemented by thousands of floating gardens.

The appearance of the Valley of Kashmir proper, the fertile, cultivated bottom of the elliptical bowl owes a great deal to man. The alluvial soil is so fertile and the land has been cultivated so long that we do not know what the valley looked like before man cut down the original forests and brought in his crops and especially the fruit, the roadside and the shade trees.

The Valley of Kashmir has been inhabited for a very long period and the ruins of ancient temples on prominent scenic spots such as the ones at Avantipur and Martand, in the main valley, and a number of side valleys, arouse the interest of visitors, especially those interested in history, because these temples are built of very large, smoothed or sculptured stones and the buildings suggest some of the ancient temples of Egypt or Greece. These temples were Hindu shrines dedicated to the god Shiv. Although the Kashmiris were Buddhist before this Hindu period, no Buddhist stupas or monasteries remain as they do in Afghanistan and in the Peshawar and Swat Valleys. Neve says that most of these temples date from 200 to 1000 A.D. There are no modern temples or mosques to compare with these ancient buildings. There was a time when Kashmir had kings who ruled over a wide area, but for centuries the Kashmiris were ruled by outsiders.

It is more than 300 years since the Mogul Emperors ceased to visit Kashmir but they have left their mark in several ways. They loved formal gardens and built them where there were slopes which could be terraced and where there was plenty of water for fountains and flowers. The two most famous of these gardens are Shalimar and Nishat on the north shore of Dal Lake. There is a road to them from the city but one should go by *shikara* to enjoy the lake and its water lilies and other flowers and the views of the mountains around the valley. The huge, shady Oriental Plane trees and the tall, ubiquitous Lombardy poplars are imports brought in by the Moguls. In addition a number of the garden flowers and escapes in the valley were probably brought in by them from the northwest. For example in the

spring there are tulips. *Tulipa lanata* growing on mud walls and rooftops. There are a number of kinds of Irises. *I. germanica*, purple or white, grow in graveyards; *I. reticulata* in saffron fields; *I. spuria* and ssp. *songarica*, and *Ixiolirion tataricum* grow in saffron fields. *Sternbergia fischeriana* is the second flower to bloom in Srinagar after the yellow *Colchicum*. The saffron plant, *Corcus sativus*, which is cultivated on the Pampur plateau and in Kishtwar, is also thought to be of Mogul introduction.

Kashmir is one corner of India which has always had plenty of water and when there has occasionally been a famine it is because of floods rather than drought. There are two crops a year in the valley but at higher altitudes, where corn is the staple crop, there is only one crop a year. In the valley wheat, barley and mustard are the first crops and the chief plants of the second crop are rice and maize. Only the rice needs to be irrigated. In the valley, rice is much the most important second crop. Rice does not do well above 2000 m. It does not like cool weather. Maize is the chief crop between 1800 m and 2700 m.In the higher valleys, a good deal of buckwheat, *Amaranthus* and millets are raised. There are two millets, *Setaria italica* and *Panicum miliaceum*, and both may be found in the same field.

In the valley there are large numbers of shady villages with great Oriental Plane trees and vast numbers of willows and Lombardy poplars. From Baramulla at the lower end of the valley, clear to Islamabad, in Kashmir, a distance of 60 miles, both sides of the road are lined by the tall poplars with the trunks only a few feet apart. The characteristic appearance of the towns and villages is due to these poplars, willows and *chenar* or Oriental Plane trees. With the exception of some horse-chestnuts, walnuts and willows, all of the trees of the valley have been introduced. Some of the species of willow in the valley are probably the descendants of original willows but the Weeping Willow, the Cricket-bat Willow and *Salix alba* are adventives. The American locust, *Robinia pseudacacia*, is an introduction which is spreading as though it were a native.

The trees and shrubs of Kashmir are pretty well known. No list of the trees of the Vale has been published but W. J. Lambert of the I. F. S.in 1933, published a "List of trees and shrubs for Kashmir and Jammu Forest Circle". For. Bull. No. 80, Calcutta. It is only a list without any descriptions but most of these species are described in Parker's Punjab and Hazara Forest Flora.

The main Kashmir valley is unforgettable and the capital, Srinagar, is located on the Jhelum River with a large and most beautiful lake, the Dal, between the city and a rim of mountains about 1200 m higher. Snowy mountains are in view to the west, and to the south are the snow peaks of the Pir Panjal Range. There is water everywhere with canals running through the city and leading to the Dal Lake. Many thousands of "boat people", the *manjis*, live on boats and there are many hundreds of large and comfortable houseboats for tourists lining waterways and the lake front. These modern houseboats are floating hotels. The waterways are like busy streets lined with boats of various types built for work or for pleasure. Those for,

pleasure, or used as taxis, are called *shikaras* and are very comfortable. They are propelled by boatmen using heart shaped, round bladed paddles. Merchants in shikaras laden with flowers, fruit, groceries, and merchandise of all sorts travel from houseboat to houseboat selling their wares.

Few valleys are as fertile as this one. There are gardens everywhere and the most interesting are those which float. As the sewage of the city daily fertilizes the waters around it, the vegetation thrives. There are many beds of cat-tails, large sedges, reeds and rushes. The farmers cut these water plants and make floating mattresses, perhaps a yard wide and fifteen feet long and anchor them by a pole at each end. Small conical heaps of earth are placed on top as seed beds. Various kinds of vegetables such as tomatoes and cucurbits of many kinds produce prodigiously. This is applied *hydroponics*. Thieves sometimes capture floating gardens by night.

Besides the floating gardens, the land adjacent to the lake is also intensively cultivated and is gradually extended out into shallow water by collecting mud and vegetation from the lake. The boatman paddles out into the lake. His or her only equipment is a paddle and a pole. The pole is thrust down into the waterweeds, twisted a time or two and they are pulled up, dripping with water, and the weeds are deposited in the bottom of the boat, which is taken ashore when it is full. In spite of the fact that this activity looks as if it were continuous, in the summer the vegetation does not seem to be reduced. It is interesting to see animals wading out into shallow water to graze. Horses are very fond of *Nymphoides* (*Limnanthemum*) leaves which float on the water like those of water-lilies. The flowers are yellow.

The area around Srinagar must be one of the best in the world to study temperate water plants including algae. There are many acres of large, pink lotuses. There are large and small white flowered water-lilies and when I visited Kashmir in 1974, after many years, there were many large pink flowered water-lilies which seem to have spread from a water garden which belonged to the Maharaja, a kind which I never saw before. Two water plants are of special interest. The first is *Euryale ferox*, with large floating leaves. They may be four feet in diameter. They are green above and red or purple below with spine covered ribs. The second is the water-chestnut, *Trapa bispinosa*. The floating leaves are triangular in shape and only two or three inches wide. The hard leathery fruits bear two strong spines and the flesh of the fruits tastes something like that of a chestnut. Moorcroft, 150 years ago, wrote that 100,000 donkey loads of these nuts were gathered annually from the Wular Lake and that they were the staple food of many of the people.

I began visiting Kashmir in 1912 and my last collecting vacation there was in 1947, the year India was divided. The cease-fire Line of 1949 cut the Rawalpindi-Kashmir Road at Uri (c. 1350 m) and the flourishing trade between the Punjab and Kashmir abruptly came to a halt and as Gordon College was on the Pakistan side of the line, my trips to Kashmir were also halted. The thousands of specimens of

Kashmir plants which I collected from all parts of the state are now in the Pakistan National Herbarium in Islamabad with many duplicates at the New York Botanical Garden, the Royal Botanic Gardens at Kew and at other herbaria.

The first to do any collecting in Kashmir and Ladak was Wm. Moorcroft, (1765-1825), a pioneer of pioneers. He was the first Englishman to become a Veterinary Doctor and the first with this training to be employed by the E.I.Co. He was the first to collect a bundle of Tibetan plants in 1814 while he was there in search of a flock of the goats which supply the wool used to make the Kashmir shawls which were very fashionable at the time. The plant specimens were sent to Robert Brown in London. In 1820, on his own, officially at least, he started out for Yarkand in Turkestan to buy stallions in order to improve the Indian breeds of horses. He was 55 when he started this difficult and dangerous journey on which he died in Afghanistan in 1825. Moorcroft was not a botanist but more of a geographical explorer, as in his time the centre of Asia was a blank on the map and little of the Himalayas had been explored.

It was the heyday of Maharaja Ranjit Singh's little Empire. He had captured Ladak in 1819, the year Moorcroft started on his great journey. Instead of entering the Sikh Empire by the front door, the Punjab, he tried to slip around the Kashmir Valley and enter by a long and difficult route from Kulu into Lahul by the Rotang Pass. He then followed the road to Rupshu and Ladak after crossing the high Balalacha La (c 4880 m). Arriving in Leh, the little capital of Ladak, Moorcroft found that he could not get permission to proceed to Kashgar. The Kashmiri traders desired to prevent competition and keep the route secret. He did not turn around and go back to India but explored in Ladak, and asking thousands of questions, tried to learn all that he could about Ladak and the surrounding region.

With difficulty he succeeded in getting permission to visit the Kashmir Valley in 1822. He visited the Lolab Valley in western Kashmir but he was followed, wherever he went, and came to hate the Sikhs and suggested to the Ladakis that they ally themselves with the British.The only reason that Moorcroft appears in this history is that, as an after-thought, he put together a little bundle of 23 plant specimens and sent them to Wallich in Calcutta, who, finding a number of them new to science, named *Gentiana, Nepeta* and *Corydalis moorcroftiana*, and a few more in his honour. Because of this Moorcroft is credited with being the first to collect both in Ladak and in Kashmir. There is not much botany in his book.

The second to work in Kashmir in person was an attractive young French botanist, Victor Jacquemont (1801–32) who had won Ranjit Singh's good will. After doing a little collecting in the Punjab he was allowed to go to Kashmir in 1831. He went early in the season and as the Pir Panjal Pass was still closed by snow he used the Hajipir variation of the Pir Panjal route. This pass is only c. 2590 m high and is open most of the year. From the pass the trail drops down to the Jhelum River at Uri. He then ascended the Jhelum to Srinagar, collecting a few plants here and there, as he went. He made a circuit of the valley and after making

large collections but not of plants, he left the Vale by a Pir Panjal route across Jammu and back to the plains. He died in Bombay in 1832, probably of malaria. Considering the fact that Jacquemont was a trained botanist the number of species which he found in Kashmir in one summer is very small, less than 100. What puzzles me is that he collected so few while there were so many more to be found. Because he was the first to collect in many places, it is not surprising that he discovered a number of new species and so there are both *jacquemontiis* and *jacquemontianas*. Jacquemont was a much better collector than Falconer and Thomson in that he carefully reports dates and localities but there are difficulties with his labels becuase of the French way he spelled his place names. Of course there was no accepted English spelling of Kashmir place names at this period, Cashmere, being a common spelling for Kashmir. Jacquemont no doubt wrote down what he thought he heard. He spelled Shupiyon as Choupienne, Wular as Voulleur; Djellalpur is his spelling of Jalalpur, Sounemeurgue of Sonamarg. In some cases I have not been able to decide what place had had in mind. Considering that some of his species came from Poonch, Kunawur and the Punjab as well as from many other places in India, why did he not collect 1000 species instead of less than 200?.

I feel that Dr. J. F. Royle (1800-58) deserves more credit as a pioneer in Kashmir botany than does Jacquemont. He was at this period, Civil Surgeon and Director of the Botanical Garden at Saharanpur in the U.P. Jacquemont on his trip north to meet Ranjit Singh in 1830, stopped to meet Royle, who showed him a hundred or more Kashmir plants growing in his garden. Royle was thus interested in Kashmir before Jacquemont and had procured seeds and plants through shawl merchants and through collectors that he had sent into Kashmir with the shawl merchants. Jacquemont's premature death made it necessary for Cambessédes and Decaisne to prepare the four folio volumes, which described the results of his work published between 1840 and 1844.

Royle's two sumptuous folio volumes with hand coloured illustrations are the most beautiful ever issued, dealing with Kashmir and the Western Himalayas. His work is entitled "Illustrations of the botany and other branches of the natural history of the Himalayan Mts. and the Flora of Cashmire", 2 vols, London (1833-40).

Royle had a large personal herbarium which he took with him to England when he retired. Foolishly, not realizing its value for future botanists, he deposited it in an unimportant pharmaceutical museum in Liverpool where it was lost for a hundred years until the collection was found, much deteriorated from lack of care. No one knows how many old, valuable collections are similarly lying unused in scores of little known herbaria. What is the use of making collection at great expense and effort and then not putting a set in a place where the specimens will be used? Another waste is collecting unicates. A unicate is a single specimen. If you find a good thing and there is plenty of material, six or seven sheets should be gathered so that duplicates can be sent to leading herbaria. Collecting several specimens makes an exchange of material possible. A friend of mine returned from

New Caledonia to-day and he said that he had made seven sheets of each number when that much material was available.

The next three botanical visitors went to Kashmir in rapid succession. The first, after Jacquemont, to obtain permission to enter Kashmir was a well-to-do adventurous traveller from Britain, G. T. Vigne (1801-63). He set out for India by the land route thinking that he might travel for a couple of years, and was away for seven. It should be remembered that the period we are talking about was before there were steamboats or railroads and that sailing ships might take six months to reach Bombay via the Cape. Burkill says that he carried a plant press but only used it in Astor and in Dras. His chief interests seem to have been geographical and he travelled widely making crude surveys everywhere and noting useful products and strategic places such as the passes leading into the Valley. As an appendix to his books he lists 90 Kashmir plants which Royle named. None seem to have been new. He travelled extensively in Kashmir between 1834 and 1838.

The next visitor was a German born nobleman, Baron Carl von Huegel, (1794-1870), whose specimens went to Austria. Although he knew a good deal of botany and did some collecting in India, he did very little in Kashmir and in his four volume work on the history of the Sicks (Sikhs) he does not mention botany. The proof that he did some collecting is that *Gentiana huegelii* Griseb. from the Pir Panjal Pass, was published in Austria as a new species. He travelled to Kashmir with a retinue of 150 in 1835.

He was followed in 1837 by Hugh Falconer (1808-65). He was a paleontologist and not a botanist, but he was assigned botanical posts, by the E. I. Company first at Saharanpur, and then at Calcutta. His title to zoological fame rests on his work on the tons of *Pleistocene* fossil bones from the Siwaliks which he took to London for study. He did not write up the many bundles of plants he took to London. They were stored there until Sir Joseph Hooker rescued them, when he was looking for material for use in his Flora of British India. He reached Srinagar in the autumn of 1837 by a route through Hazara and spent the winter in Srinagar and the collecting season in Western Kashmir, going to Baltistan by the Gilgit Road, where he met Vigne. What work he did in the Kashmir Valley I do not know. His specimens are at Kew.

One of the most important of Kashmir collectors was Thomas Thomson (1817-78), who was sent to Ladak as a member of the Tibetan Boundary Commission. Most of his work was in the Trans-Himalayan parts of Kashmir, but he did do work in the Valley. He entered the Sind Valley by the Zoji Pass, descended the Sind River and crossed the main valley eastward into Jammu. His specimens went to Kew and duplicates were distributed to other herbaria. I used a set in 1914-16 that had been sent to New York, by Hooker. He published a diary of his expedition. He was a doctor and had been a pupil of Wm. Jackson Hooker, while he was a professor at Glasgow, before he became the Director at Kew. He was a classmate of Joseph D. Hooker who followed his father as Director at Kew and on his retirement

Thomson helped Sir Joseph.

It is strange that so many of these early visitors wrote books on their work but in the more than a hundred years following Thomson, very little has been written on Kashmir plants though probably hundreds did some collecting.

The next good collector was C. B. Clarke (1832-1906) who crossed the whole of Kashmir in 1876 from Jammu to Gilgit. He served in the Indian Educational Service. In the University he took Honours in Mathematics, not Botany, but his series of collection numbers runs up to 30,000 and he probably did more solid taxonomic work than any one in the Indian Botanical Service. He retired to Kew to spend the rest of his days on research work there. He did a lot of monographic work and his monographs were not on small, easy families but on *Compositae, Cyperaceae, Umbelliferae, Begoniaceae* etc. He was Sir Joseph's best collaborator on the flora of British India.

The next collector to write about his work, was J. F. Duthie (1845-1922), of the Botanical Survey, who was first in charge of the Saharanpur Garden and collections and then lived in Dehra Dun after the herbarium was transferred there. He made long collecting trips to Kashmir in 1892 and 1893. In 1892 he made an important tour in Astor and Gilgit and adjacent areas and then in 1893 he returned to Kashmir and explored the Lidder Valley watershed. He did not publish a list of what he gathered in either year but the specimens went to Kew. A set is at Dehra Dun and probably another at Calcutta. He described these tours in the very first volume of the Records of the Botanical Survey of India. His collector, Inayat, also collected in the Jhelum Valley.

The only woman collector and author who worked in Kashmir was Emilia Frances Noel (d. 1950) who published "Some Wild Flowers of Kashmir" 1903, Nottingham. Her specimens went to Liverpool as did Royle's.

In 1905 Alfred Karl Meebold made a very long collecting trip to India which ended by covering many parts of Kashmir including the Valley and Trans-Himalayan provinces. He discovered some new species.

Frank Ludlow (1885-1972) went to India in the Educational Service. After some years in India he was given the post of Headmaster of a school in Llassa. For many years he collected plants of horticultural value in the Himalayas, especially along the frontier with Tibet; part of the time with Major Sherriff (1898-1967) who had served in the Political Service in Kashgar. He collected in what is now Azad Kashmir, Kashmir proper and Jammu. I met him once in Srinagar and many times at Kew and the BM. He specialised in *Corydalis* and *Primula* but the only paper of his I know of is "The Primulas of Kashmir" in 1951.

As far as I know the last minor collector in the Kashmir Valley in the British period was Dr. Walter N. Koelz of the University of Michigan (1895-). He studied

art and then fishes and finally became a professional collector of plants and bird skins. He collected in Kashmir in 1931, 34 and 36. Part of the time he collected for the University of Michigan and part of the time for the U. S. Dept. of Agriculture. His main collections are in the U.S.A., but duplicates are in Kew, Edinburgh and other herbaria. Unfortunately he was not interested in naming or writing about his plants. My first job when I came to Michigan in 1960 was to sort thousands of his specimens and those of his collector Rup Chand, and get them ready to insert into the herbarium. I named those that I could without too much trouble and got experts to name the specimens of the orchids, grasses and sedges. I took the grasses to Dr. N. L. Bor at Kew and the orchids to Mr. Taylor. The sedges went to Dr. Marcel Raymond in Montreal, Canada. The Afghan and Iranian specimens went to Dr. Rechinger at Vienna and identifications are appearing in the *Flora Iranica* as fascicles are printed.

My connection with Kashmir botany has been an unusual one, thanks to the fact that I have been blessed with a long life. I first visited Kashmir in 1912 and before Pakistan was separated from India, I probably visited Kashmir thirty times, and although most of the trips were in the summer, I visited Kashmir at other seasons as well. I lived at Gordon College, Rawalpindi at the beginning of the Rawalpindi-Murree-Jhelum Valley Road, most of the time between 1911 and 1960, and have visited all of the major areas in the former Empire of the Maharajahs of Jammu and Kashmir. I have not visited the Upper Shyok, Nubra or the Bhadarwah area near the Chamba Line. I have visited Astor, Gilgit Town, Hunza and Nagar but not the Upper Gilgit River or the lower Indus Valley between 1300 m and Attock. I have entered Kashmir by the Hazara route, the Jhelum Valley, the Poonch route, the Jammu route from Suru and down the Upper Chenab River from the Padar area of Chamba. I have gone in on foot, by bicycle, auto, bus, and tonga and in 1974 by air.

Before partition in 1947, there were a few important Kashmir area which I had not visited, in the western part of the state where all of the inhabitants were Muslims. At partition, these areas came to be parts of Pakistan so that I was able to visit them in 1954, flying to Gilgit.

While I worked at Gordon College from 1911 to 1960 my botanical work was largely in teaching and collecting except for the Second World War years. In the Spring of 1941, Mrs. Stewart and I returned to the U.S.A. on regular furlough. I began working at the New York Botanical Garden on specimens I had taken home for naming. After a few months I came to realize that the war was going to be a long one and that we would not be able to return to India until the war was over. So that we would not be a burden to the Presbyterian Church, I accepted the post of Curator of the Oriental Herbarium in place of a conscientious objector and served in this post until I was able to leave the U.S.A. for Bombay on a Dutch boat which left the U.S. from New Orleans in a convoy on Jan. 1, 1944. There were delays along the way and the journey took three months. Only men were able to travel on this boat.

In the years I was on the Botanical Garden staff the most interesting thing I had to do, besides naming my own specimens, was to name a large collection of plants from the Himalayas which had been collected by Walter N. Koelz. Much of this material was from the Trans-Himalayan areas of Ladak and Rupshu, regions I had visited in 1912 and 1913. By a curious coincidence my first assignment here at Michigan in 1960 after I was appointed a Research Associate, was to sort and name or get named 30,000 specimens of plants from India, Kashmir, Iran etc. which had accumulated here in Michigan because no one was familiar with Asiatic plants. Most of these plants had been collected by Koelz and his collector Rup Chand. After I had succeeded in getting these specimens ready for mounting with the help of specialists, I was able to turn to my own research work and in 1981, I am still here. For about ten years most of my time was devoted to preparing an "Annotated Catalogue of the Plants of Pakistan and Kashmir". This was published in Karachi in 1972 with funds provided by the U.S. Dept. of Agriculture.

Between 1960 and 1977, I spent fourteen summers at the Royal Botanic Gardens at Kew, near London, working on some phase of the botany of Pakistani or Kashmiri botany. Much of my last summer there, that of 1977, was spent in gathering material for a history of the Botany of this region, inspired by I. H. Burkill's "Chapters on the History of Botany in India". In 1962 my wife and I returned to Pakistan in order to collect intensively in parts of Pakistan where more collecting was needed and in 1974 with my wife and daughter we revisited Kashmir after an interval of 27 years. We were treated royally by M. Rashid Khan who is now (1980) the Chief Conservator of Forests.

When we were in Srinagar in 1974, Rashid Khan took us several times to the new Kashmir University and introduced us to the professors there. What a difference from the conditions before 1947, when we went to Kashmir almost every year!

Before 1947, Kashmir had no University and there was no botanical research. The schools and colleges in Kashmir were affiliated to the Punjab University. I remember that once or twice, the Punjab University had asked me to go to Srinagar to superintend Botanical Practical Examination in Srinagar. I do not think that B.S.c. Botany was taught there at that time. Now in 1974, I found capable professors and students preparing for Ph. D. degrees. Many times Mrs. Stewart and I had camped under the chenars at Nasim Bagh on the Dal Lake. In 1974 we found that this area had been allotted to the new Kashmir University and that Kashmiris were writing papers on the flora of the valley, and had started a herbarium. This is, not the first herbarium to be established in Kashmir, for Col. R. N. Chopra who died in 1974, aged 91, after studying medicinal plants for many years, had this herbarium in Srinagar which is now probably in Jammu. Only a week or so ago, a Jammu botanist wrote me to say that he was preparing a book on Kashmir alpine plants. In Srinagar, Prof. G. N. Javeid has published a list of 761 taxa which grow in the Valley.

When I visited the Kashmir University Botanical Department in 1974,

several of the professors there gave me copies of papers which they had written. What troubles me about their work is that most of what they publish is not distributed widely enough. Since 1960 during the summers I was at Kew, I watched the many publications which came in daily, looking for those dealing with India and Pakistan. As far as I know nothing published in Kashmir or by Kashmiri scholars was reaching Kew. A few years ago when Dr. Santapau was Director of the Botanical Survey of India, he wrote a small paper on the topic of 'effective publication'. There is a provision in the botanical code dealing with the description of new species. It emphasizes the point that a new species should be published effectively, that is in a publication which is widely read so that the botanical world will know about it. Dr. Santapau stated that there are many Universities in India which publish botanical papers but many of them do not even get to the Calcutta Herbarium. If a botanist wants his material known in the botanical world, he should send reprints of what he writes to the leading herbaria of the world. I wonder how many of the papers being prepared by Srinagar botanists have been or will be effectively published. Is it worth while publishing only for a few friends and neighbours?

Until the modern period, after 1947, Indians did not have much of a share in plant collecting except as helpers. Duthie's collector, Inayat Khan was the best of these and collected from 1894 to 1912, possibly longer. He worked chiefly in Hazara and Kashmir.

The next Indian to collect was a ranger, Rai Bahadur Keshavanand of the Dehra Dun Forest School. He collected in the Kaj Nag Range in W. Kashmir in the Jhelum and Neelam watersheds (1906-9; K,DD, Oxf.).

The native doctors in both India and Pakistan and also the general population have great faith in the curative properties of herbs. Seeing me gather specimens, the local people used to ask what the plant I was gathering was good for, assuming that I was collecting medicines. In various places in India and Pakistan, there are collections of plants, not for taxonomic reasons but only with medicine in mind. For many years in Kashmir Col. Ram Nath Chopra, (1883-1974) was in charge of a group of botanists who only collected plants for practical purposes. This group has done a great deal of work on medicinal and poisonous plants, publishing books and articles. Many , if not all of their papers, are listed in Kazmi's 1973 Bibliography, No. 4, References. I once saw Col. Chopra's collection of dried plants in Srinagar and understand that his organization has turned into a Gov't.of India Regional Laboratory in Jammu. At one time, Col. Chopra did a great deal of work on *Artemisia* and had a *santonin* factory in Srinagar. Systematic botanists working on Kashmir should examine this Herbarium. The Pakistan Forest Institute in Peshawar and the Pakistan North Regional Laboratories also in Peshawar, have similar collections of medicinal plants.

Only two efforts have so far been made to provide illustrated books on the beautiful flowers of Kashmir for the general public. The first was a work by Mr. B. O. Coventry (x-1929) of the Kashmir Forest Service who published three small

volumes entitled "Wild Flowers of Kashmir" 1923, 1927, 1930, London. There are fifty coloured photographs in each volume. There is a description of each flower illustrated, along with notes on related species. When I knew him, he lived in Gulmarg. His pictures were taken in the early days of colour photography.

The second work was published in 1928 in two volumes by Father Ethelbert Blatter (1887-1934) of St. Xavier's College, Bombay. The coloured illustrations were made from water colour paintings by Halder Joo Wali and Mrs. G. A. Wathen (Millicent). Wali was an art student in Bombay and Mrs. Wathen was the wife of Prof. Wathen who was teaching at the Khalsa College in Amritsar. Her paintings were made from life in Gulmarg in 1919. *Erysimum melicentae* Dunn was named in her honour. In 1954 there was a second edition.

Blatter's volumes were to have been prepared and issued by Prof. P.F. Hallberg, a Swedish professor at St. Xavier's in Bombay. He spent 1921 collecting in Kashmir and happened to visit Sonamarg when we were camping there. Unfortunately he died in 1924, before his two volumes were ready for publication, and Mr. F. J. Mitchell, a Srinagar business man, who had been financing the venture, asked Prof. Blatter to take over Prof. Hallberg's materials and prepare the books for publication and and the two volumes were published in London in 1928. There are 62 coloured plates and each one contains pictures of, from three to eight species. I have used the volumes a great deal but they are not a flora as weeds, cultivated plants, rushes, sedges and grasses are omitted.

It is strange that in the year since Coventry and Father Blatter, no one has brought out an illustrated book on the beautiful flowers of Kashmir. The Japanese have published such a book for the Eastern Himalayas. I have heard that a book is planned by Oleg Polunin, who has published such a book for Europe. He has done a good deal of trekking, collecting, and photographing in parts of Kashmir for many years and I hope that his book will soon be published.

Until the days of the aeroplane it has never been easy to get to Kashmir. This is because the famous valley lies between the Pir Panjal Range of mountains with peaks more than 4500 m in height and the Great Himalayan Range. Considering the time needed to get to India from Europe in the days of sailing ships and the time needed to get to the foothills of the Himalayas from Bombay on horse back, with one's goods in bullock carts, it is remarkable that so many travellers got to Kashmir before the days of the railroads and before there was wheeled traffic on the Rawalpindi-Murree-Jhelum Valley Road in 1890.

Before 1890 there were three routes commonly used in going to Kashmir. The first was the Eastern Punjab route which left the plains at Jammu City, climbed to the Banihal Pass c. 2750 m , dropped down to Verinag and followed the Jhelum down to Srinagar. The favourite route of the Mogul Emperors was the Poonch route which left the Punjab Plains at Bhimbar and crossed the Pir Panjal Pass at c. 3500 m. This is much the shortest route to the Valley but is only a summer

route because of heavy winter snows, so that Hajipir Pass, leading to the Jhelum Valley at Uri was used by many of the first visitors including Jacquemont. It is only about 2600 m and can be used most of the year.

The third route from the plains was the Hazara route, ordinarily used by travellers coming from the north. Leaving the Grand Trunk Road at Hasan Abdal they went to Hazara and going east to Domel on the Jhelum River it was followed up stream.

A much longer and more difficult fourth route was used by Moorcroft in 1820 because he wanted to avoid the Sikhs who ruled the Punjab and the Kashmir Valley. This road from Kangra goes to Kulu, to Lahul, then to Rupshu, ending up at Leh, near the Indus in Ladak.

In 1917 Mrs. Stewart and I used a fifth route. We crossed the little state of Chamba. We then crossed the range corresponding to the Pir Panjal by the Sach Pass. We visited Pangi and then turned west and followed a branch of the Chenab through Padar to Kishtwar. In 1913, the party I was with, entered the Wardan Valley of Jammu by a pass from Suru in the north of the main range. Several times I have left and entered Kashmir from the Trans-Himalaya by the Zoji La, the Burzil and the Kamri Passes.

The road that I have used most frequently was not built until 1890 and when it was finished, it stopped the use of the Poonch route. This route left the N.W. Railroad at Rawalpindi and climbed the Murree Hill to c. 2200 m at Jhicca Gali. The road then drops down to the Jhelum River at Kohala at c. 580 m. It follows the River clear up to Srinagar, a distance of 196 miles. The road was 'metalled' or 'mechadamized'. The stone used was broken into small pieces by hundreds of labourers, wielding hammers. Small hotels called *dak bungalows* were built at scenic spots every 12 or 15 miles equipped with a corps of servants from cook to sweeper.

This road was in its glory from 1890 to c. 1920 when cars and busses replaced horse transport. Then cars could leave Rawalpindi by 8A.M. and arrive in Srinagar for supper, making it unnecessary for people to spend a night in a dak bungalow. People only need to stop for a meal or two by the way. This made less business for the bungalows. The road was still busy untill 1947 when it was completely closed to ordinary traffic and now only the officers of the U.N., monitoring the Cease Fire Line, can pass the barriers at Uri.

In 1912 and 1913, the small party I was with, went to Srinagar by bicycle sending our cook and baggage on old fashioned one horse *ekkas* travelling about 45 miles a day. The road was a feat of engineering as in some places tunnels were needed and in others, the road was cut into the cliffs. Many bridges were required and in the monsoon there were occasional heavy rains which washed away the bridges, or some of them, and in other places landslips covered the road with debris

or even carried away the road. Some place on the roads was always in need of repair. It was, however, a beautiful road with hills and mountains always in view. The hillsides are grassy or well wooded. During the monsoon everything is green and there is a great variety of vegetation of many kinds. In many places there was danger from falling stones from the cliffs above. Ordinary *tongas* or phaetons usually took up to eight days for the journey but the 'Mail gari' with change of horses every four miles could get the mail through in 24 hours. Passengers in a hurry could book a seat in the mail *gari*.

I have covered much of Kashmir on foot and have used two ways of collecting. The first is by trekking. This has been the usual method which most collectors in Kashmir have followed; Thomson, Clarke, Meebold etc. By this method you cover more ground but it is not a thorough method as you only see a place once at one season. When we had small children, we only trekked as far as a good centre and then made a camp where we could live for most of July and August, from which I could go out on day trips in all directions and occasionally go further afield for two or three days. We could then do a thorough job.

The main Kashmir valley is very hot in July and August and in the old days the fashionable European set, mostly Army people, moved up to Gulmarg, c. 2620 m , when Srinagar became too warm. There they could play golf, tennis or polo. They could live in tents or 'huts' or in Nedou's hotel and there were many interesting places to go for picnics. During two summers we camped with some friends at Khillanmarg above Gulmarg at about 3050 m by a spring in the forest just below the alpine meadows. About once a week I would climb up to the alpine lake, Alo Pattar, 4115 m or to the crest of the range in search of alpine.

To provide for clean drinking water in Gulmarg, the authorities fenced off a 'catchment area' straight up the mountain behind and above Gulmarg, clear up to the top of the Pir Panjal Range. The shepherds were not allowed to take their sheep or cattle into the *'rakh'* though they did sometimes slip in and cut vegetation for them. I got a pass allowing me to enter the preserve and the collecting was far better inside the fence than outside. This area is on the north slope of the Pir Panjal Range which separates the valley from the plains side of the range. There are a number of species which are found on this north slope which I have not found on the south slopes of the main Himalayan range.

It was noticed by the first visitors to the Vale that the wild tree flora on the south slope of the Pir Panjal Range is very different from that on the hillsides in the valley. The wild trees in the valley are temperate and belong to European genera while many of the trees on the southern slope are Himalayan (Sino-Japanese) and more tropical. The species of oak that grow in the Murree or Poonch Hills, the *Rhododendron arboreum, Cinnamomum, Litsea, Machilus, Rhus* sp., *Cornus macrophylla, Pieris ovalifolia, Neolitsea*, etc. do not grow on the valley slopes. As the floor of the valley is at 1600 m, few Himalayan foothill plants (Sudano-Sindian plants) reach the valley. They are common in Azad Kashmir and Jammu

nearby on the southern slope.

The common trees in the great Kashmir forests between 1830 and 3660 m include the following hardwoods:- horse-chestnuts, walnut, *Corylus, Parrotiopsis, Ulmus* sp., *Prunus, Acer* sp., *Morus serrata, Fraxinus excelsior, Pyrus, Euonymus, Crataegus songarica, Betula utilis, Celtis* sp., *Salix* sp., and *Populus* sp. The common conifers are very abundant, chiefly on the steeper slopes and approaching the tree line. *Abies pindrow* (*webbiana*) which grows tall and narrow can often be recognized in the distance, lining the ridges. The blue pine may ascend from 1665 m to the tree line. The spruce, *Picea smithiana*, is the third conifer which grows commonly from 1830-3350 m but grows as low as 1220 m in the deep, narrow Neelam Valley. The most valuable conifer, *Cedrus libani* var. *deodara*, does not ascend as high as the first species mentioned. It first appears on the Jhelum Valley Road at Uri and rarely ascends to 3050 m. The yew does not grow as tall as the other conifers, though the trunks are thick for their height. The one tree juniper, *Juniperus excelsa* is probably the hardiest of the conifers and, growing on hot dry hillsides, cannot form dense forests. It is the only tree in *Artemisia* steppe.

Before 1947, when thousands of British visitors went to Kashmir each summer many, who were not interested in golf, polo and tennis, used to go trekking or camped in Pahlgam in the Lidder Valley at c. 2200 m , at Sonamarg at c. 2745 m , in the Sind valley, at Tragbol or Gurez (Gurais) on the Gilgit Road. The first two were our favourite camping grounds. We love them all but are especially fond of Sonamarg on the road from Kashmir to Ladak and Central Asia. I suppose the reason I prefer Sonamarg is that, being higher, it is nearer the snows. It does not take long to get into the alpine zone from camp and the Valley of Glaciers is one of the most attractive I know.

Among the trekkers were the hunters and the fishermen. The Kashmir Government was conservation minded and there was a Game Preservation Dep't which divided the country into blocks and hunters and fisherman could rent the right to hunt or fish in a *'block'* with a limit to what could be taken. There was a fish hatchery to improve the trout fishing.

Sonamarg, the third stage on the Ladak Road, about 39 miles north of the Kashmir Valley is a small village beside the Sind River. There is nothing special about the village but a couple of miles east is a most beautiful alpine valley, Thajwaz or Thajwas. Between Sonamarg and this valley, there is a large moraine field with scattered groups of trees on the old terminal and lateral moraines of a great glacier which once filled the valley. At the present time all that is left of the original glacier is four or possibly five hanging glaciers high up on the side of a range about 4755 m high. The fifth may be only a snow field. At the edge of the forest and between the hillocks of the moraines, there are a good many places where tents can be pitched and this has been one of the favourite camping places for many wanting to get away from the summer heat of Srinagar. We camped there two full summers and were there for shorter periods at least four times more.

It is one of the best bases in Kashmir for trips to the snow line. Starting at 2745 m one can soon climb into the alpine zone and get the plants on the moraines and the snow-melt plants near the glaciers.

Within five or six miles of Sonamarg, I collected c. 560 taxa including ferns. The genera are all temperate or alpine and almost all of them would be familiar to a Canadian, Dane or Russian. The following genera are the commonest and are represented by ten or more species:- *Carex*, *Potentilla* and *Polygonum*. The following are represented by five to nine:- *Asplenium*, *Poa*, *Juncus*, *Anemone*, *Corydalis*, *Viola*, *Stellaria*, *Astragalus*, *Cotoneaster*, *Saxifraga*, *Sedum*, *Lonicera*, *Valeriana*, *Artemisia*, *Senecio*, *Saussurea*, *Primula*, *Androsace*, *Gentiana*, *Veronica*, *Pedicularis*, *Nepeta*, *Salix* and *Allium*.

The commonest parasite is the dwarf *Arceuthobium minutissimum* a dioecious mistletoe growing on the blue pine. The most striking flower is *Meconopsis aculeata*, the Blue Poppy. *Megacarpaea* is a remarkable crucifer with large, flat siliquas, two inches across, very large leaves and many stamens instead of six. These plants can be eaten as greens. Edelweiss, which is rare in Europe, is very common. Fine alpines are numerous.

Pahlgam was the favourite camping place for Indian campers. It is at 2210 m and the nights are not so cold as they are in Sonamarg. It is even better than Sonamarg as a centre for hikes and treks. Only 22 miles up the west branch of the Lidder River, one can camp at the foot of the Kolahoi Glacier (3415 m). The Kolahoi Peak, 5420 m , is a beautiful pyramid and hard to climb. Two friends, with no experience of mountain climbing, thought that they would like to climb Mt. Kolahoi and Prof. Dickason and I were invited to go along. We were glad to accept, intending to look for alpines rather than climb the rocks. We spent a cold night sleeping on the glacier at the foot of the pyramid and early in the morning Dickason and I started out to search the crevices of the cliffs for alpines and the 2 brothers set out to climb. In the evening we all got back to camp but the brothers were fortunate to be alive for they had started a rock slide and both were wounded. We could not start the descent until the next morning. Luckily the wounded men were able to walk. When we got down to the road, we were fortunate enough to meet a veterinary doctor we knew who could attend to their cuts better than we could.

I found at least three things which I had not collected before, *Saussurea obvallata*, *Saxifraga exigua* H. Sm., det. by Mattfeld with a ? and *S. microviridis* Hara (*S. microphylla* Royle ex H. & T.) The rare *Chrysosplenium trichospermum* was found at Nafran near by.

Pahlgam is the place where the Hindus start a pilgrimage to the famous cave of Amarnath at c. 3963 m , gathering by the thousands in August. Hundreds of *sadhus* (Hindu holy men), some of them dressed in ashes, lead the pilgrimage. If the weather is bad some of the pilgrims do not return.

I kept a list of the taxa I found within a days walk of Pahlgam after spending a couple of vacations there and they amounted to 720 flowering plants and 58 pteridophytes. It is a fine centre. There are nearly 200 more species on my Pahlgam list than on that of Sonamarg. This is because the altitude of Pahlgam is only 2790 m while the camping ground at Sonamarg is about 610 m higher.

For two summers we camped on a ridge at the west end of the Kashmir valley on the Gilgit Road at a place called Tragbal, one stage beyond Bandipur, where the Gilgit Road begins. From Tragbal there are beautiful views over the Kashmir Valley toward the east and south. The altitude is 2790 m in pine forest. The Gilgit Road crosses the Rajdani Pass at c. 3660 m. I used to like to climb up beyond the tree line and search the alpine meadows for rarities. From the top of the pass the road drops down to the Gurais (Gurez) valley at c. 2370 m which is an upper portion of the Neelam (Kishenganga Valley) which is now in Azad Kashmir. On the sunny side of the Gurez Valley, the hill sides are dry as much of the monsoon rain is checked by the Rajdani and other mountains. Here in Gurez, is possibly the lowest sample of Artemisia steppe with scattered *Juniperus excelsa* trees. On rocks near the *Artemisia*, I found *Chrysanthemum pyrethroides*, a Central Asian species with white hoary stems.

Our last summer in Kashmir (1947) alongwith Prof. Nasir and his family, was spent at Nil Nag and the Yusimarg on the north slope of the Pir Panjal Range, a stage or two east of Gulmarg. Nil Nag is a fine little lake full of water plants and some of them do not seem to grow in the lakes in the valley about 600 m lower. The lake is surrounded by blue pine forest and is the result of a landslide damming the valley. The slide must be an old one because there are so many different water plants in and around the borders of the lake. In the openings of the forest, there is a good deal of *Stipa sibirica*, the poison grass, at a lower altitude than usual. In the pine forest I found a rare orchid, *Gastrodia orobanchoides* which also grows at Jhicca Gali in the Murree Hills at about the same altitude. It grows from a large tuber like a potato. A couple of weeks at Nil Nag was enough to explore the area so we moved our camp about 610 m higher, hoping to find some new things. We were disappointed, however, for here the northern slope of the Pir Panjal was overgrazed and the birch zone at the tree line had been destroyed, the birch trees having been lopped for fodder and the wood used for fuel. The only young birch trees which had escaped destruction were growing in dense thickets of juniper. The only interesting herbs were also protected by the junipers. The animals were eating the useful vegetation and the useless plants were the only ones which were flourishing; the thorny, thistly plants and the poisonous and inedible ones. Many of the poisonous plants belong to the *Ranunculaceae*, *Adonis*, *Anemones*, *Actaea*, *Aquilegias*, *Aconitums*, *Ranunculus* sp., *Caltha*, *Cimicifuga*, *Delphiniums*, *Paeonia*, and *Trollius*. I do not know whether the *Thalictrums* are edible or not (probably not). In addition the *Senecios*, some thistles, *Iris hookeriana*, *Stipa sibirica*, and the *primulas* are not good to eat, nor is *Euphorbia*.

Something must be done to save the Himalayan pastures. Yusimarg may be

worse off than many places but the whole range is suffering. The number of grazing animals must be limited to what the range can carry and to restore the vegetation the grazing should be rotated, closing valleys and hillsides temporarily to allow the edible plants to recover. The present lack of system encourages the useless vegetation and handicaps the useful.

Unfortunately the politicians and the common people on the plains do not know that this has anything to do with them. They know that floods are often very bad in September and that the floods seem to do more damage than in the past. No one has told them that unhealthy forests and overgrazed alpine meadows have something to do with floods on the plains.

Fossil Plants

I have never had time to work with fossil plants but in July 1935, Dr. Helmut de Terra of Yale University, a paleontologist, asked me to go with him to Laredura, a place near Gulmarg, on the north slope of the Pir Panjal range where a geologist had reported that there were clay beds exposed which contained large numbers of fossil leaves. There were also some fossil fruits especially *Trapa*, the water chestnut, and an occasional fish skeleton. He wanted me to gather and name the fossil leaves so that he could enter the names of the plants in a book he was writing. The leaves evidently had been blown on to the surface of a lake, settled to the bottom, were covered with a thin layer of silt and then in the following years new layers of leaves were laid down. The lake had somehow been emptied and the leaves were in the clay beds in abundance. I am told that the leaves are all from the Pleistocene. The best known beds are now at c. 2745 m. Some of the trees, like the oaks, are still growing on the south slopes of the range but 600-900 m lower down, while many of the species have disappeared from the valley and from Kashmir. One leaf resembled the *Ginkgo* leaf of China. I was principal of the college at the time and very busy so I could only give a preliminary list to Dr. de Terra and turned the specimens over to a student, Gopal Singh Puri, who prepared an M.Sc. and then a Ph.D. thesis on the leaf assemblage. Burkill in his history states that Puri discovered these fossils. This is incorrect.

After Puri got his M. Sc. degree, he left Rawalpindi and I do not know who supervised his work on the leaves which I had collected or that he may have acquired subsequently. He did not send me copies of his publications, which I did not notice, as my interest in the subject did not revive until recently when I found references to Puri's papers in Javeid's Bibliography published in Kashmir Science Vol. VIII, 1971. The subject is of some interest as Puri's papers support the belief of the geologists that the Himalayas have risen in recent geologic time. The study of these plants shows that the rise of the Pir Panjal Range cut the Kashmir Valley off from the Himalayan or Sino-Japanese flora on the south of the Pir Panjal When Laredura was a lake, the Sino-Japanese flora was in the valley but it has died out since the Pleistocene.

The oaks were common in the Laredura flora but I have never seen a wild oak in the Kashmir Valley. Similarly a good many trees in the Murree Hills and Poonch which might be expected in the valley are absent. Puri reported that *Woodfordia fruticosa* which now is not found above 1500 m in the foothill zone was found in the *karewa deposits* of the Kashmir Valley. Some of the Murree or Poonch plants which might have been expected in the Kashmir Valley today, but which are not, are *Rhododendron arboreum, Pieris ovalifolia, Cinnamomum tamala, Persea* sp., *Litsaea* sp., *Neolitsaea* etc. Out of the 101 taxa, Puri reported from the Laredura *karewa* beds, seven belong to the *Salicaceae*. Three of these are not in the valley today; the other four are: *Salix wallichiana* (*julacea*), *S. denticulata, S. viminalis* and *Populus ciliata*.

I wonder why no one has studied the micro-fossils which must be in this Laredura clay deposit. Pollen grains must be in the clay in abundance and could have supplemented and possibly corrected Puri's determinations. At that period I did not know anything about palynology.

Javeid states that Puri's theory is that the uplift of the Pir Panjal Range cut off the valley from the full effect of the monsoon rains and the heat of the plains, making the valley less tropical than it was before the uplift. This caused the death of the more tropical part of the flora. This is plausible for the rainfall in the valley now averages only 550 mm, while Murree has c. 1650 mm.

The pioneer student of fossil angiosperms in Kashmir was Dr. Birbal Sahni of a Punjab family from Bhera. He founded the Lucknow Institute of Paleontology. A number of collectors with him have made contributions to the study of these plants, Puri, Wadia, Sitholey, Ganju and others, listed by Javeid in his History of Plant Exploration in Kashmir.

Fleshy Fungi

I regret that I did not do more with the fleshy fungi. During the monsoon I found that the forests in the Murree Hills, Hazara and Kashmir were full of them. Mushrooms are not cultivated to sell in the market but the morels are well known and are gathered and sold dry and often used by vegetarian Hindus in place of meat. They are called *guchis*. As here in Michigan, the morels are found in the spring and not in the monsoon. I had studied and collected fleshy fungi in college and collected a good many for my professor from the foothills of the Green Mts. in Northern New York.

Camping a long way from Srinagar it was difficult for us to get enough vegetables so it was worth while knowing which wild plants made good greens and which mushrooms were safe to eat. Strangely, little attention has been paid to the fleshy fungi and the villagers seem to leave them alone. Some the shepherds, however, do gather and dry mushrooms but I never took time to find out what forms

they had found to be safe. I discovered, however, that they had not found out that puff balls are good to eat, for, seeing me gathering them, I was warned not to eat them.

A Swiss couple who had learned to gather and eat mushrooms in Europe often went collecting with us and recognized quite a few safe mushrooms. Italians, however, coming to the U.S.A. think that they know what fungi are good to eat and are often killed through eating *Amanitas. Amanitas* are common in the Himalayas and it may be because of them that the edible ones, except the morels, are usually left alone. We too left many monsoon mushrooms alone because we were not sure about them. We did eat a good many kinds; at least two kinds of *Agaricus*, the field mushroom, which is often common. There were several kinds of Inky Caps, including the Shaggy Mane (*Coprinus*). There were oyster mushrooms (*Pleurotus*), *Hydnums, Clavarias, Polyporus sulphureus, chanterelles* or *cornucopia* mushrooms and a *Boletus* or two. We left most *Boleti* alone, also *Lactarius, Russula, Cortinarius* and many more. We could have tried them by beginning to eat a tiny bit and then gradually increasing the dose but had too many other things to do, changing blotters and writing up field note books. Only once I discovered *Sparassis* in the Murree Hills, probably attached to the roots of a fir. The fungus was as large as a big cauliflower and weighed 14 lbs. We found it to be edible.

My wife was fond of making water colour paintings of the mushrooms and we have a good many illustrations but did not make spare prints. I had one collection named by a mycologist at the N.Y. Botanical Garden. He named those which he thought were the same as those growing in the U.S. but left the others. I asked Mr. Butler, the expert on Indian fungi if he would like me to send him specimens but he said that he had so much work in hand that he could not offer to collaborate with me. I brought a collection here to this University in 1962 but they are still lying unnamed. I wish that I had persisted and found some one in Europe who would have been willing to work on the N. W. Himalayan fleshy fungi. I collected a good many rusts and Arthur and Cumins of Purdue University were willing to name them and published two papers in Mycologia. The Indians have done a great deal of work on the mosses and liverworts but for some reason have not shown the same interest in the fleshy mushrooms. Prof. Sultan Ahmad of Lahore is the only Punjabi to do thorough work on the fungi.

Sources of Material

The only book on the history of Indian Botany is I. H. Burkill's "Chapters on the History of Botany in India", issued by the Botanical Survey of India, Calcutta in one volume in 1965. It had been previously published in parts in the Journal of the Bombay Natural History Society. It is indeed a mine of information but unfortunately it was far out of date when it first saw the light. Although he lived until 1965, Burkill stopped his history at 1900, apparently wanting people to be dead before he mentioned them. I have only noticed a few entries dated after 1900. This means that a large number of major authors and collectors whom

he must have known, are not even mentioned, for example Dr. N. L. Bor agrostologist, C. E. Parkinson, author of the Flora of the Andamans, M. B. Raizada of Dehra Dun, C. C. Calder, H. F. Mooney, A. E. and B. B. Osmaston, R. N. Parker and many more. Father Blatter is only casually mentioned once, along with T. S. Sabnis. Dr. Santapau is not mentioned.

The introductions of floras and monographs are important sources of information for botanical history. Authors of such works usually give a resume of the work of their predecessors. A great deal of information can be gleaned from bibliographies. The first good one for India I have used is that of E. Blatter in Vol. 20 (4) of the Journal of the Bombay Natural History Society. The second is H. Santapasu's Contribution to the Bibliography of Indian Botany in the same magazine in 1952. The third is S. M. A Kazmi's of 1970, edited by Henry Field and E. M. Laird, published by Field Research Projects, Miami Florida. For Pakistani workers this should be brought up to date and made more concise by dropping out works of little value for students of Pakistan and Kashmir.

What is Happening to the Grazing in Kashmir?

What I have to say about Kashmir, proper applied to the Himalayas in general. From prehistoric times herdsmen and shepherds have followed the seasons with their flocks and herds, with their tents and families. Instead of tents, some of these people who pasture their flocks in the upper forests make log huts for themselves. Those above the tree line do not build houses. I have no idea of how many thousands of nomads leave their winter quarters when the snows have begum to melt in May and gradually go higher and in September return to lower, warmer regions. The number of animals involved must be in the millions. Those who herd sheep and goats go to the highest pastures. The cows and buffaloes are not taken so high. Horses are usually used to carry the tents, tent poles, bedding, utensils etc. The migrants from Afghanistan, the 'donkey people' and the 'camel people' migrate from Afghanistan into Baluchistan and the Punjab, not into Hazara or Kashmir.

The pressure of population is worse in some places than in others but the pastures have steadily been deteriorating for many years. The increased population is probably due, as on the plains, to the fact that smallpox, plague and cholera have *not* taken a toll for many years.

The edible grasses and herbs are nibbled down to the ground providing little food and the beautiful plants which are left and flourish and set seed are poisonous or thorny. Erosion and gulleying, however, is not nearly as severe in the Valley of Kashmir and the Neelam Valley as it is in Poonch and Mirpur and the foothills toward the Punjab plains.

Ferns and Cryptograms

The ferns of Kashmir are fairly well known as most serious collectors in

Kashmir have gatherd them. A number of collectors were so fond of ferns that they did not collect any other group or hardly anything else, for example McLeod, McDonell, Atkinson, Levinge, Trotter and Venning. Venning's heirs a few years ago gave Kew his very large collection of Gulmarg ferns. The other collections are also at Kew except for that of Levinge which is at Dublin. My fern collections are listed in my 1972 Annotated Catalogue. My first set is in Islamabad and second at Kew.

As the Kashmir Valley is a mile high, it lacks most of the foothill plants which are found in Poonch, Mirpur and Jammu. Ferns are not common in the valley itself as it is almost all cultivated and there is little fern habitat. There are, however, many ferns in the temperate forests. These are mostly Himalayan or common in the North Hemisphere or endemic in the Western Himalayas. Many of the alpine ferns are wide ranging and are found in the new World as well as in the Old. The commonest fern in Ladak and Baltistan is *Cystopteris fragilis* where it is a snow-melt plant and I collected it on Mt. Kolahoi and as low as 1676 m in the Keran Valley of Azad Kashmir. All of the Kashmir ferns are soil ferns. There is not enough monsoon rain in Kashmir to develop epiphytic ferns but they begin in Chamba and become more numerous in Simla and the Mussoorie Hills to the east.

Only a beginning has been made in the study of the mosses, liverworts, fungi, algae and lichens. There has been a good deal of collecting but the facts have not been brought together with the whole of Kashmir in view. There are a number of papers on the Himalayas or the N. W. Himalayas which include Kashmir and lists of Kashmir mosses, liverworts etc. could probably be compiled from the literature but doing this would only be a beginning.

Kashmir Collectors

The first men who collected plants in Kashmir were a miscellaneous lot. A few were sent by the East India Company but many others were on their own and their specimens went to a number of countries and some of them are still lying uselessly as foreign curiosities and have never been reported on. A few of them were trained botanists. Many were not. Moorcroft was a veterinary doctor, Jacquemont was a French botanist, Vigne and Winterbottom were British well-to-do men of leisure, Winterbottom was trained as a doctor but never practiced, Von Huegel was a German nobleman, Falconer was a palaeontologist, Thomas Thomson was an Army doctor, the Schlagintweits were German geographers, Clarke was in the Indian Educational Service. Others were foresters, judges, Civil Servants, generals, officers in the Political Service, missionaries and educators. Almost all were men.

It is surprising how many have made collections in Kashmir which may be seen at Kew, the British Museum and Edinburgh as well as in American and European collections. This list which follows is not complete and does not include any recent collectors. Where I know where their collection are preserved, the initials of the Herbariums are added at the end of the citation.

K stands for Kew, BM for the British Museum, RAW for Rawalpindi, E for Edinburgh, DD for Dehra Dun, etc.

The names of the following collectors are mentioned in the text and also in my Annotated Catalogue and will not be repeated in this long list, Moorcroft, Royle (through collectors), Jacquemont, Vigne, von Huegel, T. Thomson, Duthie, Noel, Meebold, R. R. & I. D. Stewart, Frank Ludlow, W. J. Lambert, B. O. Coventry, and Oleg Polunin. I have omitted a few whose contribution was small which are mentioned in my 1972 list of collectors.

Atkinson, W. S. (d. c. 1879), entomologist, ferns given to Clarke (K).
Badhwar, R. L. & L. O. Kapoor, members of Col. Chopra's team.
Brandis, D. (1824-1907), L. G. Forests, author Forest Flora, 1874.
Burt, Miss C. C., Kashmir and Ladak c. 1930-37.
Chand, Ami, (fl. 1930-40) Baramulla, D. F. O., in charge small forest products.
Chand, Thakur Rup (1902-), b. in Lahul, head collector Walter Koelz. Retired mounter University of Michigan Herbarium, U. S. A. (MICH).
Clarke, C. B. (1832-1906), long trip in 1876 (K). Ind. Ed. Surv., author.
Culbert, R. C., Mt. Haramosh area, 1937 (BM).
Dhar, M. L., of the *Materia Medica* team of Col. Chopra.
Dickason, F. G. (1904-), while in Gordon College, 1927-8, (RAW) Burma ferns.
Drew, Frederick, 1875, Author "The Jammoo and Kashmir Territory". Good over all view.
Drummond, J. R. (1851-1921), I. C. S. Punjab (K). Used native collectors.
Evershed, 1913 (BM).
Falconer, Hugh (1808-65), Sup't. Saharanpur & Calcutta (K, DD, Calc).
Flower-Ellis (BM).
Fuller, G. L. de la C., J. & K. Forest Service c. 1913 (K, Calc).
Fuller, J. B. (1827-1910), Sup't. Saharanpur Bot. Gard. (DD).
Gammie, A. G. (1864-1924), Bot. Surv. Ind.; orchid student (K, Calc, DD).
Ghosh, S., med. plant collector with R. N. Chopra.
Gollan, Wm. (x-1905), Bot. Surv. Ind., collected for Duthie 1893 (DD, K, NY).
Hallberg, B. F. (d. 1925), Prof. St. Xavier's, Bombay. Specimens used by E. Blatter (BOMB).
Henderson, Dr. George (1836-1929), while on First Forsythe Mission to Yarkand was naturalist in 1870 with Hume.
Heybroek, H. M., Dutch specialist on the elm disease, with Melville of Kew, collected *Ulmus* in Kashmir and N. W. Himalaya c. 1969.
Honigberger, J. M. (1795 - ?), Russian born student of *Materia Medica* was in Kashmir c. (1830-1848). Physician Ranjit Singh 1830's and 1840's (W).
Hume, A. O. (1829-1912), ornithologist, accompanied Henderson to Yarkand.
Inayat Khan, collector for Duthie (1894-1912) (DD, K).
Javeid, G. N., Prof. University of Kashmir, 1970's.
Jerdon, Surj. Maj. T. C. (1811-1874), zoologist, Madras Med. Service, *Jerdonia* Wight.

Kapoor, L. D., et al. A Botanical Tour to Trikuta Hills, 1963 [Kashmir]; J. B. N. H. S. 60: 530-45, List of 111 phanerogams and four ferns.

Kapoor, S. L., 1962, Material for a flora of the Doda, Dt. of Jammu and Kashmir State, Bull. Bot. Surv. Ind. 10: 28-49. Mainly name list.

Keshavanand, Rai Bahadur, (fl. 1906-09), I. F. S., Jhelum and Kishenganga Vys. (DD, K, Oxf.).

Koelz, W. N., Michigan, USA (1895-), in Kashmir Vy., 1936 (MICH, NY, K, W, E, etc.). Professional collector birds and plants with Rup Chand.

Kohli, P. N. (fl. 1930-40) Kashmir Forests, discovered *Chelonopsis*.

Lance, J. H. (1793-1878), Bengal Civil Service (K).

Levinge, H. C. (1831-1896), Indian P. W. D., collected ferns for Clarke (K).

McDonell, J. C., Kashmir Forest Service c. 1890-1895, ferns (K).

Marten, James, c. 1900-10, ferns Mussoorie and Kashmir.

Munro, Gen. Wm. (1818-80), student grasses; before 1848.

Nasir, Eugene, (1908-) Dir. Pakistan Nat. Herbarium, formerly Gordon College, (RAW).

Neve, Dr. Arthur (1858-1919), Surgeon Church Missionary Soc., Srinagar. Mt. climber and explorer, first to climb Mt. Kolahoi (K).

Noel, Emilia Frances (d. 1909), collected 1902, specimens Liverpool.

Osmaston, B. B. (d. c. 1965), Ind. Forest Service (K).

Philimore, Col. R. H., Survey Ind., collected seeds and plants, Gulmarg bet. 1950-1960 (BM).

Pinfold, Miss, collected c. 1950 (BM).

Polunin, Oleg. Author popular European floras, collector (BM).

Prescott-Decie, (BM).

Puri, Gopal Singh (fl. 1948-70), ecologist, Bot. Surv. Ind., worked on Pleistocene fossil leaves from Laredura, c. 1935 (RAW).

Rao, T. Ananda, 1960 or 1961. A further contribution to the Flora of Jammu & Kashmir State. Bull. Bot. Surv. Ind. 2: 387-423. (687 sp. listed). . . . . 1961. A Botanical Tour in Kashmir State. Rec. Bot. Surv. Ind. 18(2): 1-67. Enumeration of taxa.

Rich, Col. H. H., Ind. Army, fine collection 1918 (K).

Sahni, Birbal (1891-1949), founder Lucknow Paleontological Inst.; spent summers in Gulmarg.

Saunders, Miss Elsie M., C. M. S. Hospital, Delhi (fl. c. 1910-40) (K).

Schlagintweit brothers, explorers 1854-58; entered by Pir Panjal (K).

Singh, Dr. Harbhajan Singh of Srinagar collected *Taraxacum* with van Soest of Holland c. 1960.

Srivastava G. D., et al. (d. 1938) found yellow *Caltha* on Sinthan Pass.

Stokoe, Canon, Chaplain Srinagar c. 1920-40; good private collection.

Vaid, Krishan Man Mohan (d. 1981), Gordon College, before Partition, then For. Res. Inst., Dehra Dun, 1947-1981. (DD).

Van Soest, Dr. J. L., Dutch *Taraxacum* expert in Kashmir, 1959 (Leiden).

Venning, Gen. F. E. W., Indian Army, Kashmir ferns, chiefly Gulmarg, 1923 (K).

Wali, M. K. & S. N. Tiku, Kashmir U., in Kashmir Vy.

Watt, Sir George (1851-1930), Economics Botanist Gov't India, author and col-

lector in many places.
Young, Alfred Prentice, Kashmir Valley, 1880, 1883 (BM).

Kashmir Bibliography

Blatter, E. 1927-29. Beautiful Flowers of Kashmir. 3 vols. London.
Bor, N. L. 1960. The Grasses of Burma, Ceylon, India and Pakistan (excluding *Bambuseae*), 767 p. Pergamon Press, Oxford & London.
Burkill, I. H. 1965. Chapters on the History of Botany in India. Calcutta, 245 p. [Originally published in Jour. Bomb. Nat. Hist. Soc., 1957-62.]
Cambessedès, J. & Decaisne, F. 1844. *Plantae rariores, quas in India orientali collegit* Victor Jacquemont, pp. 1-183. *In* V. Jacquemont, Voyage dans l'Inde, Pars Bot.
Coventry, B.O. 1923-30. Wild Flowers of Kashmir, 3 vols. each with 50 coloured plates. W. Thacker & Co., London.
Drew, F. 1875. The Jummoo and Kashmir Territory. London.
Duthie, J. F. 1893. Report on a botanical tour in Kashmir, 1892. Rec. Bot. Surv. Ind. 1: 1-18.
. . . . . 1894. Report on a botanical tour in Kashmir, 1893. Rec. Bot. Surv. Ind. 1: 25-47.
. . . . . 1894. Report on a botanical tour in Kashmir. Jour. Bomb. Nat. Hist. Soc. 9: 69-84.
Fuller, G. L. de la C. 1913. List of Trees and Shrubs and Useful Herbs of the Jammu and Kashmir Forests. Allahabad.
Huegel, Freiherr von. 1844. *Kaschmir und das Reich der Sick*, 4 vols. Stuttgart.
Lambert, W. J. 1933. List of trees and shrubs for Kashmir and Jammu Forest Circle. For. Bull. no. 80, Calcutta.
Ludlow, Frank. 1951. The Primulas of Kashmir. J. Roy. Hort. Soc. 96: 191-206.
Meebold, A. 1909. *Eine botanische Reise durch Kaschmir. Engl. Bot. Jahrb.* 43(99). 63-90.
Neve, Dr. Arthur. 1927. Church Missionary Soc., The Travel Guide to Kashmir, Ladakh, Skardo etc., 14th ed., Revised by E. F. Neve, Civil & Military Gazette, Lahore.
Noel, E. F. 1903. Some Wild Flowers of Kashmir. Nottingham.
Royle, J. F. 1833-40. Illustrations of the botany and other branches of natural history of the Himalayan Mts. and of the flora of Cashmere; I, text; II, atlas. London.
Thomson, T. 1852. Western Himalaya & Tibet. 501 p. London.

Recent Kashmir Publication after G. N. Javeid

Ahmad, Muneer	1968	Vegetation of the Mud House Tops in Srinagar. Rep. Fac. Sci. 55: Ege Univer. Bornova.
Ahmad, Muneer &	1970	The Flora of Walls in Srinagar. Dept. Bot.,

P.K. Durrani — Ege Univ., Izmir, Turkey.

Dutt, A. K., Sarin, Y. K., & Kapoor, L. D. 1965 Veg. of Srinagar with special reference to Ecological habitats. Proc. Nat. Inst. Sci. Ind. 30: 150-165.

Javeid, G. N. 1964 *Ginkgo biloba* L. in Kashmir. Kash. Sci. I: 35–37.

1965 Ferns and Fern Allies of Srinagar. Ibid II.

1968 Flora of Srinagar. Ibid V: 59-71.

1971 Flora of Srinagar. A phytogeographic and systematic study of the flowering plants of Srinagar. Ph. D. Thesis.

Kaul V. & Zutshi, D.P. 1967 A study of Aquatic & Marshland Veg. of Srinagar. Proc. Nat. Inst. Sci., Ind. 33: 111-127.

Malhotra, B. R. & Das, R. 1940 Some *Oscilatorias* of Kashmir. Proc. 27th Ind. Sci. Congr. 9: 1-34.

Jammu

Jammu is the eastern half of the former state of Jammu and Kashmir. When the British took over the Punjab in 1846, Raja Gulab Singh ruled what is now Jammu. He had been a vassal of Maharaja Ranjit Singh and had helped him conquer Kashmir. Gulab Singh had been conquering the smaller rajas within the territory which became Jammu State. Both Jammu and Kashmir for a time issued their own postage stamps.

Jammu is an irregular piece of territory which can be found on the map between c. 32.8′ and 33.4′ North and 34.6–75.8′ East. It is all in the watershed of the Chenab River just as Kashmir proper is all in the watershed of the Jhelum. The Chandrabhaga River, a branch of the Chenab, enters Jammu from the Pangi region of Chamba and flows down through Kishtwar on its way to the Punjab. Jammu is all mountainous and only has one city, Jammu City, at the edge of the Punjab plain, which can be reached from the plains by a branch of the N. W. Railroad which starts at Wazirabad and goes through Sialkot to Jammu.

There is one motor road which goes north to the Banihal Pass. c. 2745 m , and drops down to one of the sources of the Jhelum at Verinag and then goes northward to Srinagar. The whole route is c. 163 miles. From the Pass to Srinagar is about 66 miles.

No check-list has yet been published for Jammu but the total number of species must be large because the little country begins at c. 270 m on the plains side and extends to the heights of the Himalayas between Kishtwar and Suru in Ladak. The Jammu corner of the former State is tropical and contains a good many

woody foothill species which are at or near the western edge of their range and do not grow wild in Poonch or Rawalpindi Dt. toward the west. The largest number of woody species grow in the foothill zone up to c. 1500 m. Few of these species are to be found in Kashmir proper as the lowest point in the Kashmir Valley is at c. 1600 m, where the Jhelum breaks through a mountain barrier at Baramula and flows south towards the plains.

There is not much difference between the temperate and alpine floras of the Vale, and Jammu, on the whole, but there is a significant difference in the high level trees. When discussing the flora of the Valley it is often stated that there are no native oaks at the present time but oaks are abundant in upper Jammu. There are four of these oaks, *Quercus incana, dilatata, baloot* and *Q. semecarpifolia*. Furthermore on the Upper Chenab there are stands of *Pinus gerardiana*, the *chilghoza* pine, which grows in Astor and Swat but which is not reported from Kashmir proper. *Carpinus faginea* is only found from Jammu east (Parker).

Recent collecting in Poonch, Rawalpindi Dt., Hazara, Swat, Dir and Nuristan has shown that many of the species which Parker and Lambert thought were at their western limit at various places between the Ravi and Indus are now known to grow further west in favourable places. As far as I know, the following sub-tropical trees growing in Jammu have their western boundary there but many which in the 1920's were thought to have a similar western boundary are now known to grow much further west.

Sub-tropical Trees and Shrubs Not Yet Found West of Jammu.

Holoptelea integrifolia
Miliusa velutina
Cocculus laurifolius
Capparis sepiaria
Crataeva religiosa, s.l.
Tephrosia purpurea
Bauhinia malabarica
Acacia gageana
Prinsepia utilis
Terminalia chebula
Anogeissus latifolia
Leycesteria formosa
Mitragyne parviflora
Hymenodictyum excelsum
Pavetta indicum
Sida cordifolia
Pterospermum acerifolium
Aspidopterys wallichii
Feronia limonia
Murraya paniculata
M. koenigii
Indigofera atropurpurea
Maesa indica
Diospyros montana
Wrightia tomentosa
Ichnocarpus frutescens
Orthanthera viminea
Oroxylum indicum
Barleria prionotis
Lepidagathis cuspidata
Premna latifolia v. *mucronata*
Pogostemon benghalense
Taxillus vestitus
Bridelia retusa

A number of the plants in the above list are to be found west of Jammu but as cultivars. Note that these 34 species are not European but are tropical or sub-

tropical.

Since most of those who have collected in Jammu collected in the Vale as well, I appended a joint list at the end of the previous chapter. I cannot think of any collector who only collected in Jammu. A number who entered via the Banihal Pass, left Kashmir by a western route and the other way around, Jacquemont, the first to collect in Jammu, in 1831 had entered the Vale by a Poonch route. The first to do much exploring in Jammu was G. T. Vigne, an Englishman, who was in Kashmir from 1834 to 1838. The first to do much collecting was Thomas Thomson in 1848 (4). The next major collector was C. B. Clarke in 1879 and then Meebold in 1905. My collecting in Jammu was not very extensive but covered a good many years. In 1912 in August after a long collecting trip in Kashmir and Ladak, I entered the Wardan Valley from Suru by the Yarungshan La and then left Jammu by the Sinthan Pass. Next, in 1917, after a collecting trip with my wife in Kangra and Chamba, we crossed the Sach Pass, descended to a branch of the Chenab and ascended to Pangi. We then turned westward and descended the Chandrabhaga branch of the Chenab into Padar and then Kishtwar. There are a few trees and shrubs in this area, Kishtwar, that may be at the western edge of their ranges. These are *Aster albescens* (*Microglossa*), *Berberis aristata, Deutzia corymbosa, Philadelphus tomentosa*, and *Lonicera angustifolia*.

From Kishtwar we went to the Vale by the Sinthan Pass. One year, instead of going back to the Punjab by the Jhelum Valley Road, we went out by the Banihall Pass and collected by the way. It was toward the end of the monsoon and there were a good many tropical plants in flower. On another occasion Dr. Stebbins of California, a monographer of the genus *Crepis*, asked me to go to Kashmir to get him some seeds. I took a student with me and we rented a car in Jammu and collected along the way to the main valley. Instead of taking the short cut through the tunnel below the pass we climbed over the pass on foot and found a few species we would have missed otherwise. I remember *Astragalus kashmirensis, Thermopsis barbata* and *Viola falconeri*. The *Viola* is also found in the Neelam Valley of Azad Kashmir. I have heard that *Cardiocranium giganteum* has been found on this pass but we missed it.

The scarcity of floristic articles on the plants of Jammu is surprising. Although Parker did not plan to deal with Kashmir in his Forest Flora (2) yet he has given descriptions of most common Kashmir trees and shrubs and W. J. Lambert's "List of Trees and Shrubs" (1) is fairly complete, but like Parker he did not know that many Jammu plants have been found much further west then he thought. Many of these records are to be found in my 1972 "Annotated Catalogue" (3). I recently found out that Prof. P Kachroo and Dr. B. M. Sharma of the new University at Srinagar are about to publish a flora of Jammu. This is a pioneer effort.

I have run across a few small floristic papers on areas in Jammu. In 1963 L. D. Kapoor et al. published "A Botanical Tour in Trikuta Hills." J. Bomb. Nat. Hist. Soc., 50: 530–45. There is a list of 111 taxa of higher plants and four ferns.

In 1968, S. L. Kapoor published "Material for a flora of the Doda Dt. of Jammu and Kashmir State", Bull. Bot. Surv. Ind. 10: 110-34. In 1960 T. Ananda Rao published "A further contribution to the flora of Jammu and Kashmir State", Bull. Bot. Surv. Ind. 11 (?): 387-423. The author lists 687 sp., mostly angiosperms. I have not found the notice of an earlier paper.

Bibliography

1. Lambert, W. J. 1933, List of trees and shrubs for Kashmir and Jammu Forest Circle. For. Bull. No. 80, Calcutta.
2. Parker, R. N. 1924. A Forest Flora for the Punjab with Hazara and Delhi. Lahore.
3. Stewart, R. R. 1972. An annotated Catalogue of the Vascular Plants of West Pakistan and Kashmir. (E. Nasir and S.I. Ali eds.) Karachi.
4. Thomson, T. 1852. Western Himalaya and Tibet, 511 p., London.

The Flora of Afghanistan and its relation to that of Pakistan

Afghanistan is a rugged, land-locked country. The Soviet Union lies to the north, Pakistan to the east and south and Iran to the west. It is between lat. 30° 25′ North and 60°45′ East. It covers 365,000 sq. miles, an area larger than that of France. Seen on the map, Afghanistan is an irregular oblong block of territory with a narrow piece of land projecting from the northeast corner called the Wakhan Corridor. This corridor separates Pakistan from Russia and furnishes a high level summer route to China. It extends to 74°51′ East.

Although Afghanistan is included in the *Flora Iranica* as a part of an Irano-Turanian floral province, it is necessary to point out that although the main central mass of the country can be called Irano-Turanian, important parts of the flora have very different affinities.

Dr. Per Wendelbo of Sweden, who has collected in Chitral, Iran and Afghanistan, thinks that there may be enough difference between the floras of the two countries to warrant making them two sub-regions of Mediterranean type. In his paper on "Distribution patterns in the *Flora Iranica* area" (27) he says: "Probably there is a rather marked difference in the composition of the flora of Persia and Afghanistan, which makes it possible that the main parts of the two countries belong to two floristic sub-regions. The flora of Afghanistan is apparently more related to that of Central Asia than to that of Persia. The Kopet Dagh Mountains make up an important transitional zone." Dr. Wendelbo also states, "Central Asia has been an extremely important source for the flora of the whole region". The great majority of the Afghans live in the central floral zone which can be called *Turanian*. I agree with Dr. Wendelbo that there is a great deal of difference between the Persian and the Afghan floras. When the *Flora Iranica* is complete, someone should make a detailed comparison.

The great Himalayan ranges do not run east and west but have a northward trend until they meet the Hindu Kush in Chitral. They then take a distinctly southwestward turn. Mt. Tirich Mir at 7700 m is one of the great mountains of the world and is in Chitral, just east of Afghan territory. From this highland region a great spur of the Hindu Kush range runs eastward fanning out towards Iran and another runs southwestward to Baluchistan. This more southern line of ranges forms the border between Pakistan and Afghanistan. The two most important Afghan rivers are tributaries of the Indus and the two most important passes are located where these two rivers, the Kabul and the Kurram cut across the boundary range. The Kabul River enters Pakistan at the famous Khyber Pass and the Kurram River enters by the Peiwar Pass. Between these two passes the boundary range runs east and west and is called the Safed Koh (White Mountains) because Mt. Sika Ram which is 4655 m high is white most of the year. At the Peiwar Pass the range turns south and then southwestward through Waziristan into northeast Baluchistan. In Waziristan the mountains are called the Suleiman Range but as the peaks are not higher than c. 3660 - c. 4000 m they do not become snow-capped and are very barren and rugged with only a small population of nomads and shepherd farmers. There are forts instead of factories. The rainfall is not high enough to produce perennial streams and the forests are open and at high altitudes. I do not know of any meteorological figures. There is no large town in this arid area.

These mountains which separate the two countries are not only a political boundary but they are also a barrier to plant migration and they prevent monsoon rains from reaching Afghan territory except in the far north in the Afghan province of Nuristan.

Living at Gordon College, Rawalpindi most of the time from 1911 to 1960, and visiting Peshawar frequently and collecting twice in Baluchistan, twice in the Kurram Valley and once very briefly in Chitral and once being refused permission to collect in Afghanistan, I have often wondered what the flora was like on the other side of the Khyber. The first botanical exploration of Afghanistan was done by people based on India and although I do not know anyone who has done any botanical work in Afghanistan in a hundred years entering from the south. It should be of interest to Pakistani botanists to know what has been done in that country botanically and what the flora of that country is like.

In 1961 Dr. E. H. Walker of the Smithsonian in Washington, D. C. gave me a copy of Kitamura's "Flora of Afghanistan" which had been published the year before. I was working on a "Catalogue of the plants of Pakistan" and was interested in finding out which Pakistani plants grew north of the Pak.border and have been interested ever since.

The first man to do any collecting in Afghanistan was John Martin Honigberger born c. 1795 in Kronstadt, Transylvania in Russia, an adventurer who was away from home for 35 years earning his living as a doctor. He must have been a man of boundless curiosity. He first lived in Turkey and then in Egypt and by

1830, he had reached Lahore in the Punjab at a period when Maharaja Ranjit Singh was at the height of his power and lived there most of the time as Court Physician until the British took over in 1848. In 1833, after being away home for years, he determined to go home on a visit and went by a dangerous route northward into Russia via Afghanistan. He crossed the Indus at Dera Ghazi Khan and joined a caravan going to Kabul via the Kurram Valley. It was in the hot weather and there were swarms of locusts. They were robbed by the Waziris and he did little collecting until he arrived in Afghanistan. He halted for a time at Kabul and made a plant collection which he took with him to Vienna and gave to Dr. S. L. Endlicher (1804-49), who with a Dr. Eduard Fenzl (1808-79), Curator there, published a fascicle of Honigberger's plants but they did not complete publishing a list of his discoveries. The first and only fascicle was named *Sertum Cabulicum* (14). Much of his collection remained unnamed for 140 years until rescued by Dr. Rechinger who published the names of some of them in his *Symbolae Afghanicae* (16) and they will be, or have been, published in the *Flora Iranica*. Kitamura omits Honigberger from his Introduction, and gives credit to Griffith for doing the first collecting in Afghanistan. [See bibliography for note on his two volume work which contains about 400 plant illustrations.]

William Griffith (1810-45) was probably the ablest of the British botanists who served in India and the amount of work which he did in his short life and the number of species he collected, about 7000, is probably greater than that of any other botanist in India.

After arduous service in Burma, William Griffith was directed to accompany the British Army invading Afghanistan in the First Afghan War (1839-42). He entered from Baluchistan by the Chaman route. He made a tour of the country from west to east, and was the first to collect in Kafiristan, now Nuristan, the easternmost province, which is adjacent to Chitral, Gilgit and Hunza of Pakistan with a flora entirely different from that of the rest of the country, because it benefits from the summer monsoon. The rest of the country is dry all summer except in the alpine zone where there is melting snow on the mountain tops.

Due to the non-co-operation of the Kafirs (unbelievers in Islam) he was unable to do as much collecting as he had hoped. One day he was ambushed and his servant was wounded. The forests in Nuristan, like those of the Himalayas, have a closed canopy while the forests in the rest of the country are the open, park like type and without a definite tree line.

Griffith collected from April 1839 to Sept. 1840. He was a keen collector and inspired a number of army officers to collect for him and encouraged locals to bring him specimens of both plants and animals. Some of these officers collected on other occasions. David Ritchie (1809-66) and Grant were surgeons. There was a Capt. E. Sanders. Lt. Thomas Hutton was a zoologist and Henry Mortimer Durand was a Political Officer. The Durand Line, the boundary between the N.W.F.P. of Pakistan and Afghanistan, was named for him. Griffith died of malaria in 1845

before he could write up his work.

In 1970 Miss J. M. Lamond, now Mrs. Wood of Edinburgh, published "The Afghanistan collection of William Griffith." Notes R.B.G. Edinb. 30: 159–175.

Dr. J. E. T. Aitchison (1836–98), a British Civil-Surgeon, who wrote on the plants of Hoshiarpur and Jhelum Districts of the Punjab, through the influence of Gen. Collett (1836-91), Quartermaster General, was permitted to collect in the Kurram Valley. Gen. Collett also did some collecting there and *Rhododendron collettianum* is named for him. In 1902 he published *Flora Simlensis.*

In 1879 Aitchison collected both in the Upper and Lower Kurran Valleys. In 1880 he was not able to work in the Hariab, the upper district, but only in the lower valley, based in Parachinar. At that period both portions of the valley were Afghan territory, but since this war the lower valley has been a Political Agency under the N.W.F.P. of Pakistan. The inhabitants of this valley are Shiahs in a sea of Sunnis.

Aitchison published two reports, the first to be written on this flora, which is remarkable for being, like that of Nuristan, largely Sino-Himalayan. His first report was on his work in 1879. It would have been better if he had waited and published on the two years work at one time. If he had done so he would have avoided much repitition and some confusion for each year he numbered his specimens beginning with No. 1, so that in citing his specimens the collecting year needs to be added. He studied his collections at Kew and the report on the first year's work was published in Journ. Linn. Soc. 18: 1–113. 1880 and the result of the second in 19: 139-200, with 26 plates, 1881. He published some new species and others were named only to the genus.

From Sept. 1884 to Aug. 1885 Aitchison explored the southern and western parts of Afghanistan. Starting from Quetta he entered Southern Afghanistan exploring along the Helmand River to where it flows into marshes. He then went north to Herat. His report entitled "The Botany of the Afghan Delimitation Commission" was published in the Transactions of the Linnaean Society, series 2, vol. 3: 1–139 with 48 plates (1888).

In 1889 he published "A summary of the botanical features of country traversed by the Afghan Delimitation Commission, 1884-5", Trans, Bot. Soc. Edinb. 17: 421-34.

The next collector seems to have been Prof. A. A. von Bunge (1803-90), a Russian baron who collected in Western Afghanistan in 1858-59.

In 1924 and 1926-27, N. T. Vavilov and P. P. Bukinich toured in Afghanistan looking for cultivated plants. Between 1923 and 1929 C. Manger collected some plants near Kabul. In 1935 G. Kerstan of the German Hindukush Expedition

collected especially in Nuristan and part of the results were published in Fedde Repert. Beih. 108. 1938.

During 1937 and 1939 Dr. Walter N. Koelz of the University of Michigan, U.S.A. with his collector, Rup Chand toured in Afghanistan, especially in the north, collecting herbarium specimens and seeds for the U. S. Dep't of Agriculture in Beltsville, Md. There is a set of these collections here in Michigan. A set went to Dr. Rechinger in Vienna and many determinations were published in the *Symbolae Afghanicae* and are being published again in the *Flora Iranica*.

Mr. and Mrs. Koeie and L. Edelberg, members of the third Danish Expedition to Central Asia collected in Afghanistan in 1948-49. Between 1948-51 H. F. Neubauer collected especially in eastern and northern Afghanistan and in Nuristan in 1951 and O. H. Volk in 1950-53. The list of collections of all of these expeditions, like those of Koelz, are being published in the *Flora Iranica* and some were printed in the Symbolae (16).

Since 1952 Japanese botanists have been much interested in the flora of Afghanistan and the Central and N. W. Himalayas. The first to arrive in Afghanistan to collect was Dr. O. Suzuka who collected many plants while studying *Artemisia maritima*.

In 1955 a team of botanists from Kyoto University went to Afghanistan along with other scientists. The botanists were Dr. Kihara, Dr. Yamashita, Dr. Kitamura and Asstt. Prof. Nakao. Their large collections were named by Dr. Kitamura with the aid of many taxonomists and edited by him. The results were published by Kyoto University in 1960 and are entitled "Flora of Afghanistan". The book is well illustrated, has a good introduction and lists about 2680 species. This number is far from complete as the Japanese have not had the advantage of having had access to the specimens of a good many collectors which are available for Dr. Rechinger and his collaborators. We will have to wait for the completion of Rechinger's monumental work before we can estimate the number of species growing in Afghanistan. Though incomplete, Kitamura's book will be much used until someone prepares a second edition, adding many species from Rechinger's volumes because Kitamura's work is in English while Rechinger's is chiefly in German and Latin. Rechinger's volumes provide keys and descriptions while there are only descriptions of the new species in Kitamura.

I recently went through Dr. Bor's list of Afghan grasses in *Symbolae Afghanicae*, No. 6 and find that, omitting varieties, he lists 279 species while Kitamura lists 165. Dr. Marcel Raymond of Montreal lists 95 sedges as coming from the whole of Afghanistan while the Japanese only have 64. In *Cousinia*, however, Kitamura lists 103 and only 78 are in the *Symbolae*. I think that when the *Flora Iranica* is complete that the number of species listed from Afghanistan will be at least a third larger than Kitamura listed in 1960.

No one has done as much work on the whole Irano-Turanian area as had Dr. K. H. Rechinger, Prof. of Botany and retired Director of the Vienna Botanical Garden. In 1949 with M. Koeie of Denmark he began to publish *Symbolae Afghanicae* but after six fascicles, the sixth having been published in 1965, he began including Iraq, Iran and part of Pakistan in his research and started publishing his new work, the *Flora Iranica* in 1963. As this work did not begin with an introduction I expect that one will be provided when the work is complete. Fortunately there is quite a good introduction in Kitamura's *Flora of Afghanistan* (1960) and in a number of other recent papers.

According to Mr. Ian C. Hedge of Edinburgh, Dr. Rechinger first went to Iran in 1937, making extensive collections, as is his habit. He collected there again in 1948 and in N. Iraq in 1957. In 1962 he visited Afghanistan and Swat and in 1965 made his final trip accompanied by his wife and Miss Jennifer Lamond, and in Pakistan by Dr. S. M. Kazmi of Peshawar. This trip was made by land-rover. In 1932 he published some new *Rumex* species from Afghanistan and from that date to this (1981) he has been monographing genera or families of plants from different parts of the *Flora Iranica* area.

This work of Kitamura (1960) contains the first fairly complete check-list of the Afghan plants. Those omitted are mostly endemics and the rarer species. It is not, however, a proper flora ss there are no keys and the only descriptions are of the new species. There is also nothing given about abundance, distribution and uses of the plants. Personally I wish that Koeie and Rechinger had completed the *Symbolae Afghanicae* before tackling the flora of Iran. Afghan students would have benefitted. The *Flora Iranica* contains large amounts of material which Afghan students will not need.

Much more collecting is needed in many parts of the country for almost every expedition finds new species especially in the central mountainous areas where so many endemics have already been found.

During the last thirty years there have been a good many European scientists interested in the *Flora Iranica* area. Some of them taught for a few years at the Kabul University. In 1970 the Tercentenary celebrations of its botanical garden were held in Edinburgh and as a part of the programme there was held the first symposium on the flora of southwest Asia. Afghanistan was included. In 1971 a book was published which includes the papers read and the discussions on each paper. The book, "Plant Life of South-West Asia" (1971) was edited by Peter H. Davis, Peter C. Harper and Ian C. Hedge, and was published by the Botanical Society of Edinburgh (8). Three of the papers in this book deal with Afghanistan. The first is "Studies in the Natural Vegetation of Afghanistan" by Helmut Freitag. "Vegetation in Alpine Regions of Afghanistan" by S. W. Breckle is the second. Both are Germans and taught in Kabul University. The third paper is by Per Wendelbo of Goteborg, Sweden, entitled "Some Distributional Patterns within the

Flora Iranica Area". These three papers were read in 1970. I was fortunate enough to be present at the Conference. The bibliographies in these three papers are very useful.

There is a surprising amount of detailed information in a paper prepared by two Russians, Linchevsky and Prozorovsky, who never visited Afghanistan, published in Russian in 1949, and translated the same year and published in the Kew Bulletin (1949) with a map showing the distribution of the different types of vegetation. H. F. Neubauer in 1954 published a paper on the forests of Afghanistan (22) and in the same year O. H. Volk, one on the "Climate and Distribution of Plants in Afghanistan" (26). No one has yet prepared similar papers on the distribution of plants in Pakistan. Afghanistan will have a flora long before India will, unfortunately Afghan scholars have not had a share in the work and the herbarium specimens used are scattered in foreign collections.

Many Himalayan species apparently stop at the Kurram Valley but a number of them are reported from the Waziristan mountains and still further west in northeastern Baluchistan in the 'juniper tracts' between c. 2100-3500 m. I have a list of about 40 species which must have reached Baluchistan through Waziristan from either the Himalayas or the Hindu Kush. They probably went toward the southwest through the Safed Koh. Examples are *Ribes orientale, Stellaria crispata, Sageretia brandrethiana, Trigonella emodi, Sedum adenotrichum, Epilobium minutiflorum, Viburnum cotinifolium, Abelia triflora, Galium tricorne, Lonicera quinquelocularis, Heteropappus altaicus, Koelpinia linearis, Campanula cashmeriana, Ephedra intermedia* etc.

Because of the boundary range along which the Durand Line runs, most of the plants of all of Afghanistan, except the most northeastern province, belong to the Mediterranean floral type with most precipitation in the winter. This province Nuristan, has the Indian monsoonal type of flora which receives the most rainfall in the summer. This does not mean, however, that visitors to the Kabul River Valley on the other side of the Khyber would not feel at home there as the flora in the Jalalabad depression is also part of the Saharo-Sindian subtropical flora. The Peshawar Valley and northern Punjab plains both have a spring Flora of ephemerals dependent on winter moisture and are entirely different from the summer short lived plants which develop during the monsoon and come from the south or through India rather than from the west.

The Afghan flora can be divided into four main regions. The first three divisions belong floristically with the rest of the *Flora Iranica* but the easternmost province called Nuristan, formerly Kafiristan, benefits from the Indian monsoon and the rest of the country does not. The floras of nine-tenths of the country are of the Mediterranean type, that is most precipitation comes in the winter and there is a long dry summer. As a result the only typical forests are in Nuristan and the Safed Koh range, and the only forests in the rest of the country are of the open, park-like type.

Although the whole country is far from the sea, there are low altitudes both on the south toward Pakistan along the course of the Kabul River (400 m) and also toward Russia on the North (300 m). The backbone and ribs of Afghanistan are the Hindu Kush Mountains which are at their highest on the side toward Chitral and Central Asia. The great central mass of Afghanistan is mountainous, rising to more than 4725 m. Many peaks are covered with snow in the winter and there are some small glaciers. These mountains are encircled on three sides by deserts except on the east where we find the high Hindu Kush. The desert areas and the high mountains serve to isolate the plants of the heartland from those of the regions beyond the periphery of the country as well, as the ocean separates islands from each other and the main land. The heartland of Afghanistan is like an oceanic island with a large proportion of endemics. The genera and families which furnish the most endemics are not many. The greatest number are to be found in *Astragalus* of the legumes and *Cousinia* of the *Compositae*. *Acantholimon* of the *Plumbaginaceae* furnishes many endemics; also *Acanthophyllum* and *Silene* of the *Caryophyllaceae*. Among the monocotyledons *Allium* and *Gagea* of the *Liliaceae* and *Iris* are also well represented. There are endemics in other parts of the country but not in great numbers. There are very few in some of the commonest families like the grasses, sedges and chenopods. None of the gymnosperms are endemic.

In the Afghan deserts and in the mountainous heartland except in a few favourable places in the sub-alpine zone and in Nuristan, all cultivation is dependent on the streams fed by the melting snows of the alpine zone. Jalalabad (alt. 595 m) on the Kabul River obtains its irrigation water from Nuristan. This city was visited by the Japanese in 1955 and they reported the following street trees which can also be found in Punjab cities in the sub-tropical zone. They are *Morus alba*, *Salix babylonica*, *Cedrela toona*, *Ficus religiosa*, *F. babylonica*, *Cupressus sempervirens*, *Citrus aurantium* and *Thuja orientalis*.

Freitag (10) reports that in the semi-desert plant communities of subtropical affinities, perennial grasses predominate and that thorny small trees, shrubs and half shrubs are to be found in the hot basin of Jalalabad and its environs with a rainfall of 150-300 mm. The winters here are mild. He named *Ziziphus nummularia*, *Rhazya stricta*, *Acacia modesta* and *Eleusine flagellifera*, common Punjab Sudano-Sindian species, as examples. This association was found up to c. 750 m. Then comes a *Salvia cabulica-Pistacia* community with *Periploca aphylla*, *Pistacia khinjuk*, *Amygdalus kuramica* var. *aitchisonii*, *Ephedra intermedia*, *E. ciliata* and *Salvia cabulica*. At the lowest levels *Zygophyllaceae* and *Chenopodiaceae* are abundant.

With increasing altitude, up to the alpine zone, the spring comes later and the average precipitation increases. *Amygdalus* shrublands are replaced by xeromorphic woodlands. Between 1150-1800 m there are *Pistacia atlantica* communities in a broad belt. Even at these low altitudes the winters are severe.

Above the desert zone we find the Warm Temperate zone between 1200 and

2400 m. This and the Cool Temperate zone just above it include the areas with the greatest number of endemics. As one ascends from the deserts, a larger proportion of the soil is covered by vegetation. In some of the worst deserts only 1-3% of the ground may be covered with plants for most of the year. The heat is severe enough to make the lips crack. For a few weeks in the spring the desert becomes covered with an ephemeral or an ephemeroid flora. The ephemerals are the annual grasses, crucifers, labiates, borages, composites and others. They grow rapidly, flower and set seed within six weeks or so and fade more rapidly than they sprang forth. The ephemeroids are plants with corms, bulbs, rootstocks or rhizomes which lie unnoticed in the soil until they spring to life again. Such genera are *Allium, Merendera, Tulipa, Gagea* and *Bongardia*.

As the altitude increases, many familiar temperate genera appear in mixed herb communities and as shrubs and trees: *Convolvulus, Malva, Delphinium, Arnebia, Aster, Psoralea, Cousinias, Astragali, Chrysanthemum*, umbellifers, *Aegilops, Hordeum* and many more. Steppic *Artemisia* communities cover vast areas and where the soils are more saline there are *Haloxylon* (a chenopod) communities. In wet places there are sedge meadows with species of *Scirpus, Eleocharis, Carex* and *Juncus*.

The chief threat to the trees and shrubs is the fuel shortage. The winters are long and severe and the people need fuel. Large numbers of wild *Pistacia vera, Amygdalus kuramica* and *Pinus gerardiana* trees are saved from cutting because the people value the fruit.

Kitamura says that where fruit trees can be irrigated, large quantities of temperate fruits are raised, some of which reached us in Rawalpindi when I lived there. Grapes and melons of various kinds do especially well. Apples, apricots, plums, cherries, and walnuts are also raised. The street trees of Kabul must be watered. Kitamura says that they are *Ulmus campestris, Platanus orientalis, Morus alba* and *Salix babylonica*. There must be more species.

In some places in the cold temperate zone, wheat can be sown in November, grows during the winter and is cut in the spring without irrigation. The Japanese reported a wheat field near the Shibar Pass at 3200 m.

The Cool Temperate Zone is between 2400 and 3600 m. The vegetation becomes richer as one approaches the snows and the plants benefit from dew and mist. Freitag says that *Amygdalus* communities form the natural vegetation between the *Pistacia* belt and regions with more than 400 mm of moisture. The tree layer consists of *Amygdalus communis* (?), *A. kuramica*, and *Fraxinus xanthoxyloides* which may cover 30% of the ground. Shrub species become more numerous e.g. . *Cotoneaster* sp., *Rosa* sp., *Cerasus bifrons, C. verrucosa, Colutea persica, Ephedra intermedia* etc. There are numerous species of dwarf shrubs, of *Artemisia, Astragalus, Acantholimon, Perovskia atriplicifolia* etc. Among the hemicryptophytes are *Cousinias, Salvia bucharica, Leucopoa* etc., and numerous

geophytes, *Eremurus, Allium, Gagea, Tulipa, Corydalis* etc. This area is very rich in endemics.

Also in this cool steppic zone large monocarpic species of umbellifers appear as they do in Kashmir in the sub-alpine pastures. They are species of *Prangos, Ferula, Heracleum* and *Dorema.* Such herbs along with *Rheum ribes* are gathered for hay and placed in piles near the huts of the peasants to help feed the cattle in the hard winters. Fodder as well as fuel is in short supply so trees are also lopped for fodder. The alpine zone is naturally much broken up being found on many mountain tops. It is richest in the East where it is much like that of the N. W. Himalayas but becomes poorer as one moves toward the West because of less moisture. Few peaks reach 5000 m. Central Asian, Russian species predominate as one goes toward the north. The only paper I know of on the plants of this zone in Afghanistan is that of Breckle (5) of Bonn, Germany and published in 1971. It is a difficult region to study because the plants are to be found on so many different mountain tops. It contains endemics but they are not as numerous as they are at lower altitudes. The tree line varies in different regions. Breckle states that in the central parts of the country there is almost no timber in this zone except where *Juniperus* occurs in some northern parts. The average height of the timber line is 3500 m. Conditions are very variable. Where patches of snow have lain and the drainage poor, there are alpine meadows of *Carex* and *Kobresia. Koenigia alpina* is found in the Wakhan. *Viola biflora,* a yellow violet which is very common in Kashmir is found and one of the commonest alpines is *Delphinium brunonianum* which is near the snow line everywhere in Kashmir. Breckle found the Chitrali *Corydalis metallica* on Kohi-Baba, also *Didymophysa fedtschenkoana* from Russia. He also reports *Potentilla coelestis, Gynophorea weileri* and three *Astragali* (*Myobroma* sect.) which seem to be endemic. Altogether the list of alpines is a long one, many familiar genera being represented, such as *Ranunculus, Papaver, Valeriana, Erigeron, Psychrogeton, Primula, Androsace, Oxyria digyna* and *Epilobium latifolium.*

Chasmophytes are common in all parts. Examples are *Nepeta glutinosa Rubia tibetica* (?), and *Rheum tibeticum.* The only fern mentioned is *Cystopteris dickieana* which is probably only a form of *C. fragilis.* As in Kashmir, *Waldheimia* sp., and *Saxifraga flagellaris* are found near the upper limit of plant growth. *Primula macrophylla* holds the record for altitude by growing at 5450 m. This species was the highest found on K2 in the Karakorum. *Juniperus semiglobosa* was found as high as 4400 m and *Lonicera semenovii* was found with a woody stem at 5200 m. This Russian species is also the *Lonicera* growing at the highest altitudes in the Kashmir Himalayas. In Ladak, *L. spinosa* has been reported from 17000 ft (5182m). All, or almost all, of the alpines he mentions for the Wakhan and Nuristan areas are Himalayan or Russian. To sum it up, the alpine zone is only slightly Irano-Turanian but has Euro-Siberian elements and a great many plants from the Himalayas as well as a few which are circumpolar.

Except in Nuristan, steppic communities are dominant. The pressure of

population is fast removing the larger woody plants that previously could grow. To see what the original forest trees were,one must search for secluded areas and study the trees about mosques, for, as in Swat, the people do not feel free to cut the wild trees growing around mosques. Because there are two and a half million nomads and in addition the villagers also have flocks, there are not many places where the flora has not been degraded. When I was in Pakistan many of these nomads, one lot depending on camels and the other on donkeys for transport, used to migrate into Pakistan in the winter for work and forage. Their flocks like swarms of locusts clear away whatever is edible.

I will not say much about Nuristan because its flora is Himalayan and not Afghan except for a certain amount of mingling near the interface where two floral zones meet. Naturally there are years when the monsoon rains penetrate further than usual. In such years the local flora flourishes better but without permitting new species to enter.

Nuristan is chiefly drained by the Kunar River which rises in Chitral (Pakistan) and enters the Kabul River near Jalalabad. It is all rugged with a scant population living on wooded hillsides above streams in deep valleys. There is little cultivated land but it is green, well watered and well wooded. Freitag states that the forests contain different types of the West Himalayan evergreen sclerophyllous forests resembling those of the Mediterranean. Most of the species are from this flora and they grow under similar conditions. They are also alike in their altitudinal distribution. They come from a common stock and live under similar conditions. They not only have monsoon rain in the summer but they enjoy winter rains as well. The summer rains are not heavy and there are dry periods. The five to seven months of continuous drought prevent similar forests from developing in the rest of the country. In the lowest belt between 800 and 1300 m, there is a *Reptonia buxifolia* community adjoining the semi-desertic *Ziziphus nummularia* community in the lowlands and the *Quercus baloot* community above. Along with the *Reptonia*, familiar Pakistan forms, *Olea ferruginea, Acacia modesta, Pistacia khinjuk* and the shrubs, *Sageretia, Gymnosporia royleana, Dodonaea viscosa, Nannorhops* etc. cover 30–75% of the ground. The large summer grasses, *Cymbopogon parkeri, Heteropogon contortus, Apluda mutica* and *Hyparrhaenia hirta* are also Pakistani.

Quercus baloot, a very hardy oak, is found in a wide belt and stands much abuse between 1,300-2000 m; 350-400 mm of rain is sufficient for it. This species forms closed or open forests. *Lonicera griffithii* and *Rosa brunonii* are climbers. They are the first woody climbers mentioned. The shrubs, *Daphne angustifolia, Sophora griffithii, Quercus dilatata* and *Q. semecarpifolia* are confined to the Safed Koh and northernmost Suleiman ranges of Waziristan where there are some rather heavy rains. *Quercus dilatata* then replaces the *Q. baloot* at 1900-2000 m. From 2400 to 2900 m *S. semecarpifolia* becomes dominant. In the *Q. dilatata* zone, we also find *Acer turkestanicum* from the north and *Celtis caucasica, Pyrus pashia, Parrotiopsis, Indigofera gerardiana, Viburnum cotinifolium, Cotoneaster rosea*

and a few climners as well as a dense herbaceous ground layer of *Teucrium royleanum, Dioscorea deltoidea, Brachypodium silvaticum, Festuca gigantea, Rumex nepalense, Artemisia roxburghiana, Dryopteris spinulosa*, and *Aquilegia afghanica*. In dryer places *Pinus wallichiana* becomes co-dominant.

The high, *Q. semecarpifolia* community is not so rich in species but the following, which also grow in the Himalayas are present: *Taxus wallichiana, Viburnum cotinifolium, Syringa emodi, Euonymus fimbriatus, Lonicera quinquelocularis* etc. Here too the rich ground vegetation is largely Himalayan.

Except for the *Juniperus* woodlands, communities dominated by conifers are restricted to places where there is summer rain. *Pinus gerardiana*, the most xerophytic of our pines, occupies the 2100-2500 m. belt with *Quercus baloot* on one hand and *Cedrus deodara* on the other. There are few shrubs unless the trees are cut down. If they are cut they are replaced by xeromorphic, dwarf shrubs of Turanian origin, such as *Artemisia, Astragalus*, and *Acantholimon*.

The most valuable conifer, *Cedrus deodara*, has its own peculiar requirements, growing between 2500 and 3100 m, with the rainfall between 450-650 mm. It requires more winter than summer rain but needs both, at least for regeneration. The trees are from 6–30 m tall; not as tall as in Swat. In the driest places *Juniperus seravshanica* gradually replaces the cedar.

In high rainfall areas, probably with more than 800 mm, *Picea smithiana* and *Abies wallichiana, Pertya aitchisonii, Rubus irritans* and *Androsace himalaica* are characteristic species as are *Polygonum amplexicaule, Rumex nepalense, Fragaria nubicola, Pseudomertensia edelbergii, Cicerbita aitchisonii, Polygonum geminiflorum, Lilium polyphyllum* and *Habenaria aitchisonii*. Almost all are common in Kashmir.

Ascending to the tree line in the northeast there are two tree junipers; the Russian, *J. seravshanica* and *J. semiglobosa* and two small species, *J. squamata* and *J. nana*. At these high altitudes, between the small junipers, are cushion-like dwarf shrubs like *Onobrychis spinosissima, Astragalus strobiliferus* and *A. aijfreidii*.

The cushion shrublands of both north and central Afghanistan are extremely rich in small woody species of *Onobrychis, Astragalus, Acantholimon, Cousinia, Artemisia* and a few *Ephedras* including numerous endemics. Why should this extreme environment be the area with the most endemics? There are not many true shrubs but we do find *Astragalus cuneifolius* and species of *Rosa* and *Rhamnus*. The herbaceous layer is rich in *Gageas, Eremurus kaufmannii*, and *Iris* etc.

In the humid and subhumid alpine regions there are subalpine thickets of Himalayan origin while in the rest of the country the alpine vegetation is of Central Asian stock, especially from the Pamir-Alai the communities are rather open as there is less water. No one has yet made a checklist of the alpines.

Typical subalpine thickets have only been found in Nuristan in areas with high summer rainfall beginning at c. 3300 m. Toward the west in the rest of Afghanistan, the thickets are gradually replaced by cushion or hassock shrub lands in which there are many endemics. See Freitag for more details. Similar hillsides are found in highland Baluchistan.

On north facing slopes the snow line is at c. 4900 m and on south facing aspects between 5300 and 5400 m. Dense alpine meadows of Himalayan type are restricted to a few mountain ranges in Nuristan with a high summer rainfall and on the Safed Koh. In the other parts of the country the alpine vegetation is largely of Central Asiatic stock with strong connections with the Pamir-Alai region.

Many beautiful Kashmir alpines have been collected in Nuristan at high altitudes. There are two chasmophytes, *Paraquilegia anemonoides* and *Isopyrum anemonoides. Ermannia himalayensis, Saussurea* sp., *Waldheimia tomentosa, W. glabra, Saxifraga flagellaris, Primula macrophylla, Polygonum viviparum, Viola biflora, Glaux maritima, Rorippa islandica, Myriophyllum verticillatum* and *spicatum, Caltha palustris, Chenopodium botrys, Triglochin maritimum, T. palustre, Kobresia* sp. and many more are to be found.

Breckle states that the alpine belt in the Afghan mountains is the westernmost outpost of the extensive Himalaya system. He did not mention the fact that there is a Himalayan outpost still further west in the 'juniper tracts' of northeastern Baluchistan which can easily be reached from Quetta which I have twice visited. The southern slopes of the Safed Koh Mountains which can be reached from the Kurram Valley are largely N. W. Himalayan. I was not able to visit and compare it with the flora on the northern slopes.

Krascheninnikowia ceratoides formerly called *Eurotia*, a small woody shrub which is common at high desert areas in much of central Asia, is common in N. E. Afghanistan and is eaten by grazing animals and also used for fuel. There are also pure wormwood communities which may be mixed with *Haloxylon* in more salty soils.

In low lying desert communities in the far north, there are *Calligonum* communities which grow in sand and escape burial by keeping on top of the dunes. There are also *Zygophyllum* communities which can survive in dry rocky places.

Although there are at least 72 species of the *Chenopodiaceae* in the country, most of them have a wide distribution which includes Central Asia. Why should there be few endemics in this family and few endemic trees?

In wheat fields, in the subtropical zone in the Jalalabad area, all the weeds except *Centaurea depressa* (of eastern origin) are common in Pakistan. Away from the fields *Peganum harmala, Capparis spinosa, Calotropis procera* and other Pakistani species are also found.

There is a loess belt in the north Afghanistan deserts with a mean rainfall of 150-300 mm. Here are hemi-cryptophytes such as *Poa bulbosa* and *Cousinia alata*; geophytes like *Carex stenophylla, Merendera robusta* and *Gageas*, plus a large number of luxuriant annuals with numerous grasses. In spring the vegetation may cover 90% of the soil but dries up quickly in the middle of May. Where the loess soil is removed by erosion,shrubs and dwarf shrubs grow abundantly.

Above the *Amygdalus* shrub-lands and the ephemeral communities, there are open deciduous woodlands which are extremely xermophic, with a precipitation of 200–300 mm. *Chenopods* and *Zygophyllaceae* are generally absent. *Pistacia atlantica* communities are common along the mountains of South Afghanistan up to the eastern border from 1150 to 1800 m with cold winters and a rainfall from 250-400 mm. The variety of vegetation has increased and more of the ground is covered.

In North Afghanistan there is a great deal of the edible *Pistacia vera*. With this tree is *Amygdalus bucharica* and the two cover c. 40% of the area. There are many hemi-cryptophytes, *Cousinias*, a *Phlomis* and a *Salvia*, a *Carex, Eremuri, Bongardia chrysogonum* and annuals. The *Amygdalus* communities are found up to the subalpine region generally between 2000 and 2800 m in regions with c. 400 m of precipitation. *Amygdalus kurmaica* and *Fraxinus xanthoxyloides* enter the picture. Shrubs become more numerous in species. *Cotoneaster* sp., *Rosa* sp., *Cerasus* sp., *Colutea persica, Ephedra intermedia* etc. There are also dwarf shrubs; many *Artemesias*, species of *Astragalus, Acantholimon, Perovskia atriplicifolia* and many hemicryptophytes which, along with species of *Eremurus, Allium, Gagea, Tulipa, Corydalis* etc. These genera are rich in endemics.

Both Iran and Afghanistan are remarkable for the large number of endemics. They are more numerous in Iran and there is endemism in more genera there. Nevertheless they are very common in Afghanistan. Of four main floral regions of Afghanistan there is not much endemism in three. The region with the most endemism, however, is the largest and occupies the great central mountainous block of the country. There is little endemism in the ring of deserts around the central core.

The bulk of the endemics are small perennials and not annuals or trees. Many are ephemeroids. Some have woody roots. Some have short shrubby branches and can be called half shrubs.

An endemic is a species which grows in a single area and nowhere else. The area may be very small, on a single mountain, on a cliff, in a single swamp or in a single country. Some species are so rare that they are in danger of extinction and many are already extinct through loss of habitat or the introduction of rats, goats, pigs or humans. Man is the greatest destroyer by filling in swamps, cutting down forests, covering land with concrete, building roads, as well as plowing up vast numbers of acres for his fields. In Hawaii 273 species are already extinct.

Many oceanic islands which formerly had large numbers of endemics as for example New Zealand, Madagascar and St. Helna have already lost many of them because of the rats, goats, pigs etc. In the tropics thousands of endemics are being lost through loggers cutting trees and through ranchers and farmers clearing the ground with fire. In many places in Afghanistan such activities have replaced the trees by small shrubs. Some species do not seem to have changed much in eons of time and some genera are very plastic. What are the causes at work? We do not seem to know much about it. We only have come to see the sort of places where the most endemics are to be found. Isolation seems to be one important factor. Severe conditions seem to be another.

Dr. Davis of Edinburgh has noticed that where two floral zones meet, that near the interface there are often more endemics than there are in a region without any barriers to migration. It has also been noticed that stress seems to make a difference. I have noticed that desert regions tend to have more endemic species than might be expected. The reason may be that where there is plenty of water, the soil is densely covered with plants and there may be such a thick sod with no bare soil that fresh seeds may germinate but the seedling is choked by the surrounding vegetation. There are plenty of places for new or old species in a desert if they possess the requisite hardiness. A desert plant possessing a new and favourable mutation does not have to compete with neighbours.

The endemism of the Irano-Turanian area is very high. It is not, however, high in all families or in most families but in only a few and in a limited number of genera. Not many monocot groups are involved. The large grass family and sedge families are not much affected but in the *Liliaceae* there are many endemic *Alliums, Gageas* and *Eremuri* and a good many species of *Iris*. If it were not for these genera and the beautiful alpines,the flora of nine-tenths of Afghanistan would be dull indeed for the whole year. In the spring at each altitude, clear up to the alpine zone, there is a short period when the desert blossoms and when the irises, tulips, *Eremuri* and a host of annual crucifers, borages, mints, composits and grasses are at their best. For a few weeks,the arid parts of Afghanistan can be really beautiful with ephemerals and ephemeroids. The ephemeroids are perennials but they, like the true ephemerals, are only green for a few weeks and then they disappear. Cold wet winters are a characteristic of the Mediterranean floras.

When I was surprised to find out the extent of endemism in Afghanistan,I would have been still more astonished if I had begun to study the situation in Iran which has at least twice as many species and more genera are involved. The numbers, however, can not be known until the *Flora Iranica* is complete. Kitamura listed 186 sp. of *Astragalus* in Afghanistan and Rechinger in the Symbolae listed 150, but in a recent note in the *Flora Iranica* Rechinger states that there are probably 800 in the Flora Iranica. In the *Symbolae Afghanica* Rechinger lists 78 species of *Cousinia* and 377 in the *Flora Iranica*. In Iranica there are 200 species of *Acantholimon* of which 139 are endemic and altogether there are only 20 species in Afghanistan. In *Dionysia*, a desert genus in Iran related to *Primula*, there are 34 species and 33 of these are endemic while only four or five are found in Afghan-

istan. *Allium* and a number of other genera similarly provide Iran with many more endemics than Afghanistan has. The only important genus I have noticed which is better represented in Afghanistan is *Eremurus*, a genus which has come in from the north. In 1974 Grey-Wilson found 3 more new Afghan *Dionysias.*

There are hardly any ferns in Afghanistan except in Nuristan and the Safed Koh Mts. which belong to Nuristan floristically.

The main floristic elements in the Afghan flora are (1) Cosmopolitan which are chiefly weeds of cultivation; (2) Plants of the Northern Hemisphere which are chiefly in the alpine zone such as *Oxyria digyna*; (3) Pan Tropic, a few weeds; (4) Eurasian from W. Europe to East Asia, chiefly in the temperate zone, examples are *Solidago, Picris, Prunella, Trachomitum, Thymus* and *Lotus corniculata*. These are mostly in Nuristan; (5) Western elements, i.e. Mediterranean. Practically all typically Iranian genera are western; (6) Sudano-Sindian. Most of the subtropical genera in the desert zone up to 1200 m belong here; (7) Central Asiatic i.e. northern elements which have come into Northern Nuristan and into the alpine flora of the rest of the country; (8) Eastern elements, mostly those which have come into Nuristan along the Himalayas. Some come from as far as China; (9) A large number of endemics.

Orchids, ferns, water plants and monocotyledons except grasses, sedges, and irises are not numerous. Most of the gymnosperms except *Juniperus* and *Ephedra* are in Nuristan and grow in the Himalayas but many are of European genera not far Eastern.

Elements which have come in from the Sudan are *Acacia, Prosopis, Parkinsonia, Caesalpinia, Ziziphus, Combretum*, and *Capparis. Albizia lebbek* and *Dioscorea deltoidea* are tropical. *Laurus, Myrtus, Ficus, Olea* are eastern from India and Malaysia.

Some old Mediterranean relics (Tethys period) are *Ceterach* (a fern), *Bothriochloa ischaemum, B. gryllus, Arundo donax, Cirsium* sp., *Origanum vulgare, Sedum album, S. adenotrichum, Nerium* (the oleander), *Punica granatum, Cotinus coggyria* and *Cercis*.

In the far north of Nuristan, Central Asian elements as *Cercis griffithii, Acer semenovii, Crataegus songarica, C. turkestanica, Pyrus korshinskyi, Malus turkmenorum, Ephedra equisetina, Loniceras, Cotoneasters, Rosas* and *Cerasus* become common. There is also a dwarf shrub layer with Turanian affinities consisting of *Cousinias, Acantholimons.*

When the Himalayas rose from the Tethys sea, the ancestors of many of the species which colonized the new territories came in from the west. Meusel (20) states that the ancestors of the following deciduous forest elements centred in S. Europe: *Brachypodium sylvaticum, Fraxinus excelsior, Geum urbanum, Sta-*

chys sylvatica, Atropa acuminata and *Aquilegia pubiflora*. The big genera *Cousinia* and *Eremurus* came from Oriental Turkestan. *Launaea, Nepeta* and *Astragalus* are from the Mediterranean or Turkestan, radiating strongly into the West Himalayas. *Verbascum, Carduus nutans, Hypericum perforatum* and *Cichorium* are Mediterranean. Mediterranean types in Pakistan are few compared with those coming from the East. Meusel has studied the probable origin of more than 500 species of our Himalayan flora. Until our floras are reasonably complete and we know more about plant distribution such studies cannot be complete for Afghanistan.

True steppe plants are found in the Afghan mountains. They are narrow leaved caespitose grasses, drought resistant herbaceous perennials and large annual perennial like *Ferula* and *Dorema* and *Ribes*. Large numbers of the endemics in the Afghan mountains such as *Cousinas* and *Astragali* are steppic along with *Artemisias*.

There is a misleading statement in Mr. Burkill's "Working List of the Flowering Plants of Baluchistan" (1909). It is "The flora is Persian". There are no doubt Persian elements in the Baluchi flora which are important, but there are also Sudano-Sindian and Himalayan elements. He also says, "It is very much less northern than that of Afghanistan, but it is northern enough to contain a violet, a *Primula*, the English hawthorn (now considered to be *Crataegus songarica*), an *Anemone*, a Gentian, a juniper . . . . etc. These species he referred to were probably migrants from the Himalayas or Hindu Kush.

My study of the plants of this borderland has brought out one point which I have not seen alluded to previously and that is the large number of plants which are not Afghan or Persian which presumably have migrated southwest from the Himalayas along the mountains bordering the two countries. This first struck me forcibly when I was studying the flora of the Kurram Valley and the slopes of Mt. Sika Ram which is high enough to be snow covered most of the year and to have an alpine flora very similar to that of the Himalayas in Kashmir. As one moves on through Waziristan into the highlands of Baluchistan, the mountains are not high enough to produce an alpine flora and along with the loss of two or three thousand feet of altitude there is increasing aridity so the ferns and many other mesophytes found on Mt. Sika Ram have disappeared and the vegetation does not cover so much of the soil but still quite a few Himalayan plants have reached Baluchistan including two pines, *Pinus gerardiana* and *P. roxburghii*. The Himalayan spruce and yew only get as far as the Kurram. Those which reach as far to the southwest as Waziristan and Baluchistan must be the most xerophytic. The two oaks, *Quercus dilatata* and *Q. semecarpifolia* do not reach Baluchistan but reach Waziristan. Those that reach 'the end of the line' are found in the 'Juniper Tracts' of N. E. Baluchistan.

The Wakhan Corridor and Little Pamir

One of the most interesting parts of Afghanistan is the 200 mile long, beak-

like, eastward projection of Badakshan Province, the extreme northeast province which is adjacent to Russia. It is drained by the Ab-i-Panj river, a tributary of the Oxus. It is called the Wakhan Corridor because it furnishes a road from Afghanistan to China and the Central Asian Pamirs. It is an area where four countries meet, Afghanistan, Russia, China and Pakistan. At its widest the corridor is 40 miles across but at one place it is only five miles wide. Mountains up to 6000 m lie to the north and the south. The river valley begins at 4000 m of altitude and is at 2580 m when it leaves. Grey-Wilson calls the eastern portion of the Corridor, The Little Pamir. The Pamirs are extensive, alpine, grassy meadows east of the Hindu Kush. There are settlements along the valley. Grey-Wilson reported that in places the pastures had been overgrazed by yaks. The valley has been visited by quite a few collectors. One of the first was Dr. G. M. J. Giles who was surgeon at Chitral 1884-87.

The only good, recent article on the flora of the Corridor, I know, is in the Kew Bulletin No. 29: 19-81. 1974, and was written by C. Grey-Wilson of the Kew staff. He was one of two permanent members of an eight months long expedition which collected plants both in Afghanistan and Iran and the report on the Corridor is based on work done by the party from July 17 to Aug. 13, 1971. It is a thorough piece of work, being supplied with useful maps and photographs and includes descriptions of eleven new species, two from the Corridor, [The introductory summary omits *Corydalis hindukushensis*.] The Expedition leader was Prof. T. F. Hewer of Bristol. It is stated that the main object of the expedition was to supplement collections made by previous expeditions, notably those of Mr. I. C. Hedge and Dr. Per Wendelbo, Prof. K. H. Rechinger of Vienna and that of Rear Admiral and Mrs. Furse.

Grey-Wilson mentions many species which were collected in 1971, yet he has not brought them together in a comprehensive list. He mentions the common and interesting finds made at the main halting place, mentioning habitat and says something about the distribution of many of them. The party found quite a few species not reported from the area previously as well as two new species, *Corydalis hindukuschensis* and *Astragalus bahrakensis*.

Very few if any of the Wakhan plants are Irano-Turanian. Most of them are natives of the dry inner Himalayas in Kashmir, Ladak, Baltistan, Gilgit, Chitral or Western Tibet. There are a few endemics and the nearer one goes to Russia, the larger the percentage of plants from Central Asia grows. Some have a wide distribution reaching as far as Mongolia.

Afghanistan – Important References

1 Aitchison, J. E. T. (1881/2). On the Flora of Kurram Valley. J. Linn. Soc. Soc. Bot. 18: 1–113; 19: 139–200.

2 ..... (1888). The Botany of the Afghan Delimitation Commission.

Trans. Linn. Soc. Bot. Lond., ser. 3, 1–139.

3 . . . .(1889). A Summary of the Botanical Features of the Country Traversed by the Afghan Delimitation Commission during 1884/5. Trans. Bot. Soc. Edinb. 17: 421–34.

4 Bor, N. L. (1970). *Gramineae. In Flora Iranica,* K. H. Rechinger, no. 70, 573 p., dated 30.1.1970.

5 Breckle, S.-W. (1971). Vegetation in Alpine Regions of Afghanistan. In Plant Life in South-West Asia. Bot. Soc. Edinb., pp. 107–116.

6 Burkill, I. H. (1965). Chapters on the History of Botany in India. Bot. Surv. India, Calcutta, 245 p.

7 . . . . . (1909). A working List of the Flowering Plants of Baluchistan, Sup't Gov't Print., India, Calcutta, 136 p.

8 Davis, P. H., Harper, P. C. & Hedge, I. C., eds. (1971). Plant Life of South-West Asia. Bot. Soc. Edinb., 335 p.

9 Endlicher, S. & Fenzl, E. (1836). Sertum Cabulicum . . . . collegit M. Honigberger . . . . Fasc. I, Vienna.

10 Freitag, H. (1971). Studies in the Natural Vegetation of Afghanistan. In Plant Life in South-West Asia. Bot. Soc. Edinb., pp. 89–106.

11 Grey-Wilson, C. (1974). Some Notes on the Flora of Iran and Afghanistan. Kew Bull. 29: 19–81.

12 Griffith, W. (1847). Journals of Travels in Assam, Burma, Bootan, Afghanistan and the Neighbouring Countries. 435 p.

13 Hedge, Ian & Wendelbo, Per (1970). Some Remarks on Endemism in Afghanistan. Israel J. Bot. 19: 401–417.

14 Honigberger, J. M. (1952). Thirty-five Years in the East. Discoveries and Sketches Relating to the Punjab and Cashmere in Connection with Medicine, Botany, etc. 2 vols. London.

15 Kitamura, Siro (1960). Flora of Afghanistan. Kyoto Univ. 486 p.

16 Koie, M. & Rechinger, K. H. (eds.) *Symbolae Afghanicae* Biol. Skr. Dan. Vd. Selsk. 8 no. 1, 1954 to no. 6, 1965; 14 no. 4, 1965.

17 Lamond, J. M. (1970). The Afghanistan Collections of William Griffith. Notes Roy. Bot. Gard. Edinb. 30: 159–175.

18 Linchevsky, I. A. & Prozorovsky, A. V (1949). The Basic Principles of the Distribution of the Vegetation of Afghanistan. Kew Bull. 1949: 179–214. Transl. by H. K. Airy-Shaw.

19 Manger, C. (1934). Bornmüller named his Plants Collected about Kabul and Published the Names in Engler. Bot. Jahrb. 66: 216–248.

20 Meusel, H. (1971). Mediterranean Elements in the Flora and Vegetation of the West Himalayas. In Plant life in South-West Asia. Bot. Sci. Edinb., pp. 52–71.

21 Nasir, E. & Ali, S. I., eds. (1970-). Flora of Pakistan. Karachi/Islamabad.

22 Neubauer, H. F. (1954/5). Versuch einer Kennzeichnung der Vegetationsverhältnisse Afghanistans. Ann. Naturhist. Hofmus. Wien 60: 77–113.

23 Rechinger, K. H. (1963-). *Flora Iranica*, Graz.

24 Stewart, R. R. (1967). The Flora of the Kurram Valley. Biologia 13(2):

47–110.

25 . . . . . (1972). An Annotated Catalogue of the Vascular Plants of West Pakistan and Kashmir. In Flora of West Pakistan (E. Nasir & S. I. Ali, eds.), Karachi, 1028 p.

26 Volk, O. H. (1954). Klima und Pflanzenverbreitung in Afghanistan. Vegetatio (Den Haag) 5/6: 422–33.

27 Wendelbo, P. (1971). Some Distributional Patterns within the Flora Iranica Area. In Plant Life in South-West Asia. Bot. Soc. Edinb., pp. 29–42.

Note

The references used here are not at all exhaustive. There is however an excellent bibliography by S.-W Breckle, W. Frey and I. C. Hedge in Notes Roy. Bot. Gard., Edinb. 29: 357–371 and Suppl. I, *ibid.* (3) 1975.

Pteridophyta

I have loved ferns for more than sixty years and have hunted for them from Chitral to the Ganges, especially in Hazara, the Murree Hills, Kashmir and the Mussoorie Hills. In addition, for forty years, I have tried to name the ferns from the Mussoorie Hills and Nepal which Dr. R. L. Fleming has sent to me. With his wife, a physician, he founded the Shanti Bhawan Hospital in Kathmandu where he lived for nearly thirty years, moving there from Landour, Mussoorie. Many hundreds of his fern specimens from all corners of Nepal as well as from the Mussoorie Hills are stored in the fern herbarium here at the University of Michigan at Ann Arbor.

Most major plant collectors in India and Kashmir have collected ferns and quite a few like Dr. Fleming, an American, have only collected ferns or collected little else. The Mackinnon brothers of Mussoorie collected orchids and ferns. Between about 1880 and 1900 a surprising number of amateurs,along with Duthie, Gammie and Gollan of the Botanical Survey collected ferns. They all collected in the N. W. Himalayas except Beddome (1830–1911),the best fern man of them all, who was a forest officer in South India and the author of the most useful book on the ferns of India, Burma and Ceylon, completed in 1892 and not improved on since.

The collectors of this period were a most heterogeneous lot. J. E. T. Aitchison (1835–98) was a Civil Surgeon, H. F. Blanford (1834–93) was a zoologist and author of the ferns of Simla (1880). T. Bliss of Simla was a pharmacist. Sir Dietrich Brandis (1824–1907) was Inspector General of Forests. C. B. Clarke, (1832-1906) of the Indian Educational Service became Sup't. of the Calcutta Botanical Garden from 1869 to 1871. In 1880 he published in the Transactions of the Linnaean Society "A Review of the ferns of northern India."

Gen. Sir Henry Collett (1836–1901), was the author of the "Flora Sim-

lensis" in 1902. He did much collecting on the N. W. Frontier, in the Kurram Valley, in Simla and in Burma. J. F. Duthie (1845–1922) was a professional botanist in the Botanical Survey, an author and collector. George A. Gammie, son of James A. Gammie, Cinchona specialist, was an economic botanist and collector. William Gollan (d. 1905) collected in Burma and N. W. India. Miss Herschel, the only woman, was a fern collector in Mussoorie c. 1890. C. W. W. Hope (1832–1904) was a Civil Engineer who collected in N. W India, sometimes with Bliss. He was the author of "Ferns of N. W. India" (1831–1904) in the Journal of the Bombay Nat. Hist. Society. Henry C. Levinge (1831–1896), an Irishman, in the Bengal Public Works Dept. collected ferns in Kashmir which were entered in Clarke's collection list. He also collected in other parts of India. I have no date about MacDougall. Gustav Mann (1836–1916) of the Indian Forest Service, collected palms and ferns. J. C. McDonell was a Kashmir Conservator of Forests. Philip and Vernon Mackinnon, brewers of Mussoorie, in the 1880's discovered nine new orchids and collected many ferns.

A Col. McLeod collected many ferns in Kashmir before 1895. James Marten collected in the Mussoorie area between 1897 and 1904. Oertel, a friend of E. W. Trotter collected in Hazara. E. W Trotter, (fl. 1885–90) Director, Punjab Post and Telegraph Dept., collected extensively in Azad Kashmir, especially in Poonch and exchanged specimens with a number of the other fern lovers. He accumulated a fern herbarium of c. 2000 specimens which is now in my collection in the National Herbarium in Islamabad. Along with his books, it was given to me by his heir. Another of the fern lovers of this period was one of the most eminent. He is Sir George Watt (1851–1930), Economic Botanist, and Prof. of Botany, Calcutta. He collected in many places and was the author of a "Dictionary of the Economic Products of India." 6 vols. 1899–1907. Gen. F E. W. Venning made a large fern collection in Gulmarg, Kashmir in 1923, which is at Kew.

Ferns require more water than do many other groups, because in the prothallus stage of their life history, the sperms need to swim to enter the archegonium in order to fertilize the egg, so ferns cannot exist in most dry regions, unless by springs, on the inner walls of wells or stream banks. In the whole of Baluchistan there are only ten pteriodophytes while in Kashmir there are c. 148 and in Nepal 450. *Bryophyta*, similarly, are uncommon in dry, arid countries. Sind, Waziristan, the Punjab Plains and the N. W. F. P. do not have much water or much shade, so they are poor in ferns, mosses and liverworts.

It is surprising that in the ninety years since Beddome published his Handbook of the ferns of British India, Ceylon, and Malay Peninsula, with Supplement (1892), Calcutta, no one has brought it up to date, though it has been reprinted. Since Beddome's time many thousands of fern specimens have been collected, many additional species have been described and the study of the group has made many advances entailing a change in the names of many species but no one has come forward to bring this valuable work up to date. There are many Ph. D.'s in Botany in India and Pakistan and some of them are pteridologists. If bring-

ing it up to date is too much for one man to undertake, the task might be divided. There are fern men at work in Lucknow publishing articles on individual genera. There are pteridologists in the Indian Punjab and also in Calcutta. It would have saved me a lot of time if I had been able to use a fern manual with keys.

I began collecting ferns along with higher plants in Kashmir in 1912 and 1913 and kept my first set of specimens and for many years deposited my second set in the herbarium of the New York Botanical Garden. After twenty years or so, after my parents left New York, and I came to know the botanists at the Royal Botanic Gardens at Kew near London, I began leaving my second set there. Over the years I had 'home leave' from time to time and I brought home with me the puzzles which I had accumulated since my last leave. As I did not leave Rawalpindi for good until 1962 and kept in touch with a number of fern men I owe thanks to a good many. I have received help from C. V. Morton (1905–1972) of the Smithsonian in Washington D.C. At Kew where I worked for 14 full summers after 1960 I have been helped by Francis Ballard (1896–1976?), Dr. Frances Jarrett (1931-), Dr. Wm. Arthur Sledge (1904–), of Reading and Ceylon whom I met at Kew, Dr. Gopinath Panigrahi (1924-) of Calcutta, while at Kew, and the premier living pteridologist, Dr. Richard Eric Holttum (1895), also of Kew. The late A. H. G. Alston (1902–1958) of the British Museum named many ferns for me. Since coming to the University of Michigan in 1960 I am grateful for the great help of Dr. W. H. Wagner Jr. (1920-) and Michael G. Price (1941-), formerly of the Philippines, now a Ph. D. candidate in this University.

I have been a collector rather than a fern specialist. My effort has been, first to find species and then to find the correct name so that my papers on ferns have only been annotated catalogues of the ferns of different regions in Pakistan and Kashmir.

Whenever I have published checklists of the plants of various places like Swat, Hazara, the Kurram Valley, Rawalpindi Dist., etc. I have always included the ferns. When in 1972 I published my Annotated flora of the whole of Pakistan and Kashmir, the first 21 pages bring together all of the lists of ferns I had published previously making them unnecessary as check-lists. The paper entitled "The Ferns and Fern Allies of West Pakistan and Kashmir" published in Biologia Vol. 3(2) Dec., 1957, pp. 133–164, has much fuller notes on each species listed. The only fern paper I have published on another area is "The ferns of Mussoorie and Dehra Dun" which appeared in the 150th Anniversary volume of the Calcutta Botanical Garden, Pt. II, 159–172. 1942. Calcutta.

As a result of my collecting I have been able to add a number of species to the fern flora of Pakistan and Kashmir but only discovered one new species and one new hybrid. Mr. Fraser-Jenkins of the British Museum, has described *Dryopteris stewartii* from the *D. ramosa* complex and a hybrid, *Polystichum lonchitis* x *prescottianum*. Both grow in Swat. This hybrid and one or two more I have disco-

vered turned up in my collections accidentally Dr. Wagner tells me that hybrids should be looked for in the field for they usually have hybrid vigour and can often be easily recognized as being somewhat different from their neighbours in a stand of ferns. I should have known this sixty years ago.

As far as I know, Bombay is the only Indian province to have its own fern flora. This is due to Dr. Ethelbert Blatter (1877–1934) of St. Xavier's College, Bombay and J. F. R. D'Almedia (1891–1949) of the same college. They published "The ferns of Bombay" in 1922.

Most of the ferns which are found in our area grow in the Himalayas between 1500 and 3000 m in altitude and in my checklist there are no less than 132 taxa of ferns and 14 fern allies. Some fern fronds are short lived, developing rapidly when the monsoon begins and starting to dry up as soon as the monsoon ends. Others are tough and xerophytic like some of the species of *Polystichum* which live through the winter buried under the snow and some epiphytic species of *Pleopeltis* which roll up and last through the winter.

The ferns in Pakistan are rooted in the soil. There is not enough rain to keep epiphytes alive. Very occasionally a fern may be found on the base of a tree trunk but travelling eastward toward the Bay of Bengal, the monsoon rainfall steadily increases and the number of epiphytes of many kinds increases and also the number of species of ferns, mosses, liverworts, lichens, aroids, orchids etc.

Many of our Pakistan ferns are wide ranging and no less than 24 are also found in North America in the U.S.A. and Canada. The list is as follows.

Adiantum capillus-veneris
A. pedatum
Asplenium ruta-muraria
A. trichomanes
A. viride
Athyrium acrostichoides
A. dentigerum
A. filix-foemina var.
Botrychium lunaria
B. virginianum
Cryptogramma stelleri
Cystopteris fragilis
C. montana
Equisetum arvense
E. palustre
Lycopodium selago
Ophioglossum vulgatum
Osmunda claytoniana
O. regalis
Polystichum lonchitis
Pteridium aquilinum
Salvinia natans
Selaginella rupestris
Thelypteris hexagonoptera ?
T. palustris
T. phegopteris

Ferns gregarious on high open hillsides in the N. W. Himalayas

Athyrium filix foemina var.
Athyrium wallichianum Ching, (*Dryopteris brunoniana* (Wall.) O. Ktze.)
Dryopteris barbigera & var. *falconeri*

Osmunda claytoniana
Onychium contiguum
Polystichum prescottianum & P. bakerianum
Pteridium aquilinum

Since in most of Pakistan the rainfall is less than 250 mm a year, there are few ferns. In the whole of Baluchistan there are only ten ferns reported. In the Kurram Valley there are 32 ferns and fern allies. *Cystopteris fragilis* in the only common fern in Ladak and three species of *Equisetum* are reported but only *E. ramosissimum* is common. This *Equisetum* is the only pteridophyte Jafri reports from the Karachi area of Sind.

In Rawalpindi District the following ferns have been reported from below 900 m.

Actiniopteris australis, only in Attock Dt
Adiantum capillus-veneris
A. incisum
Ceterach dalhousiae
Cheilanthes persica
C. pteridioides
Equisetum ramosissimum
Marsilea minuta
Ophioglossum capense
O. vulgare
Pteris vittata

The fern list of the *Flora Iranica* has not been published yet but Alston published a list of Afghan ferns in the fourth volume of *Symbolae Afghanicae* and he listed 30 *Pteridophyta*. All but one of 30 are in the N. W. Himalayas. This a Central Asian fern *Asplenium samarkandense*. Most of these 30 are not typical of the flora of Afghanistan as a whole as they are mostly found in the portion of the country which has a monsoon i.e. in Nuristan. The Kurram Valley also benefits from the monsoon. I was surprised to find that of the 32 pteridophytes in the Kurram list the following are not in Alston's Afghan list.

Adiantum aethiopicum
Asplenium nesii?
A. viride
Athyrium acrostichoides
A. dentigerum
Botrychium lunaria
Ophioglossum capense
Cryptogramma brunoniana
Dryopteris barbigera
D. blanfordii
Pleopeltis clathrata
P. excavata
Thelypteris dentata
Woodsia alpina
Salvinia natans

All of the above, except two, are Himalayan species but two require a note. The first is an African fern and the second was called *A. varians* by Aitchison but Dr. Reichstein who is at work on these ferns for the *Flora Iranica* suspects that it is the E. Asian *A. nesii*.

The first to call attention to remarkable cases of disjunct distribution in

Pakistan ferns was Duthie who published the names of the plants collected on the Chitral Expedition led by Gen. Gatacre for the relief of Chitral in 1895. He reported *Dryopteris ludens* and *Lygodium scandens*, far west of where they might have been expected to turn up. In 1934 at c. 1400 m , above Abbottabad in pine forest, I found *Pellaea hastata* which looks like a miniature *Pteris* with its nearest locality in Tehri Garhwal. Some even more remarkable ferns have turned up in the Jhelum watershed. In 1927 at c. 1230 m in the Jhelum Valley, I discovered *Microlepia wilfordii* Moore, now called *Coptidopteris* by Nakai and Momose. McDonell had found it earlier c. 1890. It is a Chinese fern. *Asplenium pekinense* Hance is another Chinese fern which seems to have been first found by Oertel at Dhamtaur in Hazara and others have found it on the Jhelum between Domel and Rampur between 610 and 1220 m. *If Asplenium nesii* from the Kurram is correctly named it is another example.

Although many of our ferns are well known and widely distributed we have on the other hand a good number of endemics which presumably originated in the Western Himalayas. These are about 20% of the whole. They are;

Athyrium atkinsonii Bedd.
A. dentigerum (C. B. Cl.) Mehra
A. macdonellii Bedd.
A. mackinnonii (Hope) C. Chr.
A. rupicola (Hope) C. Chr.
A. setiferum C. Chr.
A. wallichiana Ching (*Lastrea brunoniana* Wall.)
Cheilanthes anceps Blanf.
C. dalhousiae Hk.
C. grisea Blanf.
Crypsinus stracheyi (Ching) Jarrett
Dryopteris barbigera (Moore) O. Ktze.
D. barbigera var. *falconeri* (HK.) R.R.S
D. blanfordii (Hope) C. Chr.
D. chrysocoma (Christ) C. Chr.
D. marginata Wall.ex Christ
D. ramosa (Hope) C. Chr.
D. scottii (Bedd.) Ching
D. serrato-dentata (Bedd.) Ching
D. sino-fibrillosa Ching
D. stewartii Fraser-Jenkins
Pleopeltis clathrata (C.B.Cl.) Bedd.
Polystichum thomsonii (HK.) Bedd.
Thelypteris levingei (Baker) Ching
T. repens (Trotter & Hope) R.R.S.

Selaginella sanguinolenta (L.) Spring forma *aitchisonii* (Hieron) Alston
S. sanguinolenta (L.) Spring f. *indica* (Milde) Alston

A good many of our ferns which have their relatives from further east in the Himalayas to be at the western edge of their range and drop out one by one toward Afghanistan. Before they disappear, the localities where they are found seem to be further apart. Their distribution is said to be disjunct. Some of them are hundreds of miles further west than the next locality where they are known to grow. Of course the valleys of the Himalayas have not been exhaustively combed in the search for ferns and some new localities will turn up but I think that most of the gaps will remain. No one has yet plotted the distribution of our ferns the way Hulten has published a map on the distribution for every Arctic species.

Nath Mehra of the Indian Punjab University at Chandigar who became interested in ferns while studying under Prof. S.R. Kashyap and taught botany at the D A.V College, Lahore before leaving Pakistan in 1947. He has published a number of papers on ferns but none on the ferns of Pakistan.

There are large numbers of Pakistani and Kashmir ferns in collections and I wish that some one would have line drawings made of each of our ferns and produce a book on the lines of Beddome which would be attractive to visitors and Pakistani plant lovers. At 91 I am too old to volunteer.

Bryophyta – Musci

Considering the fact that the mosses are so small and unimportant economically, it is surprising how much work has been done on the group. The inspiration for moss studies, which have made great progress in India in the past sixty years, is due to Prof. Shiv Ram Kashyap of the Punjab University, Lahore, the liverwort specialist, who did not publish any moss papers himself. R. S. Chopra, his student, was born in Gujranwala in the Punjab and for some years collaborated with Prof. Kashyap on liverworts. Since 1947 he has worked at the Indian Punjab University and worked on the mosses of India (23).

Kazmi's *Bryophyta* section of his Bibliography of 1970 is very incomplete and for bibliographies on mosses there are two published in India which are more complete and up to date. They are Ram Singh Chopra's of 1975 and Ram Udar's of 1976.(25)

For many years Hugh Neville Dixon (1861-1944), a teacher in a school for the deaf in England,was the specialist on Indian mosses to whom moss collectors sent their collections for naming. When I began my collecting in the Himalayas in 1912, there was no Catalogue or Manual of the mosses of the region and there is none today. Realizing that I would be collecting in some places where it was probable that no one had ever collected mosses,I began to put them in my press and began sending packets to Dixon. The first was sent about 1924. Mr. Dixon named them and sent me lists of determinations with voucher packets. In his letters he reported some new genera, species and records. I kept sending packets and receiving determinations for a long time supposing that Mr. Dixon was having his work properly published. A year or so ago here in Michigan,I thought that I would look up where these moss names had been published and to my surprise found that of the lot only one species had been published and I have no idea how this single species was singled out for publication. I have written to Prof. Nasir in Rawalpindi and he has found these packets named by Dixon and sent them to Edinburgh and it will be interesting to see how many of my 'new species' have been named by some one else in the fifty years or so since they were collected.

After Mr. Dixon died I continued to collect mosses and sent them to the New York Botanical Garden and they sent them to Mr. E. B. Bartram of the famous

Bartram botanical family of Bushkill, Pennsylvania and he published a list of 102 sp of mosses in the Bulletin of the Torrey Botanical Club 82(1): 22–29. 1955. In this paper he describes three species as new, *Barbula* and *Pohlia stewartii* and *Haplocladium himalayanum*. These collections were mostly from Kashmir and the N.W. Himalayas but some were from the Mussoorie Hills. Bartram lists ten species which he says were found further west than usual. They were probably all from the Mussoorie Hills.

Indian bryologists have, unlike most workers on Angiosperms, a broad view of their field and have not exhausted their energies working on small, local fields. The two men who have done the most in recent years are R. S. Chopra (23) and Ram Udar (25). Both have long and useful bibliographies which are more complete than that of Kazmi.

The first man to write anything about Indian mosses was Wm. Mitten, who in 1859, published "Mosses of the East Indies", J. Linn. Soc. III (18). Brotherus (5, 6) and P. J. Bruehl also did much pioneer work on mosses (7).

A good many collectors of higher plants, list in an appendix, the names of the mosses they found. I think that the most important of these are listed in the bibliography which follows this paper. If these lists were all brought together, quite a long list could be compiled but as they were prepared by many different workers, it cannot be assumed that they were all correctly named and some of the names are no doubt obsolete so that if some one desires to compile an up-to-date authentic list, he or she will have to go and see these mosses at the herbariums where they are stored or else borrow the original packets for study. As far as I know, Ram Singh Chopra is the only collector in Pakistan who was enough of a bryologist to name his own collections. He is the only real bryologist born and trained in what is now Pakistan.

Very few collectors have gone on expeditions looking for bryophytes only. Exceptions are two Scottish professors from Murray College, Sialkot. Prof. Wm. Lillie and The Rev. John Garrett loved to go on long hikes in the N. W. Himalayas and the Trans-Himalayas including Gilgit and over the years collected many mosses which Lillie sent to his father in Scotland who was interested in the group. He turned them over to H. N. Dixon who published a paper on their findings (8).

In 1913, a Dr. M. Piasenza sent an expedition to Kashmir which explored the desolate regions, beyond the Himalayas, of Suru, Zanskar, Dras, and the beautiful Sind Valley of Kashmir. On this expedition Prof. Borelli collected mosses. I covered much of the same ground in 1912, collecting flowering plants. V. F. Brotherus published the results of this trip in 1928 in *Annales Bryologici* 1: 28–46. Six varieties and 106 species are listed. Four species and one variety are said to be new and 35 species and two varieties are said to be new to the Himalayas. In this paper many of the place names are spelled in a peculiar manner. It is stated that many of the specimens were sterile. This seems to be the largest moss collection from

Kashmir (6). I have only heard of one collection of the mosses of the Kashmir Valley. Raj Kumari Koul & Gurcharan Singh of the new Kashmir University in the 1972 Bryologist, pp. 586–588 published the names of 37.(16)

For the convenience of moss students a moss herbarium should be built up as part of the fledgeling herbarium in Islamabad. As there does not seem to be a serious student of mosses in Pakistan at the present time, there is an opportunity for someone looking for a neglected field in which to work.

Moss Bibliography

1. Asghar, Ali. 1957. A list of mosses of West Pakistan. Biologia 3: 44–52. Collected on several expeditions, Tirich Mir, Chitral Relief, Garrett & Lillie from Kaghan to Gilgit, and Sultan Ahmad from Swat & Murree Hills.
2. Bartram, E. B. 1955. Northwest Himalayan Mosses. Bull. Torrey Bot. Club 82(1): 22–29. A list of 101 species which R. R. Stewart had sent to the New York Botanical Garden. Three new.
3. . . . . 1960. Northwestern Himalayan Mosses, II. Rev. Bryol. et Lichenol. 29: 165–172. List of 104 mosses collected by Walter Koelz of Michigan, U.S.A. from Kashmir and the Punjab. Four new; one from the Punjab.
4. Blatter, E. & Fernandez, J. 1929. Waziristan Mosses. Jour. Ind. Bot. Soc. 10: 143–153. Named by Dixon.
5. Brotherus, V. F. 1898. Contributions to the bryological flora of the N. W. Himalayas. Acta Soc. Sci. Fennica, Helsingfors 24(2): 1–76.
6. . . . . 1928. *Contributions á la Flore Bryologique du Cachemire*. Results of Dr. M. Piasenza's Expedition to Suru, Zanskar, Dras and the Sind Valley of Kashmir on which Prof. Borelli in 1913 collected mosses. Ann. Bryol. 1: 28–46. In this paper 106 sp. and 6 vars. are listed. Four sp. and 2 vars. are said to be new.
7. Bruehl, P. 1931. A census of Indian mosses. Rev. Bot. Soc. Ind. 13(1): 1–135; 13(2): 1–152.
8. Dixon, H. N. 1926. Mosses of William Lillie and John Garrett. Bull. Bot. Surv. Ind. 9(5): 303–313, a list of 51 mosses, 7 new, one of R. R. Stewart; 2 new vars.
9. Dixon, H. N. 1929. Mosses collected by Mr. J. Fernandez in 1927. Jour. Bombay Nat. Hist. Soc. 35: 278–283.
10. . . . . 1930. Additions to the Moss Flora of the North-Western Himalayas. Ann. Bryol. 3: 31–70. Sixteen new sp. and two vars. Some of these were collected by Kashyap & R. L. Badhwar.
11. . . . . 1942. Some new species of Acrocarpous Mosses from N. W. Himalayan Flora, 150th Anniv. Vol., Roy. Bot. Gard., Calcutta 173–182.
12. . . . . & Badhwar, R. L. 1938. Some new N.W. Himalayan Mosses. Rec. Bot. Surv. Ind. 12(2): 163–179.
13. Duthie, J. F. 1895. In Botany Chitral Relief Expedition. Rec. Bot. Surv.

Ind.: 180–181. Mosses 39, Hepaticae 2. Named by Brotherus.

14. Froelich, J. 1955. Bryophyten aus Afghanistan und Nordwest-Pakistan. Ann. Naturh. Mus. Wien 67: 149–158. Mosses collected by K. H. Rechinger.
15. Herzog, Th. 1938. Bryophyta. In Bot. Ergebnisse der Deutschen Hindukusch Expedition. Feddes Repert., Beih. 108: 3–12. Some mosses from Kashmir.
16. Koul, Raj Kumari. 1972. Some mosses from Kashmir. Bryologist 75(4): 586–588.
17. Mathur, L. N. 1925. On a Lahore moss, *Trematodon brevicalyx* Dix. sp. nov. Jour. Ind. Bot. Soc., 287–297.
18. Mitten, W. 1859. *Musci Indiae Orientalis*. Jour Linn. Soc. Bot. Suppl. 1: 1–171. Four credited to Kashmir.
19. Noguchi, A. 1959. Mosses from Pakistan, II. Jour. Hattori Bot. Lab. 21 292–295. 61 mosses collected by S. Ahmad, Gov't College, Lahore. 13 species said to be new for Pakistan.
20. Robinson, H. 1965. A small collection of bryophytes from Kashmir. Bryologist 68(3): 313–320. A list of plants collected by Grady Webster and E. Nasir in Gilgit and Baltistan in 1955 while with the Harvard University Climbing Expedition to the Karakorum. This replaces the moss list of Narindar Chopra who died before finishing his list. There were 56 mosses, two new and four liverworts.
21. Robinson, H. 1967. Notes on the Bryophytes from the Himalayas and Assam. Bryologist 77(7): 82–97.
22. Stormer, P. 1964. Mosses from Tirich Mir, contributions to the bryology of northwest Pakistan. Nytt. Mag. Bot. 3: 213–226. Collected by Per Wendelbo.
23. Chopra, Ram Singh. 1975. Taxonomy of Indian Mosses. *Chronica Botanica* Co., New Delhi.
24. Kazmi, S. M. A. 1970. Botany of W. Pakistan and Kashmir and Adjacent Regions. Pub. by Field Research Products, Miami, Fla. *Bryophyta*, pp. 93–98.
25. Ram, Udar. 1976. Bryology of India.
    At the end of Chopra's and Ram Udar's books are valuable bibliographies.

Hepaticae

Like the ferns, mosses and lichens the *Hepaticae* or liverworts are not abundant in Pakistan and Kashmir because they are not xerophytic. Also they are not epiphytic or epiphyllous. Only three genera are recognized by non specialists like me, *Riccia, Marchantia* and *Anthoceros. Riccia fluitans* is easy to recognize because the thallus is divided into narrow lobes and floats on pools of still water. *Marchantias* are the commonest and easiest to find. I rarely found *Anthoceros*, the horned liverwort.

Considering the fact that they are not abundant in our area and have no use or value, that I know about, it is remarkable that there are so many papers on the group. This is all due to the influence of one man, Prof. Shiv Ram Kashyap (1882-1934) who was born in Jhelum and was the leading figure in botany in the region which is now Pakistan and Kashmir, while he lived, as there was then only one University in the entire area. He became a professor in the Gov't College Lahore in 1912 and was given the title of University Professor in 1919. In 1933 Cambridge University gave him an Honourary D. Sc., *honoris causa*. He died the next year prematurely of heart failure. He was a very capable man with wide interests but his first love was the Liverworts and most of his graduate students wrote their theses on the *Bryophyta* and some of them when they moved to India, before or at partition, continued to work on this group.

Prof. Kashyap was interested in the Angiosperms and in exploration and made several adventurous journeys into Ladak and Western Tibet as far as Lake Manasorowar. He did a great deal of work preparing for the publication of a flora for Lahore District but, in his time and since, the bias of research work in Lahore has been on Cryptogams while in most countries the trees, shrubs and other flowering plants are studied first and then later the plants of less economic importance. I have always thought that it would have been better for the development of Pakistani botany if Prof. Kashyap's first interest had been a family of Angiosperms.

Kashyap's work was all done long before there was any Pakistan. His field was largely the liverworts of the Western Himalayas which includes Kashmir and omitted much of Pakistan. His important papers are included in Kazmi's Bibliography but he omits the last,which was published in 1932,which he published with his student R. S. Chopra who has carried on his liverwort work in the Indian Punjab. This paper is Part II of Supplement I of his earlier "Liverworts of the Western Himalayas and the Punjab Plain." By studying these papers,it is probable that a list of Kashmir liverworts can be prepared. Kashyap described some new genera and many species.

Kashyap was not the first to work on the liverworts of the sub-continent. The first to publish anything on mosses and liverworts was William Mitten (1819–1906). In 1861 he published "*Hepaticae Indiae Orientalis*", J. Linn. Soc., London. I believe that only four Kashmir liverworts are included in this. I do not think that any one has studied Pakistani liverworts in recent years.

Of the few students of Prof. Kashyap, who remained behind in Pakistan after the Hindus went to India in 1947, Dr. Sultan Ahmad is most eminent. He has not only done an enormous amount of work on the fungi but he has published on the grasses, sedges and one paper on the liverworts. In 1942 he published "three new species of *Riccia*", Curr. Sci. Vol. 11: 433–4.

The Algae of Pakistan and Kashmir

In his botanical bibliography Kazmi lists about 142 papers on the algae. Of

this large number less than 10% deal with those from Pakistan. A few deal with Afghanistan and the great majority with India. Kazmi's list is not complete and a number of papers have been written since 1970 but it is clear that there has not been very much work published on Pakistan and much less on Kashmir, which with so many lakes and waterways, must have a rich algal flora. In the British period, the only work I had on a group of Pakistani algae was J. Groves paper on the *Charophyta*, in J. Linn. Soc., Bot., London, Vol. 46: 359–76. This work deals with the whole sub-continent.

Research work in Botany began in Lahore when Prof. Shiv Ram Kashyap was head of the Dept. of Botany in about 1915 and in that period there was a great deal of interest in Cryptogamic Botany. Prof. Kashyap was chiefly interested in the *Bryophyta* while Prof. S.L. Ghose was interested in the Blue Green Algae and the *Myxophyceae*. In 1919 Prof. Ghose published "The *Myophyceae* of Lahore", J. Ind. Bot., Vol. I, pp. 8–13, and in 1923 "A systematic and ecological account of a collection of blue-green algae from Lahore and Simla", J. Linn. Soc. Bot. Lond. Vol. 46. Prof. Ghose does not seem to have written anything more and the next paper on algae seems to have been, Majid, A., 1935"Fresh water algae of the Bacillariophyta" (Diatoms). Monograph, P. U., Lahore.

Before partition, P. L. Anand was a student of marine seaweeds and between 1940 and 1943, he published Marine Algae from Karachi: I, II. Lahore. Between 1960 and 1967 M. Nizamudin of Karachi University worked on the *Fucales* of the Karachi sea coast and in 1963 published a study of *Udotae indica*, a green alga, in Pac. Sci. 17: 243–45.

The man in Pakistan who has probably done the most work on Pakistani Algae is Dr. M. A. F. Faridi of Peshawar University. He and his students have published several papers on freshwater algae but only one of his publications reached Harvard for Kazmi, who prepared his bibliography at the Harvard University Library, only lists one Faridi paper. This paper is I. I. Siddiqui and M. A. F. Faridi's 1964 paper on "The *Chlorococcales* of Peshawar Valley, "*Biologia* Vol. 10, pp. 53–88, figs. 113. I also have a note that one of Faridi's students, Amanullah Arbab, for his M. Sc. thesis wrote on the *Oscillatoriaceae* of the Peshawar Valley. In 1971 Faridi also published "The genera of fresh-water algae of Pakistan and Kashmir" in *Biologia* (Pak.) 17(2): 123–142. He has also published "*Coleochaete*" in Pakistan Systematics I: 1–6. 1977.

In 1966, Minou Hirano of the Kyoto University team of botanists in Siro Kitamura and Riozo Yosii's Additional Reports, Kyoto Univ., published "Freshwater Algae of Karakorum and Swat Himalaya" p. 15–55. Hitano did the collecting in the Karakorum and Honda in Swat. The collections were small, only 20 are listed in the first paper and 37 from Swat. Hirano states that desmids were dominant in the Karakorum.

There must be a very large number of algae in the Valley of Kashmir. In

Kazmi there is only one paper listed. In 1957, Shams ul-Islam Khan published a paper in Vol. 3 of *Biologia* (Pak.) entitled "Culture of algae of the rice fields." In addition J. N. Javeid lists Malhotra B. R. and Das, R. "Some *Oscillatorias* of Kashmir," Proc. 27th Ind. Sci. Cong. 1–34. 1940.

A good many papers on algae have been published in India and some of them will probably prove to be useful for Pakistani students because they are monographs and so cover much ground and contain keys such as M. S. Randhawa's *Zygnemaceae*, Ind. Counc. Agr. Res. 478, pp. 521, figs., New Delhi.

P. N. Saxena's algal papers published by the Lucknow Botanical Garden as Bulletins in 1961 and 1962 on *Chaetophorales* and *Vaucheriaceae* should also be useful for students in Pakistan. Lastly, K. R. Ramanathan in 1964 published *Ulotrichales*, Ind. Counc. Agr. Res., New Delhi, xi ± 188 pp., tables 1–152.

There is still a vast field of opportunity for industrious algologists in both Pakistan and India.